EXAMINING THE EFFECTS OF THE FLIPPED MODEL OF INSTRUCTION ON STUDENT ENGAGEMENT AND PERFORMANCE IN THE SECONDARY MATHEMATICS CLASSROOM: AN ACTION RESEARCH STUDY

by

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Abstract

In many of the secondary classrooms across the country, including the research site for this study, students are passively engaged in the mathematics content, and academic performance can be described, at best, as mediocre. This action research study sought to bring about improvements in student engagement and performance in the secondary mathematics classroom through the implementation of the flipped model of instruction and compared student interaction in the flipped classroom to that of a traditional format. The flipped model of instruction is a relatively new teaching strategy attempting to improve student engagement and performance by moving the lecture outside the classroom via technology and moving homework and exercises with concepts inside the classroom via learning activities. Changes in the student participants' perceptions and attitudes were evidenced and evaluated through the completion of a pre- and post-survey, a teacher-created unit test, random interviews, and a focus group session. In addition, the researcher documented observations, experiences, thoughts, and insights regarding the intervention in a journal on a daily basis. Quantitative results and qualitative findings revealed the student participants responded favorably to the flipped model of instruction and experienced an increase in their engagement and communication when compared to the traditional classroom experience. The student participants also recognized improvements in the quality of instruction and use of class of time with the flipped model of instruction. In terms of academic performance, no significant changes were demonstrated between the flipped model of instruction students and those taught in a traditional classroom environment.

Dedication

I dedicate this work to my precious niece, Chloe Grace, who I know will prove her commitment to education by achieving great success in the years to come. I love you to the moon and back.

Acknowledgments

First and foremost, I must acknowledge Dr. Mark Thogmartin, my mentor and my friend. Throughout this entire process, his feedback was valuable, his support was endless, his response was timely, and his nature was caring. I thank him for sharing his knowledge and expertise and for leading me from the very start. His guidance saw this project to completion through many obstacles and opportunities. I am forever grateful and appreciative of him. I could not have asked for a better mentor.

My committee members, Dr. Janet Buckenmeyer and Dr. Frances Dolley, deserve recognition. Their interest in this project proved to be quite valuable, and their input, feedback, and encouragement were much appreciated and welcomed. I am thankful to share this experience with them.

Finally, I acknowledge my student participants. I thank each of them for doing their part and helping me complete this project. They knew how important this process was for me and sacrificed accordingly. I hope they remember this experience the next time a lesson is flipped.

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CHAPTER 1. INTRODUCTION

Introduction to the Problem

By now it should be beyond dispute the mathematics skills of American students leave a great deal to be desired. Even after a decade of accountability reforms, the performance of U.S. students on mathematics assessments ranges from "simply mediocre to extremely poor, depending on the type of test and grade level" (Schmidt, 2012, p. 133). The National Assessment of Educational Progress (NAEP), the Trends in International Mathematics and Science Study (TIMSS), and the Program for International Student Assessment (PISA) all reveal most students educated in American schools lack the ability to comprehend and apply mathematical concepts (National Center for Education Statistics, 2012). Such weak mathematics performance has rightfully alarmed U.S. policymakers, educators, and the general public.

A report released by the U.S. Department of Education further acknowledged American teenagers are trailing behind their counterparts in other industrialized countries in their academic performance, especially in mathematics (State Educational Technology Directors Association, 2011). Specifically, the report compared U.S. students with students from other countries and identified the U.S. high school students' performance in mathematics to be in the bottom quarter of the countries that participated. Validated by Schmidt (2012), U.S. students' mathematics skills decrease as they develop, "falling from rough parity in the early grades to badly behind their peers by graduation" (p. 136).

Simply put, the U.S. educational system is fundamentally failing its duty and responsibility to prepare students for a world requiring strong quantitative skills.

A likely cause of the nation's current performance and achievement in mathematics can be attributed to the passive learning experiences students receive in the classroom (Freeman & Lucius, 2008; Mueller, Yankelewitz, & Maher, 2011; Peterson, Corey, Lewis, & Bukarau, 2013). A study conducted by Weiss and Pasley (2004) found the correlation between students' learning experiences and performance to be rather significant. Based on their observations and interviews of 480 mathematics teachers from 120 high schools across the country, they concluded effective mathematics instruction invited "students to interact purposefully with the content" and included "various strategies to involve students and build on their previous knowledge" (p. 25). Thus, engagement affects achievement and performance (Fredricks, 2011; Marzano, 2013). In response to these and other indicators, the National Council of Teachers of Mathematics (NCTM, 2009) encouraged educators to place great emphasis on student-centered learning strategies and students' independent investigations of mathematical ideas in their individual classrooms to improve academic performance.

Ultimately, the improvement in mathematics performance and achievement rests in the skills of the millions of classroom teachers all across this country. To date, every educational issue upon which reform efforts have focused, including curriculum standards, standardized testing, and accountability, have all been secondary and intended to support the fundamental interaction between teachers and students. Corcoran and Silander (2009) highlighted the need to worry not only about *what* teachers teach, but also *how* they teach. To improve the mathematics achievement of U.S. students, reform efforts must address the effectiveness of instruction including active student engagement within the classroom environment (Schmidt, 2012). According to McKinney and Frazier (2008), this is especially true in the area of secondary mathematics where “effective teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well” (p. 202).

As stated above, engagement affects student achievement and performance (Fredricks, 2011; Marzano, 2013). Finn (1993) stated, “Understanding the constellation of factors that maintain students’ emotional and behavioral engagement in school remains of critical importance” (p. 266) because “student engagement in school and class activities is an important, essential antecedent of successful achievement outcomes” (p. 265). In a national study of 6,000 eighth grade students, Finn (1992) found high levels of active engagement led to increased academic achievement. Moreover, in an experiment testing whether student attitudes and behavior contributed to mathematics and reading achievement among high school students, Akey (2006) found prior successful levels of student engagement in mathematics positively influenced academic performance in later years. Based on her longitudinal study spanning three school years, Akey said, “Engagement in school was a critical predictor of mathematics achievement for high school students” (p. 31).

Background and Context of the Study

The state of Louisiana has witnessed similar results in terms of poor performance and achievement among secondary mathematics students. According to a report released by the National Center of Education Statistics (NCES, 2011), Louisiana, throughout the last few years, has consistently ranked between 43 and 46 out of 50 states in terms of mathematics performance on national tests of student achievement. Under new administration and leadership, the Louisiana Department of Education has implemented new policies and procedures, including universal curriculum guidelines and innovative content practices, to improve current performance levels in the area of secondary mathematics (Louisiana Department of Education, n.d.). While the idea of new policies and procedures sounds promising, the implementation of those strategies has been an extremely tedious task for the classroom teacher.

The research site in this study is a public high school serving approximately 450 students located in rural southwest Louisiana. A recent report compiled by the Louisiana Department of Education (2012) revealed consistent low scores for the research site on the state mandated Algebra I End-of-Course Exam. The Algebra I End-of-Course Exam is administered at the end of the school year to those students enrolled in the course for the entire school term. Students can earn four levels of achievement: excellent, good, fair, and needs improvement with the latter representing an unsatisfactory score. Specifically, the report showed 20% of the Algebra I students performing at the unsatisfactory level during the 2011 school year and 22% during the 2012 school year (Louisiana Department of Education, 2012). Such actions of poor student performance on the Algebra I End-of-Course Exam can potentially be credited to the passive learning experiences students receive in the secondary mathematics classroom (Freeman & Lucius, 2008; Mueller et al., 2011; Peterson et al., 2013; Weiss & Pasley, 2004). These results testify to the critical need to implement effective instructional strategies to boost student engagement and performance in the secondary mathematics classrooms at the research site.

Additionally, in many of the mathematics classrooms at the research site, the teachers lead a large group demonstration of skills followed by individual practice. According to Franke, Kamezi, and Battey (2007), this instructional pattern with limited student communication and engagement is coined *IRE*, where the teacher *initiates* by asking a question, a student *responds*, and then the teacher *evaluates* that response. Furthermore, communication in the mathematics classrooms at the research site can be defined as traditional teacher talk: teachers explaining procedures, giving directions, and clarifying mistakes in ways that require very little student-to-student or even student-to-teacher interaction. This type of classroom discourse heavily limits students' opportunities to learn and become independent thinkers.

These indicators, along with the urgency issued by the NCTM (2009) to incorporate student-centered learning strategies into mathematics classrooms, caused the mathematics department at the study site to brainstorm and research innovative instructional approaches to use in their respective classrooms to boost student engagement and performance.

Theoretical Framework of the Study

Action science theory provided the theoretical framework for this research study. Stringer (2007) defined action research as a "systematic approach to investigation that enables people to find effective solutions to problems they confront in their everyday lives" (p. 1). Action research combines theory with practice within a cycle of activity that includes problem diagnosis, action intervention, and reflective learning. Gall, Gall, and Borg (2007) stated action research has played a "growing role in the field of education in recent years because of its promise for improving educators' practice, strengthening the connection between research and practice, and improving the justice of education's impact on society" (p. 597). The key to action science theory is the implementation of an intervention and an evaluation as to whether or not the intervention improved a situation. According to Argyris and Schön (1996), action science theory brings a "broader, systematic perspective to the table that contributes to the growth and learning of an organization, as well as its ability to move with agility and address problems efficiently and effectively" (p. 43). The practice of the mathematics department at the research site of not only looking for a problem but also seeking ways to improve the current situation exemplified a distinct feature of action science theory.

In addition, the theory of constructivism provided the framework for the study's intervention. Constructivism is a philosophy of learning based on the science of how people acquire knowledge (Brooks & Brooks, 1999; Clements, 1997; Galvin, 2002; Saphier & Gower, 1997). These researchers of human development and learning discovered people learn by being able to relate new information to existing knowledge and create patterns. Many proponents of mathematics reform have advocated a constructivist perspective of teaching and learning (Cobb, Perlwitz, & Underwood-Gregg, 1998; Noddings, 1993; Simon, 1995; Zazkis, 1999). Constructivists recognize experience and environment play a large role in how well the learner learns and language plays a key role in the acquisition of knowledge (Dewey, 1938; Larochelle, Bednarz, & Garrison, 1998; Piaget 1954, 1970, 1973). With this study's intervention, the student contributors had the opportunity to be actively involved in the learning process by participating in a student-centered classroom in an attempt to boost engagement and performance in the secondary mathematics classroom.

As an action research study, the need to understand change management was also of vital importance for the successful execution and future continuation of the intervention. In all living systems, which include humans, change will occur through emergence. Large-scale changes that have had great impact never originated in plans or strategies from on high; instead, they began as small, local actions (Wheatley & Frieze, 2007). As suggested by the theory of emergence, the intervention for this research study, having its roots in a rural mathematics classroom in southwest Louisiana, could potentially lead to changes to other mathematics classrooms in the school, district, and possibly state if promising results are yielded.

Statement of the Problem

In many of the secondary classrooms across the country, including the research site for this study, students are passively engaged in the mathematics content, and academic performance can be described, at best, as mediocre. In the influential book, *The World Is Flat*, Friedman (2005) claimed secondary mathematics achievement is one of the key predictors of a nation's long-term economic potential. With such influence, the National Council of Teachers of Mathematics (NCTM, 2009) encouraged educators to place great emphasis on student-centered learning strategies and approaches where the students have the opportunity to be actively engaged in the content being presented, thus improving performance and achievement in the secondary mathematics classrooms. For the mathematics classes at the study site, the consistent decline in End-of-Course Exam scores and the lack of student involvement attested to the critical need to find and promote instructional strategies improving academic performance and enhancing student engagement.

Purpose of the Study

The study sought to bring about improvements in student engagement and performance through the use of an effective instructional strategy in the secondary mathematics classroom. Inherent in the design of effective mathematics teaching is the view taken of the teacher as the facilitator of learning within the classroom. As students engage in investigations, teachers are expected to create an environment in which mathematical discourse takes place (NCTM, 2009). The teachers guide the learners' thinking by creating an open forum for the exchange of ideas. The teachers also help students synthesize their findings and connect those findings to a coherent mathematical structure as they devise strategies for evolving students' thinking from an intuitive to a more rigorous level. In many ways, these new visions of teaching place greater demands on teachers than the traditional method of instruction in which the teacher disseminated bits and pieces of knowledge to students. Thus, it is crucial that educators call for operational reform and search for effective instructional approaches to boost student engagement and performance in the secondary mathematics classroom.

One such approach is the flipped classroom model of instruction. The flipped classroom model of instruction is a relatively new teaching strategy attempting to improve student engagement and performance by moving the lecture outside the classroom via technology and moving homework and exercises with concepts inside the classroom via learning activities (Bergmann & Sams, 2012; Brunsell & Horejsi, 2011; Tucker, 2012; Young, 2011). The core idea with this blended learning strategy is to flip the common instructional approach: instruction that used to occur in class is now accessed at home, in advance of class, via teacher-created videos and interactive lessons, and work that used to occur outside of the classroom is now completed in class in the presence of the teacher. Using this inductive approach, Tucker (2012) stated class becomes the place to "work through problems, advance concepts, and engage in collaborative learning" (p. 82). Such use of class time could potentially give students the opportunity to learn how to think for themselves by being actively engaged in the mathematics content.

The overall goal of the study was to find and promote instructional strategies that improved academic performance and enhanced student engagement in the mathematics classrooms. Specifically, the study sought to bring about improvements in student engagement and performance through the implementation of the flipped classroom model of instruction and assess its effectiveness among mathematics students. Changes in the student participants' perceptions and attitudes were evidenced and evaluated through the completion of a pre- and post-survey, a teacher-created unit test, random interviews, and a focus group session. In addition, the researcher documented observations, experiences, thoughts, and insights regarding the intervention in a journal on a daily basis.

Rationale

Use of the flipped classroom model of instruction, if implemented properly, has the potential to lead students in becoming their own learners. In contrast to their current passive classroom experiences, the students have the opportunity to learn how to become independent thinkers by being actively engaged in the content being studied. According to Young (2011), the students become collaborators and help each other out during the flipped experience, thus increasing engagement. In addition, the teachers utilizing the flipped classroom model of instruction are able to speak to each individual student on a daily basis in every class.

Brunsell and Horejsi (2011) stated flipping the classroom creates a pedagogical shift from teaching methods involving static content delivery and opens up room for conversation between students and instructors around the application of course content and reflection on learning experiences. Teachers might find it difficult to make the shift from lecturer to facilitator; however, by making lecture materials available for students to review before class, teachers can better use instructional time to engage students in activities around course content and assess student learning (Young, 2011).

With any fundamental shift in teaching practices, there will be a period of transition both for students, to unlearn the passive approach to traditional lectures, and for the instructor, to become familiar with what works for his or her teaching style and course goals (Brunsell & Horejsi, 2011). According to Young (2011), there is a disconnect that occurs under a traditional lecture model. In particular, the students have trouble connecting what they are taught in class with what they are trying to apply at home. By not making the flipped pedagogical shift, this disconnect may continue to grow and hinder student performance and engagement in the secondary mathematics classroom.

The practical implications of this study include the intervention's potential impact on student engagement and performance in the secondary mathematics classroom. The intervention could significantly change the current mathematics classroom environments by altering instructional strategies and delivery approaches, thus improving the problem of mediocrity at the research site and possibly extending to both state and national levels.

Research Questions

The following research questions guided this study related to the implementation of the flipped model of instruction and its effect on student engagement and performance:

1. How does the flipped classroom model of instruction affect student engagement and performance in the secondary mathematics classroom?
2. How do the students interact in the flipped classroom environment compared to the traditional setting?

Definition of Terms

Action Research

Stringer (2007) defined action research as a "systematic approach to investigation that enables people to find effective solutions to problems they confront in their everyday lives" (p. 1). Action research combines theory with practice within a cycle of activity that includes problem diagnosis, action intervention, and reflective learning.

Constructivism

The theory of constructivism is a philosophy of learning based on the science of how people acquire knowledge by being able to relate new information to existing knowledge and create patterns (Brooks & Brooks, 1999; Clements, 1997; Galvin, 2002; Saphier & Gower, 1997). Simply put, constructivism is the theory of learning which espouses how students should construct their knowledge through engaged learning activities.

Emergence Theory

According to Wheatley and Frieze (2007), change does not happen as a result of top-down, predetermined strategic plans, or from the mandate of any single individual or boss. Emergence theory describes how change begins as local actions spring up concurrently in many different areas. If these changes remain disconnected, nothing happens beyond each locale; however, when they become connected, local actions of change can emerge as a powerful system of influence at a more global or comprehensive level.

Engagement

Jimerson, Campos, and Greif (2003) defined engagement as a multifaceted construct that includes involvement in academic performance, classroom behavior, extracurricular involvement, interpersonal relationships, and school community.

Flipped Model of Instruction

The flipped model of instruction reverses the common instructional approach: instruction that used to occur in class is now accessed at home, in advance of class, and work that used to occur at home is now completed in class under the guidance of the teacher. Specifically, the flipped model of instruction moves the lecture outside the classroom via technology and moves homework and exercises with concepts inside the classroom via learning activities. Students in a flipped classroom listen to teacher lectures at home at their own pace, typically through instructional videos posted online or via podcasts that can be easily downloaded. Then, the students use their class time to apply what they have learned from the lectures, working in the presence of teachers, often in collaboration with other students (Young, 2011).

Hands-on Learning

In general, hands-on learning refers to learning by experience. Specifically, in the mathematics classroom, students manipulate objects and other materials to demonstrate content and further develop their understanding of the concepts (Holstermann, Grube, & Bögeholz, 2009). According to Franklin and Peat (2005), mathematics students gain a more realistic and exciting experience of the content by experiencing a classroom environment promoting hands-on learning. In addition, conducting hands-on activities leads to positive motivational outcomes (Holstermann et al., 2009).

Novelty Effect

The novelty effect is the tendency for performance to initially improve when technology is instituted (Kuykendall, Janvier, Kempton, & Brown, 2012). If positive results are seen with the implementation of an intervention involving technology, it may be due to the novelty of the intervention as opposed to the intervention itself.

Podcast

A podcast is a digital recording, with or without images, which instructors can use to deliver content to students in an easy asynchronous fashion (Chester, Buntine, Hammond, & Atkinson, 2011).

Project-based Learning

Project-based learning is defined as a curriculum design model with a focus on a student-centered approach to learning that is interdisciplinary and results in students completing a final project (Buck Institute for Education, 2011). Some fundamental elements of this strategy include: an essential, guiding question; collaborative skills; immediate feedback; and a final project demonstrating comprehension of the concepts.

Response to Intervention

Response to Intervention (RtI) is a method of academic intervention used to provide early, systematic assistance to struggling students who are having difficulty learning (Fuchs, Mock, Morgan, & Young, 2003). At the research site, RtI was a 30-minute period embedded in every student's daily schedule. For the purpose of this research study, the students used RtI as a time to view the flipped classroom media pieces and seek further assistance with the content being studied.

Traditional Instruction

The traditional view of education has been teachers are experts in a particular field of knowledge and transmit that expertise to students through lectures and recitations. Students are supposed to learn the facts and concepts by rote and practice of the attendant skills until they can demonstrate their mastery on certain tests (Ertmer & Newby, 1993). Klein (2009) described traditional instruction as teaching that is teacher-focused with students receiving direct instruction.

Significance of the Study

The significance of action research in educational settings has been well documented (Charles & Mertler, 2002; Johnson, 2005; Mills, 2000). Mills (2000) asserted that action research encourages change in schools and urges educators to reflect on their practice. Similarly, Johnson (2005) contended action research is important because it has the potential to bridge the gap between theory and practice and empowers teachers and educators to become change agents. Likewise, Charles and Mertler (2002) noted action research "resolves an immediate problem and has the potential for bringing about improvements in teaching and learning" (p. 310).

The flipped model of instruction has the potential to transform the mathematics teaching practices of teachers all across this country. According to Bergmann and Sams (2012), the flipped classroom has the ability to speak the language of today's students by using 21st century technological tools; help those students who are involved in multiple extracurricular activities by allowing them the opportunity to work ahead; promote real differentiation in the classroom by enhancing class time to allow teachers the opportunity to individually assess their students' understanding and comprehension; and improve classroom management by requiring all students to become accountable for their own learning and progress, thus limiting classroom disturbances.

Nature of the Study

The study used an action science research method involving an intervention leading to potential improvements in student engagement and performance in the secondary mathematics classroom. The flipped classroom model of instruction was implemented over a seven-week grading period to 42 ninth grade students who were enrolled in Algebra I courses at the research site. The students prepared for class by watching videos, listening to podcasts, reading articles, viewing presentations, and contemplating questions demonstrating the required topic of study. Completion of homework content notes was used to determine whether or not the students had adequately prepared for class. During class, the students engaged in hands-on activities, participated in real-world applications, and at times, completed independent practice in the presence of the teacher. Such use of instructional time allowed the teacher an opportunity to assess the students' understanding and comprehension of the content.

For those students with no Internet access at their homes, media was made available on flash drives and DVDs that the students checked out and watched at home. In the event a student was still unable to view the content at home, then arrangements were made for that student to view the media pieces during Response to Intervention (RtI) time so he or she could be adequately prepared for class.

Since this action research study focused on the impact the flipped model of instruction had on student engagement and performance in the secondary mathematics classroom and compared student interaction in the flipped classroom to a traditional format, a mixed methods approach collecting both quantitative and qualitative data was utilized. Changes in the student participants were evidenced and evaluated through the completion of a pre- and post-survey, a teacher-created unit test, random interviews, and a focus group session. In addition, the researcher documented observations, experiences, thoughts, and insights regarding the intervention in a journal on a daily basis.

Assumptions

For the purpose of this action research study, it was assumed that:

1. Students would desire to pair up and complete meaningful tasks in a flipped classroom. However, in some situations, students may be perfectly content working alone, and collaboration may potentially be a barrier to success. A flipped classroom lesson where a student works in isolation still makes effective use of class time because the teacher is available for further explanation and individual conferencing. Thus, there are still benefits to receiving the instruction before class. While Howe and Strauss (2000) document that 21st century learners prefer teamwork and cooperation, it is important to honor differences and recognize that collaborative learning is not the goal of a flipped classroom; rather, efficient use of class time is of utmost importance.

2. Parents would be supportive of the increased responsibilities required of them at home with the implementation of the flipped model of instruction. According to Bergmann and Sams (2012), “Consistent, clear communication goes a long way when introducing something new” (p. 80). By taking the time to explain the purpose of the flipped classroom, parents may become more supportive and appreciative of this novice instructional approach.

Limitations

The known limitations of this action research study included the following:

1. Coghlan and Brannick (2005) reported conducting action science research in one’s organization is political. Therefore, as an employee of the research study site, there can be no opportunity allowing for a position of authority to influence the participants of the study.
2. This study was limited to the use of only one teacher’s classroom for the flipped model of instruction intervention. Although it would have been beneficial to have several teachers involved in the study to reduce instructor bias, the researcher did not have the authority to request participation from other teachers.
3. This study was also narrowed by the limited time frame of the project. The timeline for this project was approximately seven weeks. Such limitation allowed for the possibility of the novelty effect associated with the use of technology within the intervention. According to Kuykendall et al. (2012), the novelty effect is the tendency for performance to initially improve when technology is instituted. If the novelty effect is indeed a factor, future research

must be designed to determine at what point the technology loses its effect so teachers can be aware of it.

Organization of the Remainder of the Study

This chapter offered an introduction to the action research study and highlighted the importance of conducting such a study. The problem was presented within a national context and correlated with issues at the research study site. In addition, the statement of the problem and the purpose of the study were discussed emphasizing the alignment to the research study questions. Definitions of key terms used throughout the study were provided to promote a basis of clarity and solid understanding. Finally, the significance and nature of the study, along with assumptions and limitations, completed the chapter.

The remainder of this study contains four additional chapters: Chapter 2 includes a review and examination of the literature relevant to the intervention; Chapter 3 addresses the research methodology; Chapter 4 provides an explanation of the data analysis process and presents the results; and Chapter 5 presents the conclusion discussion and recommendations of the study.

CHAPTER 2. LITERATURE REVIEW

Introduction to Chapter 2

In many of the secondary classrooms across the country, including the research site for this study, students are passively engaged in the mathematics content, and academic performance can be described, at best, as mediocre. In the influential book, *The World Is Flat*, Friedman (2005) claimed secondary mathematics achievement is one of the key predictors of a nation's long-term economic potential. With such influence, the NCTM (2009) encouraged educators to place great emphasis on student-centered learning strategies and approaches where the students have the opportunity to be actively engaged in the content being presented, thus improving performance and achievement in the secondary mathematics classrooms.

A likely cause of the nation's current performance and achievement in mathematics can be attributed to the passive learning experiences students receive in the classroom (Freeman & Lucius, 2008; Mueller et al., 2011; Peterson et al., 2013; Weiss and Pasley, 2004). In fact, researchers have acknowledged the simple truth that students are not engaged in school (Steinberg, Brown, & Dornbusch, 1996; Yazzie-Mintz, 2007). Moreover, studies have shown engagement is an area of concern and one in need of further investigation (Finn, 1993; Fredricks, 2011; Fredricks, Blumenfeld, & Paris, 2004; Klem & Connell, 2004; Lamborn, Brown, Mounts, & Steinberg, 1992; Marzano, 2013). Therefore, a large portion of the review of literature for this research study focused on the importance and significance of student engagement by detailing the various factors that promote active engagement and lead to improved student performance.

In order to fully understand why the flipped model of instruction was selected as the intervention of choice to improve student engagement and performance in the secondary mathematics classrooms at the research site, it was imperative to examine the theory of constructivism and explore how such an approach can lead to student-centered classrooms where the students are actively involved in the learning process and construct their own personal understanding through interactions within their individual, social, and cultural environments (McDougall, 1997). Consequently, this review of literature provided a thorough understanding of the theory of constructivism and its supportive use in the area of secondary mathematics by comparing it to traditional instruction and learning.

Additionally, as an action research study, the need to understand change management was also of vital importance for the successful execution and future continuation of the intervention. In all living systems, which include humans, change will occur through emergence. Large-scale changes that have had great impact never originated in plans or strategies from on high; instead, they began as small, local actions (Wheatley & Frieze, 2007). As suggested by the theory of emergence, the intervention for this research study, having its roots in a rural mathematics classroom in southwest Louisiana, could potentially lead to change to other mathematics classrooms in the school, district, and possibly state if promising results are yielded.

The strategy used to gather data for this study primarily rested with a review of published journal articles, independent studies, and books written by educational theorists. The books were accessed via the Calcasieu Parish Public Library system; the articles and independent studies were derived from multiple electronic databases: Academic Search Premier, Education Research Complete, ERIC, Dissertations and Theses Full Text, ProQuest Educational Journals, and ProQuest Psychology Journals. The search criteria used to explore the databases included the following key terms: *action research, active engagement, best instructional practices, constructivism, emergence theory, flipped model, principles of constructivist pedagogy, student-centered learning,* and *student engagement*.

The review of literature was divided into four sections: (a) an overview of research on student engagement, which presented five factors that affect engagement and lead to improved performance; (b) the theory of constructivism, which offered an overview of the learning theory and its comparison to traditional instruction as evidenced in many secondary mathematics classroom; (c) the flipped model of instruction, which provided a detailed look at current research and how students respond to this novice instructional approach; and (d) change management, which addressed the need for change based on the theory of emergence.

Overview of Research on Student Engagement

Research indicated a significant relationship exists between student engagement and performance (Fredricks, 2011; Marzano, 2013; Newmann, 1992; Skinner, Wellborn, & Connell, 1990; Steinberg et al., 1996). Skinner et al. (1990) described student engagement as one of the key factors to earning better grades, scoring higher on standardized tests of achievement, and being more personally and socially adjusted. In addition, several studies linked student engagement with higher achievement, greater educational attainment, and lower dropout rates (Fredricks et al., 2004; Griffiths, Sharkey, & Furlong, 2009). Research on student engagement and its impact on both learning and student achievement has increased in recent years (Fredricks, 2011; Newmann, 1992; Steinberg et al., 1996). However, there is very little literature focusing on student engagement in the high school mathematics classroom. In an organized review of more than 40 articles spanning 22 years, Fredricks et al. (2004) found only four articles dealing with engagement in a mathematics classroom, and only one of the four involved student engagement in a secondary mathematics classroom.

Numerous factors affect student engagement (Fredricks, 2011; Marzano, 2013). Five factors considered to be the most relevant to this action research study were explained in detail due to their correlation to improved student performance. In addition, those factors were easily detectable in the flipped model of instruction classroom. The five factors included: (a) teacher support; (b) quality of instruction; (c) peer connections; (d) classroom structure and management; and (e) parental involvement.

Teacher Support

Research suggested a meaningful relationship exists between teacher support and student academic engagement and performance (Akey, 2006; Birch & Ladd, 1997; Connell & Wellborn, 1991; Cothran & Ennis, 2000; Fredricks, 2011; Furrer & Skinner, 2003; Klem & Connell, 2004; Ryan & Patrick, 2001).

In a longitudinal study involving elementary and middle school students, Klem and Connell (2004) examined the links between teacher support, engagement, and academic success by analyzing student records and teacher and student survey data. Their quantitative results indicated teacher support was an important factor in terms of increasing student engagement and improving academic performance. Students who perceived teachers as creating a caring, well-structured learning environment in which expectations were high, clear, and fair were more likely to report higher levels of engagement. In turn, those higher levels of engagement were associated with higher attendance records and improved test scores. While the study only examined elementary and middle school students, the need to further explore the relationship between teacher support and student engagement at the high school level is necessary. In addition, the need to analyze and review this relationship in a qualitative manner must be addressed.

Similarly, while studying motivation among third to sixth grade students, Furrer and Skinner (2003) discovered students who felt appreciated and valued by their teachers were more actively involved in classroom activities and viewed those activities as interesting and exciting. Conversely, those students who did not feel valued or appreciated experienced feelings of boredom, discontent, and anger during the classroom activities. Furrer and Skinner conducted this longitudinal study of student's motivation over a two-year period and collected data from a subgroup of 641 students in the form of surveys, teacher reports, and academic records. While the results were analyzed quantitatively, they suggested there was still a need for an examination of a "wider range of academic outcomes, distinguishing, for example, performance in specific subject areas, [mathematics] and including other markers of school success, such as attendance or participation in extracurricular activities" (Furrer & Skinner, 2003, p. 159). The need to further investigate the relationship between student engagement and teacher support using qualitative data must be addressed as well.

Other researchers also found parallel connections between teacher support and student engagement. The research findings of Connell and Wellborn (1991) revealed students who were struggling with content, but had a positive relationship and rapport with their teacher were more apt to continue engaging in various classroom activities by showcasing their motivation to learn the content. Comparably, in her exploratory analysis of school context, student attitudes and behavior, and academic achievement of 449 high school students over a three-year period, Akey (2006) found students who experienced encouraging teacher support indicated they had higher levels of engagement in school.

In their large-scale study of middle grade students in 30 mathematics classes, Ryan and Patrick (2001) found teacher care and support promoted more student-teacher communication, more student-centered learning, and less disruptive behavior in the mathematics classes. Their results indicated teachers who created and maintained environments within their mathematics classrooms where mutual respect was valued, student ideas were respected, and student efforts were appreciated were more likely to have students who applied themselves more during classroom activities. Furthermore, the teachers in the study increased their students' engagement by being honest and fair, considering their students' opinions when making decisions, and listening and talking to their students.

Cothran and Ennis (2000) referred to teachers as the "bridge-builders to student engagement and performance" (p. 106). They found student engagement and performance levels were positively impacted by the teacher's willingness to communicate with students inside and outside of class about things other than the content area. In their study involving physical education classes, students who felt they were not involved in the decision-making process within the classroom were less likely to be engaged. Additionally, students who felt the teachers cared enough to work with them and showed concerns over their personal lives and safety were more engaged and performed better. Notably, the need to compare these results and findings to the secondary mathematics classroom must be recognized.

While Klem and Connell (2004), Furrer and Skinner (2003), Connell and Wellborn (1991), Akey (2006), Ryan and Patrick (2001), and Cothran and Ennis (2000) found teacher encouragement increased student involvement and achievement, other research indicated teacher reinforcement had negative effects. Birch and Ladd (1997) found in a study of 206 kindergarten students that those students who had an unhealthy dependency on their teachers were less likely to be engaged in the classroom. Since this study only examined kindergarten students, the correlation between teacher support and student engagement must be investigated further in order to validate or refute such a relationship at the secondary mathematics level.

Research revealed teacher support was a major factor contributing to student engagement. While the majority of studies investigated students at the elementary and middle school grade levels, the need to further explore this relationship at the secondary level must be addressed. It is also necessary to further examine this relationship at the secondary mathematics level using rich, descriptive qualitative data.

Quality of Instruction

The review of literature suggested the quality of instruction received in the classroom was also a predictor of student engagement and achievement (Dotterer &

Lowe, 2011; Fredricks, 2011; Marzano, 2013; Newmann, 1992; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003).

Dotterer and Lowe (2011) examined the relationship between the instructional environment, school engagement, and academic achievement among fifth grade students. Incorporating both observational and self-reported assessments of various dimensions of instruction, their results revealed student engagement and achievement increased in classrooms where the instructional tasks were varied, interesting, meaningful, and challenging. When students felt they were in an environment that was enriching and supportive, they were more likely to engage mentally and behaviorally in the learning environment. According to Dotterer and Lowe, this type of learning environment was more enjoyable and contributed to the students' desire to pay attention and engage in the learning process. While this study focused on participants in the fifth grade, further examination at the secondary level must be initiated in order to verify these findings.

In a longitudinal investigation of high school students in the United States, Shernoff et al. (2003) found academically meaningful activities relating to real world applications supported active student engagement in the classroom. Higher expectations and challenges afforded to the students led to higher levels of engagement and performance. The researchers argued the importance of teachers thinking of their students as learners and appropriately modifying instructional activities in the classroom to meet the needs, developmental stages, and interests of their students.

Newmann's (1992) findings, in his study of 16 high school social studies departments, suggested when students were required to think independently, they tried more, focused more, and were more interested in their studies. Based on 500 lesson observations, in-depth interviews with teachers and administrators, and student interviews and surveys, results indicated higher-order thinking skills led to higher levels of student engagement and improved academic performance. Even though Newmann's investigation was conducted in social studies classrooms, the same search for relationships between higher-order thinking and engagement and performance should be examined in the mathematics classroom and was done so in this action research study.

Sheehan and Nillas (2010) found a significant correlation between instruction involving technology integration and student engagement and performance. Investigating honors geometry and AP calculus classes, the researchers collected transcripts of classroom communications, student surveys, and teacher journals and evaluated the effectiveness of the use of technology in relation to students' learning outcomes. They discovered the use of technology enabled students to complete activities faster, thus increasing their productivity. Students also identified the use of technology simplified their learning, made content easier, presented an opportunity for additional practice, and helped their grades. Ultimately, Sheehan and Nillas indicated when students were the primary users of technology, they were more engaged in learning and attained higher levels of understanding.

Furthermore, in the area of instruction, Fredricks (2011) and Marzano (2013) suggested the importance of students playing an active role in constructing knowledge as opposed to merely reproducing the knowledge. Fredricks (2011) encouraged the use of problem and project-based instruction due to the positive effects on engagement. In these instructional environments, the students worked "collaboratively with peers to investigate a cognitively complex real world problem and selected a driving question or challenge to investigate over an extended period of time that culminated into an authentic product, presentation, or performance" (Fredricks, 2011, p. 332). Marzano (2013) also recognized student engagement is strongly influenced by what teachers do in class. He recommended demonstrating how the content is relevant and important to their lives outside of the classroom.

Research indicated the quality of instruction was a factor affecting student engagement and performance. Considering the research on the relationship between the quality of instruction and student engagement and performance at the secondary level, there is a need to strengthen the body of knowledge by observing such a connection in the secondary mathematics classroom.

Peer Connections

The review of literature acknowledged peer connections as a factor affecting students who were striving for academic success and who were academically engaged (Fredricks, 2011; Furrer & Skinner, 2003; Perdue, Manzeske, & Estell, 2009; Steinberg et al., 1996).

In a ten-year study of more than 20,000 students in nine high schools in California and Wisconsin, Steinberg et al. (1996) noted peer connections "are the chief determinants of how intensely students are invested in school and how much effort they devote to their education" (p. 138). Additionally, Perdue et al. (2009) studied the influence of peer relationships on student engagement among third grade students and found a strong connection between support from friends and active engagement in the classroom. Peers supported engagement by sharing information, by modeling academic achievement and motivation, and by reinforcing and encouraging positive attitudes towards school.

Conversely, some previous studies contended the notion that peer connections did not affect student engagement at all (Goodenow, 1993; Ryan, Stille, & Lynch, 1994; Wentzel, 1998); however, those studies were conducted at the elementary and middle school levels. One dissenting researcher and colleagues noted highly engaged students, no matter the grade level, seemed to locate and bond with other engaged students with whom to work in the classroom. Kindermann and his colleagues (Kindermann, 1993; Kindermann, McCollam, & Gibson, 1996) found that children who associate with highly engaged peers increased their engagement over time.

Although peer connections have consistently been identified as a theoretically important influence on school engagement, the relationship has only recently been examined and remains an ideally important but relatively understudied contextual influence (Furrer & Skinner, 2003). Certainly, additional studies into how peer connections affect student engagement are needed since there appears to be limitations, contradictions, and inconsistencies in the research findings resulting from similar investigations.

Classroom Structure and Management

The review of literature also indicated the organization of the classroom structure and the classroom environment as a forecaster of student engagement and achievement (Akey, 2006; Fredricks, 2011; Marks, 1995, 2000; Shernoff et al., 2003).

When students felt the classroom environment was under their control by being afforded the opportunity to direct their own personal learning, their engagement and performance increased (Shernoff et al., 2003). Marks (1995, 2000) reported higher levels of classroom engagement when students felt they were valued as a part of the classroom environment that supported their learning and understanding. Furthermore, an environment that was respectful, fair, secure, and promoted positive communication was favorable to students, which in turn enhanced their engagement and performance. If students perceived the conduct rules as clear and fair, they were also more likely to be engaged in the classroom and performed at a higher level when compared to an environment where classroom management was not as effective (Akey, 2006). Similarly, Fredricks (2011) claimed teachers in well-managed classrooms employed procedures, routines, and clear expectations to increase the time students were engaged in learning and minimized time lost to transitions.

Although the research indicated a structured classroom environment promoted active student engagement, there is a need to investigate the relationship further by observing how students interact in the flipped model of instruction classroom and relate to various issues centered on classroom management skills.

Parental Involvement

The literature review also revealed the impact parental and family involvement had on student engagement in the classroom (Connell & Wellborn, 1991; Farkas & Grolnick, 2010; Furrer & Skinner, 2003).

Furrer and Skinner (2003) researched students' sense of relatedness as a factor of academic engagement. They found attachment to parents was a high predictor of student engagement in the classroom. Additionally, students who entered the classroom with a high level of parental relatedness were more apt to follow the classroom agenda. Likewise, Connell and Wellborn (1991) found student-parent relationships influenced school engagement. Student engagement was affected because the quality of the relationships at home was transferred over to the relationships between the student and teachers and other students in the classroom.

Farkas and Grolnick (2010) surveyed and interviewed sixth and seventh grade students to gain an in-depth examination of the parental structure's role and position in supporting student engagement and performance. Findings suggested parenting that supported a child's autonomy, supplied high levels of warmth and involvement, and provided a controlled home life structure facilitated motivation, enthusiasm, and persistence as well as social adjustments and personal well-being. While their investigation showed parental involvement was connected to student engagement and performance at the middle school level, what remained to be explored was how the parental structure affected student engagement and performance in the secondary mathematics classroom.

Summary of Engagement Research

Five factors affecting student engagement, including teacher support, quality of instruction, peer connections, classroom structure and management, and parental involvement, were presented and explained in detail. As noted, research surrounding several of those factors should be further examined as to how it affects engagement and performance among students at the secondary mathematics level. This action research study attempted to provide that essential information. In addition, the research identified some contradictions in the findings as to how some of those factors affect student engagement. Again, this action research study attempted to clarify some of those inconsistencies by addressing those factors specifically within the flipped model of instruction secondary mathematics classroom.

The Theory of Constructivism

At the core of active student engagement and student-centered classrooms is the theory of constructivism. Constructivism is a theory of learning attempting to explain what knowledge is and how it is acquired. According to the theory, learners construct new knowledge by filtering new ideas and experiences through their previous knowledge (Cannella & Reiff, 1994; Richardson, 1997). Thus, knowledge is gained through interactions with the content, not through imitation or repetition (Kroll & LaBoskey, 1996). Wheatley commented, “As much as we would like to, we cannot put ideas into students’ heads; they will have to construct their own meanings” (as cited in Betne & Castonguay, 2008, p. 62). Simply put, constructivist learning theory depicts the learning process as one of constructing knowledge by being an active participant as opposed to absorbing knowledge by being a passive recipient of transmitted information (Herring, 2004; Hung, 2001; Joyce & Weil, 1996; McInerney, 2005; Ormrod, 2008; Wang, 2007). Developmental psychologists Jean Piaget and Lev Vygotsky had a great impact on cognitive psychology and were both instrumental in the design of constructivism.

Piaget and Vygotsky’s Theories of Constructivism

Beginning in the 1920s, Swiss psychologist Jean Piaget founded a research program that unquestionably has had a “greater impact on contemporary theories of cognitive developments than any other single research model” (Ormrod, 2008, p. 309). He studied learning during child development and stressed the notion that “whatever gets into the mind has to be constructed by the individual through knowledge discovery” (Hung, 2001, p. 282). He believed people were individually responsible for their own knowledge construction and learned by finding, organizing, and integrating knowledge into information they already understood (Piaget, 1954, 1970, 1973). Using Piaget's terminology, through an active process, learners constructed their own schema (mental representation) as they interacted with their environment through the process of assimilation and accommodation (Hung, 2001; Joyce & Weil, 1996; McInerney, 2005). Assimilation involved interaction with an object or event consistent with an existing schema; assimilation allowed for growth, but not change (Joyce & Weil, 1996; Ormrod, 2008). Accommodation involved modifying or replacing an existing schema in the event a conflict arose; accommodation made change possible (Joyce & Weil, 1996; Ormrod, 2008). Piaget's principles are fundamental to what is termed as individual or personal constructivism.

Like Piaget, Russian psychologist Lev Vygotsky began studying children's thinking in the 1920s and believed individuals constructed their own knowledge. Unlike Piaget, Vygotsky believed learners constructed meaning from within their social and cultural environments (Dembo, 1994; Hung, 2001; McInerney, 2005; Ormrod, 2008; Vygotsky, 1978; Wang, 2007). Vygotsky's (1978) greatest contribution to cognitive learning theory included what he called the zone of proximal development, "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). Chowdhury (2006) contended the task of an instructor is to find a learner's level within the zone of proximal development and build upon that knowledge to advance to a higher level of understanding through scaffolding. In scaffolding, the instructor provided "various forms of support for the student, such as simplifying the task, breaking it into smaller, more manageable components, or providing less complicated equipment” (Ormrod, 2008, p. 337). Viewing learning as a profoundly social process, Vygotsky has been associated with what is termed social constructivism (McInerney, 2005).

Traditional versus Constructivist Pedagogy

The traditional view of education has been teachers are experts in a particular field of knowledge and transmit that expertise to students through lectures and recitations. Students are expected to learn the facts and concepts by rote and practice the attendant skills until they can demonstrate their mastery on certain tests (Ertmer & Newby, 1993). The unfortunate side of this view is students have no voice in what they learn. Accordingly, traditional teachers tend to think “learning has occurred when students become mirror images of themselves and of the educational institutions they support” (Gregory, 1995, p. 7). However, Resnick (1987) contended traditional, didactic learning does not prepare students for the learning and performance required in the real world involving shared cognition, tool manipulation, contextualized reasoning, and situation-specific abilities. As a reaction against the traditional view, many educators have advocated a more authentic, holistic education based on the constructivist view (Brooks and Brooks, 1999; Roblyer, Edwards, & Havriluk, 1997).

A variety of researchers and scholars have attempted to describe the distinguishing aspects of the traditional approach to education and the constructivist approach (Brooks and Brooks, 1999; Roblyer et al., 1997). Roblyer et al. listed four major differences between the constructivist and the traditional approaches to instruction:

1. The constructivist approach focused on learning through problem solving and the creation of an end result. The traditional approach centered on teaching a sequence of skills from a low level to a higher level.
2. The goals of the constructivist teaching approach were global in nature with an emphasis on the general applicability of problem-solving and research skills. The traditional approach stated specific skill objectives measured by related test items.
3. The constructivist approach emphasized group work more than individual work. The traditional approach concentrated more on individual work than group work.
4. The constructivist approach allowed for alternative learning and assessment methods, including open-ended questions and scenarios, development of an end product, research, performance checklists, assessment of student portfolios, presentations, and open-ended test questions. The traditional approach emphasized lectures, skill worksheets, specific activities, and tests with specific, predetermined correct responses.

Similarly, Brooks and Brooks (1999) further provided a comparison between traditional and constructivist classrooms as shown in Table 1.

Table 1

Comparison Between Traditional and Constructivist Classrooms

Traditional Classrooms	Constructivist Classrooms
Curriculum is offered part to whole with emphasis on basic skills.	Curriculum is offered whole to part with emphasis on big concepts.
Strict adherence to fixed curriculum is highly valued.	Pursuit of student questions is highly valued.
Curricular activities rely profoundly on textbooks and workbooks.	Curricular activities rely profoundly on primary sources of data and manipulative materials.
Students are viewed as blank slates onto which the teacher etches information.	Students are viewed as thinkers with emerging theories about the world.
Teachers generally behave in a didactic manner, disseminating information to students.	Teachers generally behave in an interactive manner, mediating the environment for students.
Teachers seek the correct answer to validate student learning.	Teachers seek the students' points of view in order to understand students' present conceptions for use in subsequent lessons.
Students primarily work alone.	Students primarily work in groups.
Assessment of student learning is viewed as separate from teaching and occurs almost entirely through testing.	Assessment of student learning is interwoven with teaching and occurs through teacher observations of students at work and through student exhibitions and portfolios.

From *In Search of Understanding: The Case for Constructivism*, by J. Brooks and M. Brooks, 1999, Alexandria, VA: Association for Supervision and Curriculum Development. Copyright 1999 by the Association for Supervision and Curriculum Development. Reprinted with permission.

Moursund (1999) identified various distinctions between the traditional approach and the constructivist strategy to teaching and learning. The differences were grouped into two categories: instruction and assessment. Tables 2 and 3 show the differences in terms of instruction and assessment respectively.

Table 2

Differences Between Traditional Instruction and Constructivist-based Instruction

Educational Component	Traditional Instruction	Constructivist-based Instruction
Classroom Activity	Teacher-centered. Teacher driven. Teacher is responsible for covering a set of curriculum.	Learner-centered (student-centered). Cooperative. Interactive. Student has increased responsibility.
Teacher Role	Dispenser of knowledge. Expert. Fully in charge. Gatekeeper.	Collaborator. Facilitator. Learner.
Teacher-Student Instruction	Teacher lectures and ask questions. Students recite.	Teacher works with student groups.
Instruction	Lecture/demonstration with quick recall and student recitation of facts. Seatwork, quizzes, and exams. Single discipline oriented. *Sage on stage.*	Mentoring. Discovery-based learning. Peer instruction. Interdisciplinary orientation. *Guide on the side.*
Technology Use	Computer-assisted learning (drill and practice, tutorial, simulations). Tools used for amplification.	Communication, collaboration, information access, information processing, multimedia documents and presentations.
Parent and Home Role	Help or encourage during homework. Support of traditional education.	Parents and students learn from each other.
Physical Layout	Chairs arranged in rows in a fixed format. Chairs may be bolted to the floor.	Movable furniture to facilitate easy regroupings of furniture and students.

From *Digital Technology: Transforming Schools and Improving Learning*, by D. G. Moursund, 1999, In B. Day (Ed.), *Teaching and Learning in the New Millennium*, Indianapolis, IN: Kappa Delta Pi.

Table 3

Differences Between Traditional Assessment and Constructivist-based Assessment

Educational Component	Traditional Assessment	Constructivist-based Assessment
Student Role as a Learner	Listener (often passive). Quiet, well behaved. Raises hand when prepared to respond to a teacher's question. Studies directed toward passing tests and completing required work.	Collaborator, teacher, peer evaluator, sometimes expert. Actively engaged. Active learning. Problem poser. Active seeker after knowledge. Students learn as they help each other.
Demonstration of Success	Quantity and aspect of recall.	Quality of understanding.
Use of Technology during Assessment	Allow simple tools, such as paper and pencil. Occasional oral presentation.	Students assessed in environment in which they learn.
Student Work-Products	Most student work-products are written and private, shared only with the teacher. Occasional oral presentation.	Most student work-products are public, subject to review by teachers, peers, parents, and others. Multiple forms of products.
Assessment	Norm referenced. Objective and short answer. Focus on memorization of facts. Discipline specific. Lower-order thinking skills.	Criterion referenced. Authentic assessment of products, performances, and presentations. Portfolio. Self-assessment. Peer assessment.

From *Digital Technology: Transforming Schools and Improving Learning*, by D. G. Moursund, 1999, In B. Day (Ed.), *Teaching and Learning in the New Millennium*, Indianapolis, IN: Kappa Delta Pi. Copyright 1999 by Taylor & Francis Group. Reprinted with permission.

Jonassen, Peck, and Wilson (1999) contrasted the fundamental differences between traditional and constructivist views in terms of attributes such as knowledge, reality, meaning, symbols, learning, and instruction. Table 4 displays this information.

Table 4

Traditional vs. Constructivist Learning Methods

Attributes	Traditional Method	Constructivist Method
Knowledge	Transmitted, external to knower, objective, stable, fixed, decontextualized.	Constructed, emergent, situated in action or experience, distributed.
Reality	External to the knower.	Product of mind.
Meaning	Reflects external world.	Reflect perceptions and understanding of experiences.
Symbols	Represents world.	Tools for constructing reality.
Learning	Knowledge transmission, reflecting what teacher knows, well-structured, abstract-symbolic, encoding-retention-retrieval, product-oriented.	Knowledge construction, interpreting word, constructing meaning, ill-structured, authentic-experiential, articulation-reflection, process oriented.
Instruction	Simplify knowledge, abstract rules, basics first, top-down, deductive, application of symbols, lecturing, tutoring, instructor derived and controlled, individual competitive.	Reflecting multiple perspectives, increasing complexity, diversity, bottom-up, inductive, apprenticeship, modeling, coaching, exploration, learner-generated.

From *Learning with Technology: A Constructivist Perspective*, by D. H. Jonassen, K. L. Peck, and B. G. Wilson, 1999, Upper Saddle River, NJ: Prentice Hall. Copyright 1999 by Education Development Center, Inc. Reprinted with permission.

Summary of Constructivism

The two approaches, traditional and constructivist, can both be considered in a theoretical framework; however, teachers in the real world, especially those whose job is to train and prepare 21st century learners for an ever-changing world, must wrestle with the decision as to which method is more suitable for their students' success and achievement. Noticeably, constructivist practices require more work from the teacher than traditional methods. Gordon (2009) commented that applying constructivism could be a complex, multifaceted process for teachers because student learning, at times, is unpredictable. Therefore, teachers need to be strong in their content areas, consciously aware of their classroom management, and have an understanding of the culture of their classroom environment to truly be successful at implementing constructivist practices.

According to Weiss and Pasley (2004), effective mathematics instruction invited "students to interact purposefully with the content" and included "various strategies to involve students and build on their previous knowledge" (p. 25). This is certainly the main characteristic of constructivism and one such novice approach is the flipped model of instruction.

The Flipped Model of Instruction

The flipped classroom model of instruction is a relatively new teaching strategy attempting to improve student engagement and performance by moving the lecture outside the classroom via technology and moving homework and exercises with concepts inside the classroom via learning activities (Bergmann & Sams, 2012; Brunsell & Horejsi, 2011; Tucker, 2012; Young, 2011). The core idea with this blended learning strategy is to flip the common instructional approach: instruction previously occurring in class is now accessed at home, in advance of class, via teacher-created videos and interactive lessons, and work previously occurring outside of the classroom is now completed in class in the presence of the teacher. Using this inductive approach, Tucker (2012) stated class becomes the place to "work through problems, advance concepts, and engage in collaborative learning" (p. 82). Such use of class time will give students the opportunity to learn how to think for themselves by being actively engaged in the mathematics content.

Current Research and the Flipped Model of Instruction

Current research on the flipped model of instruction is extremely limited (Baker, 2000; Johnson & Renner, 2012; Lage, Platt, & Treglia, 2000; Strayer, 2007). Only one study was located that examined the effect of the flipped classroom on student performance and achievement at the secondary level. Specifically, the study inspected the efficacy of the flipped model of instruction in a high school computer application course (Johnson & Renner, 2012). Thus, the need to further investigate this instructional strategy at the secondary level, especially in the content area of mathematics, is critical to deeming this approach as effective and useful.

In addition, current research on the flipped model of instruction could be described as mixed in terms of its effectiveness as determined by the student participants (Baker, 2000; Johnson & Renner, 2012; Lage et al., 2000; Strayer, 2007). With such varying results, the flipped classroom should be further examined in order to establish concrete evidence as to whether or not the strategy is suitable for improved learning and performance.

Baker (2000) had a vision of using electronic means to cover rote material outside of class. He realized during a college lecture that his students were capable of retrieving the notes and slide presentations themselves and encouraged them to do so. In class, rather than lecturing, Baker allowed his students to work together on application of the principles from the content under his guidance and direction. Student survey responses in

Baker's two flipped college courses indicated positive student perception toward the flipped classroom. Representative student comments indicated the learning was more personalized, the cooperative groups fostered critical thinking, and the online resources provided students with more control over their learning.

Lage et al. (2000) designed and implanted a similar procedure in their college economics courses. They referred to the concept as the *inverted classroom* and similarly held the expectation that students would view lectures in advance of class, then spend class time clarifying difficult concepts and working in small groups. They stated, "Inverting the classroom means events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa. The use of learning technologies, particularly multimedia, provide new opportunities for students to learn" (p. 32). Student perceptions were measured using a survey instrument with a Likert-scale and open-ended questions and revealed positive student perceptions about the course. Representative comments on the surveys revealed the students thought it was easier to ask questions, learning from peers was different and enjoyable, and the video lectures were quite valuable.

Strayer (2007) reported in most instances where the flipped model of instruction is used, the goal is to create an active learning environment during class meetings while ensuring content coverage. Conversely, his study's findings, which compared the flipped classroom and the traditional approach in two different college level introductory statistics courses, showed the flipped classroom students were less satisfied with how the structure of the classroom oriented them to the learning tasks in the course. The variety of learning activities in the flipped classroom contributed to feelings of unsettledness among the students that the traditional classroom students did not experience. Strayer argued the flipped classroom was "better suited for certain classrooms and courses than others" (p. 198). Certainly, the need to further investigate this recommendation is quite important.

Finally, Johnson and Renner (2012) examined the efficacy of the flipped model of instruction within a high school computer application course by comparing it to traditional approaches. They hypothesized students in the flipped classroom would benefit more due to the transitioning of class time from lower-level activities to collaborative group work; however, their results did not support that hypothesis. Students did not fully embrace the flipped classroom expectations due to being exposed to traditional methods implemented by the teacher. Johnson and Renner assumed the "failed attempt at the flipped model of instruction is what caused such varying results, rather than the intervention itself" (p. 72). The study provided insight into further research in order to more successfully evaluate the instructional strategy's effectiveness.

Summary of the Flipped Model of Instruction

As demonstrated in the current research, there is a need to further investigate the flipped model of instruction in order to assess its usefulness as an effective instructional strategy. Specifically, there is a need to examine this instructional approach at the secondary mathematics level. With limited studies at the secondary level and no studies involving the content area of secondary mathematics, this action research study enhanced the current body of knowledge by providing findings on the effectiveness of the flipped model of instruction in terms of student engagement and performance.

Change Management

As an action research study, the need to understand change management was also of vital importance for the successful execution and future continuation of the flipped model of instruction intervention. In all living systems, which include humans, change will occur through emergence. Large-scale changes that had great impact did not originate in plans or strategies from on high; instead, they began as small, local actions (Wheatley & Frieze, 2007). As suggested by the theory of emergence, the flipped model of instruction, having its roots in a rural mathematics classroom in southwest Louisiana, could potentially lead to change in other mathematics classrooms in the school, district, and possibly state if promising results were yielded.

Emergence occurs in three stages: networks, communities of practice, and systems of influence (Wheatley & Frieze, 2006). First, in order for change to occur, the development of networks is essential for people finding like-minded individuals to work in collaboration with each other to promote effective change. It is important to note networks are based on self-interest: people usually network together for their own benefit and to develop their own work. This action research study led to the development of a network among the mathematics teachers at the study site focused on changing current instructional practices. Certainly, the first stage of emergence, networks, makes it possible to find other people engaged in similar work.

Once a network is established, the development of communities of practice occurs. Many smaller, individuated communities surface from a robust network. Communities of practice are usually self-organized among people who share a common work and realize there is a great benefit to being in a relationship (Wheatley & Frieze, 2006). They use this community to share what they know, to support one another, and to intentionally create new knowledge for their field of practice. This action research study easily fostered a community of practice by bringing together teachers within the school district who were willing to work together to change the current mathematics instructional practices to see improvements in engagement and performance.

The third and final stage in emergence is one that can never be predicted. It is the sudden appearance of a system of influence that has real power and authority (Wheatley & Frieze, 2006). Wheatley and Frieze (2006) described the third stage as "innovative efforts hovering at the periphery, which quickly become the norm" (para. 17). The practices developed by the bold communities quickly become the accepted standard. People no longer hesitate about adopting these approaches and methods, and they learn them easily. Members of the system of influence become the leaders in the field and are acknowledged as the experts for their particular issue. Regarding this action research study, the system of influence could potentially occur when the teachers in the community of practice focus their instructional reform efforts toward the entire state.

Emergence is the fundamental scientific explanation for how local changes can materialize as global systems of influence (Wheatley & Frieze, 2007). As a change theory, it offers methods and practices to accomplish the system wide changes that are needed, especially at this time in the realm of education. As leaders and communities of concerned people, it is imperative to intentionally work with emergence so reform efforts result in an improved future. According to Wheatley and Frieze (2006), no matter what other change strategies are learned or favored, "emergence is the only way organized change really occurs" (para. 18).

Chapter 2 Summary

This chapter presented an overview of the literature relevant to this action research study. First, a review of research on student engagement was presented by detailing the various factors that promote active engagement and lead to improved student performance. Since the research was extremely limited in the area of secondary mathematics, the need to further investigate this area was stressed. Second, the theory of constructivism and its exploration of student-centered classrooms and active engagement were discussed. Specifically, the review of literature compared traditional approaches to constructivist-based strategies based on numerous components. Third, the flipped model of instruction and research surrounding this instructional strategy was documented. It was also stressed further investigations of this intervention need to be completed at the secondary level, especially in the secondary mathematics classroom. Finally, the need to understand change management based on the theory of emergence was reviewed.

The next chapter provides an explanation of this study's research methodology.

CHAPTER 3. METHODOLOGY

Introduction to Chapter 3

As stated by Friedman (2005), secondary mathematics achievement is one of the key predictors of a nation's long-term economic potential. With such influence, the National Council of Teachers of Mathematics (NCTM, 2009) encouraged educators to place great emphasis on student-centered learning strategies and approaches where students have the opportunity to be actively engaged in the content being presented, thus improving performance and achievement in the secondary mathematics classrooms. This research study sought to bring about improvements in student engagement and performance through the use of the flipped model of instruction in the secondary mathematics classroom. This chapter discusses the methodology that was used to collect and analyze the data and is comprised of the following areas: statement of the problem, research questions, research methodology, research design, population and sampling procedure, sources of data, field test, instrumentation, validity, reliability, data collection procedures, data analysis procedures, ethical issues, and a final summary.

Statement of the Problem

In many of the secondary classrooms across the country, including the research site for this study, students are not actively engaged in the mathematics content, and academic performance can be described, at best, as mediocre. To address this problem, there was a need to implement effective instructional strategies to boost student engagement in performance in the secondary mathematics classrooms. Specifically, there was a need to change current traditional delivery approaches to more student-centered methods where the students were actively engaged in the content being presented.

Research Questions

The review of literature for this study demonstrated a need to further investigate instructional strategies affecting student engagement and performance at the secondary mathematics level. The review also led to the following research questions related to the implementation of the flipped model of instruction and its impact on student engagement and performance:

1. How does the flipped model of instruction affect student engagement and performance in the secondary mathematics classroom?
2. How do the students interact in the flipped classroom environment compared to the traditional setting?

Research Methodology

The flipped classroom model of instruction was implemented over a seven-week grading period at the research site to 42 ninth grade students who were enrolled in Algebra I courses. The students prepared for class by watching videos, listening to podcasts, reading articles, viewing presentations, or contemplating questions demonstrating the current topic of study. All of the media pieces for this research study were original products of the teacher and were uploaded to the classroom Blackboard site in which all of the student participants were enrolled. Completion of homework content notes was used to determine whether or not the student had adequately prepared for class. During class, rather than listening to a lecture, the students engaged in hands-on activities, participated in real-world applications, and at times, completed independent practice in the presence of the teacher. Such use of instructional time allowed the teacher an opportunity to better assess the students' understanding and comprehension of the content.

For those students with no Internet access at their homes, media was made available on flash drives and DVDs the students could check out and watch at home. In the event a student was still unable to view the content at home, arrangements were made for that student to view the media during Response to Intervention (RtI) time so he or she could be adequately prepared for class.

Since this study focused on the impact the flipped model of instruction had on student engagement and performance in the secondary mathematics classroom and compared student interaction in the flipped classroom to a traditional format, changes in the participants' perceptions and attitudes were evidenced and evaluated through the completion of a pre- and post-survey, a teacher-created unit test, random interviews, and a focus group session. In addition, the researcher kept a journal to document daily observations, experiences, thoughts, and insights involving the flipped classroom.

Research Design

This study utilized an action science research design involving the implementation of the flipped model of instruction and the collection and analysis of both quantitative and qualitative data to assess the model's impact on student engagement and performance in the secondary mathematics classroom. Gall et al. (2007) stated action research has played a "growing role in the field of education in recent years because of its promise for improving educators' practice, strengthening the connection between research and practice, and improving the justice of education's impact on society" (p. 597). The key to action science theory is the implementation of an intervention and an evaluation as to whether or not the intervention improved a situation. For this research study, the intervention was the flipped model of instruction.

According to Argyris and Schön (1996), action science theory brings a "broader, systematic perspective to the table that contributes to the growth and learning of an organization, as well as its ability to move with agility and address problems efficiently and effectively" (p. 43). The practice of the mathematics department at the research site of not only looking for a problem but also seeking ways to improve the current situation of poor student engagement and performance exemplified a distinct feature of action science theory.

Both quantitative and qualitative data were collected and analyzed in this action research study. Quantitative data included a pre- and post-survey and a teacher-created unit test; qualitative data included student interviews, a focus group session, and notes documented in the researcher's journal. A mixed methods study provided an opportunity to explore factors that contributed to the impact the flipped model of instruction had on student engagement and performance in the secondary mathematics classroom. According to Creswell (2008), a mixed methods approach is useful when both forms of data can be used to gain a greater understanding of the research problem than either method would by itself. Validated by Suter (2006), mixed methods research in education has "great potential to influence ways of thinking about problems and practices in the teaching and learning process" (p. 65).

Population and Sampling Procedure

Population

The research site in this study is a public high school serving approximately 450 students located in rural southwest Louisiana. Two Algebra I classes at the research site served as the context for this study. The algebra courses were selected due to the rigorous content and structured curriculum. Both sections were classified as regular education courses and included a diverse group of students with varying learning abilities. Since these classes employed the flipped model of instruction, the key stakeholders were those ninth grade students who were enrolled in the courses. The study participants were between 13 and 16 years of age and voluntarily agreed to participate in this research study with parental permission. While all of the students were expected to participate in the flipped model of instruction intervention, only those students who turned in parental permission and child accent forms were allowed to take part in the data collection processes of this study. A total of 42 students (18 boys and 24 girls) participated in the data collection processes of this study.

Sampling Procedure

In terms of the quantitative aspect of this study, all of the student participants completed the pre- and post-survey as well as the teacher-created unit test for data collection purposes. The sampling procedure used for the qualitative data, including student interviews and a focus group session, was a simple random sampling. An *i*Pad with a name selector app was used to determine the sample. The students' names were entered into the data section of the app, and a random sequence option selected the sample. Twenty-two students were randomly selected to participate in the interviews and focus group session. According to Trochim (2006), simple random sampling is a reasonable method to generalize the results from the sample back to the population. In addition, this action research study considered simple random sampling as a fair way of selecting the sample from the given population since every member was given equal opportunities of being selected. An unbiased random selection and a representative sample are important in drawing conclusions from the results of a study (Trochim, 2006).

Sources of Data

Both quantitative and qualitative data were collected and analyzed for this action research study. The quantitative data included a pre- and post-survey as well as a teacher-created unit test. The qualitative data included student interviews, a focus group session, and notes documented in the researcher's journal. Each is briefly described below.

Student Surveys

A pre- and post-survey were used to gather data from the student participants. Specifically, the pre-survey assessed the students' learning experiences in a traditional classroom setting while the post-survey evaluated the students' learning experiences in a flipped classroom. The Student Perception of Instruction Questionnaire (SPIQ), previously used in a study comparing blended and face-to-face course delivery options, used a Likert scale to capture students' perceptions of instruction (Araño-Ocuaman, 2010). Permission to use the survey and to modify it to fit the needs of the flipped model of instruction was granted. Appendix A contains the survey instrument.

Unit Test

Since the flipped model of instruction was implemented over a seven-week period, a teacher-created unit test was used to assess whether or not the student participants learned the content. The specific unit focused on solving systems of equations by graphing, substituting, eliminating, and using Cramer's Rule. Additionally, a small unit on solving systems of inequalities by graphing was also taught using the flipped model of instruction approach. The unit test for this action research study included questions involving the grade-level objectives required for solving systems of equations and inequalities.

Student Interviews

The student participants were randomly selected to complete interviews to gain a deeper understanding of their unique experiences with the flipped model of instruction. Creswell (2008) noted interviews as being the best method for capturing the experiences and perspectives of the participants in their own words. This study incorporated interviews as a method for including participants' experiences and perspectives as they related to the flipped model of instruction's impact on their engagement and performance. The interviews included semi-structured questions. Appendix B contains the semi-structured questions for the student interviews.

Focus Group Session

The student participants were also randomly selected to complete a focus group session to discuss their perceptions of the flipped model of instruction and its impact on their engagement and performance in the secondary mathematics classroom. The focus group session included semi-structured questions targeting the students' experiences and ideas in the flipped classroom and compared those notions to their learning in a traditional classroom environment. Appendix C contains the semi-structured questions for the focus group session.

Researcher's Journal

Observations, experiences, thoughts, and insights involving the flipped model of instruction were documented in a journal by the researcher on a daily basis. The journal also served as a means of brainstorming to expand upon impressions and thoughts about what occurred throughout the study. More important, documentation in the journal also included detailed timelines and procedures for data collection and analysis, which ensured the reliability of this action research study.

Instrumentation

The survey instrument, Student Perception of Instruction Questionnaire (SPIQ), was previously used in a study comparing blended and face-to-face course delivery options (Araño-Ocuaman, 2010). In her particular study, Araño-Ocuaman used the instrument to measure areas where technology impacted or improved student learning and engagement. Permission to use the instrument with modifications to fit the needs of this research study was obtained through the doctoral committee chair due to the recent death of the author. As described by Araño-Ocuaman, Cronbach's alpha was used to measure the reliability of the instrument. Of the possible 36 students in her study, twenty-seven valid responses to the questionnaire were used to arrive at the Cronbach alpha coefficient of $\alpha=0.731$. As noted by Araño-Ocuaman, a reliability coefficient of 0.70 or higher indicated an acceptable level of reliability in most educational research.

The teacher-created unit test included released test item questions from past Algebra I End-of-Course Exams and covered the grade-level expectations for solving systems of equations and inequalities. The format of the unit test contained multiple choice and short answer questions. In addition, there was one constructed-response question on the test, which was also a released test item.

Field Test

A field test was conducted prior to the implementation of the flipped model of instruction assessing the appropriateness of the interview and focus group session questions. Ten educational leadership experts were contacted via email and asked to review the interview and focus group session questions for credibility. Specifically, the experts were asked to determine whether or not the questions asked were clear, appropriately worded, open-ended, and in alignment with the overall research questions proposed in the study. Feedback encouraged simplifying the wording in some of the interview questions so the study participants would not have to endure any distress or discomfort. In addition, the district's Assessment, Research, Special Services, and Accountability department reviewed the instruments and stated all were aligned with the study's intended purpose.

Validity

In a broad sense, validity refers to the principles used to determine whether or not the research under question is of good quality (Trochim, 2006). There are two types of validity: internal and external.

Internal Validity

Lather (1986) delineated ways in which researchers could seek to minimize their own distortions of the data. By triangulating data sources, methods, and perspectives on the data, the researcher would be able to establish data trustworthiness. The multiple data sources in this study, including a pre- and post-survey, a teacher-created unit test, student interviews, a focus group session, and notes documented in the researcher's journal, and the use of a mixed methods approach collecting both quantitative and qualitative data encouraged trustworthiness through triangulation. Throughout the research study, feedback was elicited from a competent colleague. Through this member checking, data credibility was established. Triangulation of data sources, methods, and perspectives helped to promote a valid research study.

External Validity

While the results of this study may not be generalizable to other settings or students in the population, there is reader generalizability. Merriam (1998) argued, "Reader or user generalizability involves leaving the extent to which a study's findings apply to other situations up to the people in those situations" (p. 211). It is the reader who must decide what is in the study that can be applied to their own situations and what clearly does not apply to them. A rich description of the results provided an opportunity for readers to assess their current situations and determine whether this action research study's findings were relevant to their unique positions. Moreover, the reader might even have the possibility of seeing comparisons of this study's results to their own personal situations. The use of reader or user generalizability helped to promote a valid study.

Reliability

Reliability has to do with the quality of measurement (Trochim, 2006). In its everyday sense, reliability is the consistency or repeatability of a research study's measures. Certainly, some degree of researcher bias is inevitable in mixed methods approaches involving qualitative research in which the researcher interprets the data. One method to increase reliability and minimize bias is to operationalize as many steps as possible as was done in this study. Detailed timelines and steps for both data collection and data analysis procedures were developed. Such use of detail promoted a consistent, reliable study.

Data Collection Procedures

The district's Assessment, Research, Special Services, and Accountability department granted permission to conduct the study at the research site and approved all measures and instruments utilized within the study. In addition, Capella University's IRB reviewed and approved the research study. After the approvals and permissions were granted, the implementation of the flipped model of instruction and the collection of data began. The following procedures took place during the data collection process:

1. Prior to the flipped model of instruction intervention, the student participants completed a confidential pre-survey assessing their learning experiences in a traditional classroom setting. The pre-surveys remained anonymous and were stored and locked in a filing cabinet throughout the study. All of the student participants completed the pre-survey.
2. Throughout the flipped model of instruction intervention, observations, experiences, thoughts, and insights were documented in a journal on a daily basis. The journal also served as a means of brainstorming to expand upon impressions and thoughts about what was occurring throughout the study. Since action science research is research in action, the process of data collection was integrated with the actual intervention (Coghlan & Brannick, 2005). The journal remained stored and locked in a filing cabinet throughout the study.

3. After experiencing the flipped model of instruction for seven weeks, the student participants completed a confidential post-survey assessing the model's impact on their learning experiences. The post-surveys remained anonymous and were stored and locked in a filing cabinet. All of the student participants completed the post-survey.
4. At the conclusion of the flipped model of instruction intervention, the student participants also completed a teacher-created unit test covering the flipped content, which included solving systems of equations and inequalities. This assessment was used in years past and mirrored the Algebra I End-of-Course questions on solving systems of equations and inequalities. All of the student participants completed the unit test. The unit tests were stored and locked in a filing cabinet.
5. After the seven-week period, students were selected using a simple random sampling technique to participate in interviews to gain a deeper understanding of their unique experiences related to the flipped model of instruction. The sample students selected times feasible to their respective schedules and completed the interviews after school. The interviews were audio recorded on a computer and saved to a media storage device. The device was stored and locked in a filing cabinet. The researcher transcribed all of the interviews and stored the printed copies in a locked filing cabinet. A total of 12 interviews were completed.
6. The last data collection procedure involved the completion of a focus group session. For this data source, ten students were selected via a simple random

sampling technique to discuss their perceptions of the flipped model of instruction and its impact on their engagement and performance. In order to prevent any conflicts in scheduling, the school's administration gave permission to conduct the focus group session during the school day during Response to Intervention (RtI) time. The focus group was audio recorded on a computer and saved to a media storage device. The media storage device was stored and locked in a filing cabinet. In addition, the researcher transcribed the focus group session and stored a printed copy of the dialogue in a locked filing cabinet.

Data Analysis Procedures

Quantitative data analysis was conducted on the student surveys and the teacher-created unit test. Specifically, the quantitative data was analyzed using the various forms of descriptive statistics. According to Trochim (2006), descriptive statistics provide simple summaries about the sample and the measures. More important, descriptive statistics are used to present quantitative descriptions in a manageable form. All of the quantitative data was aggregated and displayed in Microsoft Excel tables to promote simplicity in mathematical computations and to protect the participants' anonymity. In addition, an independent-samples t-test was performed on the unit test results to determine if there was a significant difference in performance between the flipped model of instruction students and those taught in the traditional environment. The following practices occurred during the quantitative data analysis procedures:

1. Responses for each Likert scale rating for each statement on the pre- and post-surveys were tallied and entered into the Microsoft Excel spreadsheet. The

first 15 survey items were analyzed by calculating the mode, the response occurring the most. According to Ary, Jacob, and Sorensen (2010), Likert-type items classified as ordinal measurements are best described using the mode when analyzing such data. In addition, in order to gain a deeper understanding of the survey results, the percentages of students choosing *strongly agree* and *agree* for each statement on the pre- and post-survey were calculated.

2. The teacher-created unit test was graded based on the district grading scale and entered into the Microsoft Excel spreadsheet. Measures of central tendency and distribution, including the mean, median, mode, and range, were calculated to better describe the unit test data. In addition, with the use of an online electronic gradebook, the same assessment given to similar Algebra I sections taught in a traditional approach were accessed and compared to the test data gathered from the flipped model of instruction delivery format. An independent-samples t-test was performed in Microsoft Excel to determine if there was a significant difference in performance between the two groups of students.

Qualitative data analysis was conducted on the student interviews, the focus group session, and the researcher's journal. Specifically, a thematic analysis of the qualitative data was completed and involved searching for themes within the data through a repeated process of capturing keywords, journaling in logs, and coding responses from interviews and observations (Attride-Stirling, 2001). Beginning on the first day of the flipped classroom intervention, the process of looking for recurring themes began. As the observations continued and the interviews started, a constant state of comparison from one day to the next and one interview to the next transpired in order to expand, contract, delete, or add codes and categories. The qualitative data was analyzed and revisited until the point of saturation was reached. Creswell (2008) noted, “Saturation is the point where you have identified the major themes and no new information can add to your list of themes or to the detail for existing themes” (p. 257). In addition to the statements above, the following practices occurred during the qualitative data analysis procedures:

1. The researcher transcribed the recorded data from the student interviews and the focus group session, and logs were entered into a database and tracked in a Microsoft Excel spreadsheet.
2. The transcriptions were coded first. Codes were written in the left-hand margin of the transcripts and the corresponding text was highlighted.
3. Data was also coded by searching for recurring themes and how those themes related to the review of literature for this research study.
4. The coded texts were reviewed to determine emerging themes. A competent colleague served as an alternate reader to protect against bias. Potential themes were written in the right-hand margin of the transcripts.
5. Lastly, the potential themes were compared to the observations and experiences recorded in the researcher’s journal in order to appropriately describe any similarities or differences.

Ethical Issues

Researcher's Position Statement

The researcher’s position statement in this action research study was considered *insider in collaboration with other insiders*. As both researcher and teacher, the desire to remain neutral throughout this research study in order to fairly assess the impact of the flipped model of instruction on student engagement and performance was of extreme importance. Herr and Anderson (2005) declared insider researchers often “collaborate with other insiders as a way to do research that not only might have a greater impact on the setting, but is also more democratic” (p. 37). Although this research study was not collaborative in nature, the results of the study were shared with the mathematics department at the research site.

Conflict of interest assessment. There were two areas of concern regarding potential conflicts of interest with this action research study. First, the researcher was employed at the research site as a certified secondary mathematics classroom teacher. Secondly, the researcher had a professional relationship with the study participants being the student participants were enrolled in the researcher's Algebra I courses.

In order to manage personal bias caused by the relationships described, a competent colleague was used to audit the action research methods. The colleague held a PhD in Educational Leadership and Management and was the direct supervisor of the researcher. The colleague examined the research data and assessed the dependability of the project. In addition, the researcher remained in a constant state of reflection by writing in a journal on a daily basis to describe observations, experiences, thoughts, and insights involving the intervention. The journal also served as a means of brainstorming to expand upon impressions and thoughts about what was occurring throughout the study.

Position statement. As both researcher and teacher, the desire to remain neutral throughout the study in order to fairly assess the effects of the flipped model of instruction was of utmost importance. A research journal detailing insights and experiences was kept in order to honestly and objectively reflect on various aspects of the intervention to avoid any biases or preconceptions throughout the study. While the dedicated interest in ensuring the best possible implementation of the flipped model of instruction was acknowledged, there was very little known about this instructional strategy, and the model was never utilized at the research site prior to this study. Therefore, it was believed an objective and impartial viewpoint could be taken in the analysis of the results and in making suggestions for future use of the flipped model of instruction.

Ethical Issues in the Study

With increased use of the computer at home, Internet safety became the responsibility of the teacher during the implementation of the flipped model of instruction. To address this critical concern, the teacher-created media files were uploaded to the classroom Blackboard site in which all of the student participants were enrolled. By doing so, this allowed the students to navigate to one central location in order to complete the assignments outside of class. In addition, safe web browsing techniques were discussed in the introductory letter to the participants' parents, and those key procedures were posted within the classroom Blackboard site.

The flipped model of instruction involved the invasion of the home (Bergmann & Sams, 2012). Specifically, the role of the supportive parent as a tutor in helping their child complete homework assignments was diminished. No longer were students completing homework problems at the dining room table; instead, they were watching videos online via a computer or their personal electronic device and completing homework content notes. In the introductory letter to the parents, various strategies and tips were provided to help parents support their child in the flipped model of instruction classroom.

It was also considered the student participants might become fearful their grades would be adversely affected if the flipped model of instruction did not lead to a classroom environment conducive to learning, thus hindering their performance. In order to prevent such attitudes, it was stressed to the student participants that the flipped model of instruction was part of an action research study to assist in improving current conditions at the research site. Simply put, the students were told if improvements were not observed, the situation would be addressed, and changes would be made accordingly.

Finally, in order to protect the privacy of the participants during the data collection process, all identifying information from the data records was removed. Specifically, the quantitative data collected from the student surveys and unit test were aggregated and displayed in Microsoft Excel tables to protect anonymity; the qualitative data collected from the interviews, a focus group session, and the researcher's journal included a system of name substitution to avoid using the participants' actual names. In particular, participants were assigned anonymous designations—Participant 1, Participant 2, and so on (abbreviated P1, P2, etc.)—throughout the discussion of the results and findings of this action research study. In addition, the researcher emphasized both at the beginning and end of the focus group session the importance of how the participants should respect each other's privacy by not revealing identities and refraining from indicating who made specific comments during the discussion once outside the focus group setting.

Chapter 3 Summary

Through an action science mixed methods approach, both quantitative and qualitative data were collected and analyzed to address the impact of the flipped model of instruction on student engagement and performance in the secondary mathematics classroom. Since the review of literature warranted a need to further investigate the flipped model of instruction at the secondary mathematics level, the findings of this study strengthened the body of literature on the topic of student engagement and performance. More importantly, the results provided additional quantitative data and vital qualitative data to understand how the flipped model of instruction affects student engagement and performance in the secondary mathematics classroom.

The next chapter discusses the data analysis and results of the study.

CHAPTER 4. DATA ANALYSIS AND RESULTS

Introduction to Chapter 4

The review of literature for this action research study indicated a need to further investigate the impact the flipped model of instruction had on student engagement and performance at the secondary mathematics level. Thus, the flipped model of instruction was implemented over a seven-week period to ninth grade students enrolled in two Algebra I courses at the research site. Since this study focused on the impact the flipped model of instruction had on student engagement and performance in the secondary mathematics classroom, changes in the participants' perceptions and attitudes were evidenced and evaluated through the completion of a pre- and post-survey, a teacher-created unit test, random interviews, and a focus group session. In addition, the researcher kept a journal to document observations, experiences, thoughts, and insights involving the flipped classroom on a daily basis. This chapter discusses the data analysis procedures and presents the results. The following areas are included in this chapter: description of the sample, quantitative results, qualitative findings, and a final summary.

Description of the Sample

The research site in this study was a public high school serving approximately 450 students located in rural southwest Louisiana. Two Algebra I classes at the research site served as the context for this study. The algebra courses were selected due to the rigorous content and structured curriculum. Both sections were classified as regular education courses and included a diverse group of students with varying learning abilities. Since these classes employed the flipped model of instruction, the key stakeholders were those ninth grade students who were enrolled in the courses. The study participants were between 13 and 16 years of age and voluntarily agreed to participate in this research study with parental permission. A total of 42 students (18 boys and 24 girls) participated in the study.

Quantitative Results

Quantitative data analysis was conducted on the student surveys and the teacher-created unit test. Specifically, the quantitative data was analyzed using the various forms of descriptive statistics. According to Trochim (2006), descriptive statistics provide simple summaries about the sample and the measures. More important, descriptive statistics are used to present quantitative descriptions in a manageable form.

Student Surveys

Permission to use and modify the survey instrument, the Student Perception of Instruction Questionnaire (SPIQ), was granted to fit the needs of this action research study (Araño-Ocuaman, 2010). The pre-survey was completed prior to the flipped model of instruction intervention. Specifically, the pre-survey assessed the students' perceptions of their current Algebra I class they had experienced since the start of the school year, which could be described objectively as traditional instruction. The post-survey was completed after the students experienced seven weeks of the flipped model of instruction classroom. The first 15 survey items included Likert-type responses and were analyzed by calculating the mode, the response occurring the most. According to Ary, Jacob, and Sorensen (2010), Likert-type items classified as ordinal measurements are best described using the mode when analyzing such data. Table 5 displays the most common response for each statement on both the pre- and post-survey. In addition, in order to gain a deeper understanding of the survey results, the percentages of students choosing *strongly agree* and *agree* for each statement on the pre- and post-survey were calculated. Table 6 displays those comparisons.

Table 5

Mode Results on Pre- and Post-Survey Likert Items

	Statement	Pre-Survey	Post-Survey
1	I communicated a lot with other students regarding the mathematics content.	A	SA
2	I communicated with the teacher often.	A	SA
3	I had to work hard to learn the content.	SA/A	A
4	I learned a lot of new mathematics content in this classroom.	SA	SA
5	The learning activities focused on real life applications and improved my learning.	A	SA
6	The availability of course content materials helped me improve my understanding of the content.	A	SA
7	I applied my out-of-class experiences and learned from the practical applications.	SA/NAD	SA
8	I explored my own strategies for learning.	A	SA
9	I actively participated in all aspects of the course.	A	SA
10	I needed technical assistance for this class.	NAD	SA
11	The availability and access to technical support and resources helped me improve my learning.	NAD	SA
12	My desire to learn improved as a result of this course.	A	A
13	I would choose to take another course like this one.	A	SA
14	This course met my expectations.	A	SA
15	Overall, this classroom played a major factor in my understanding and comprehension of new mathematics content.	A	SA

Note. SA = strongly agree; A = agree; NAD = not agree or disagree; D = disagree; SD = strongly disagree.

Table 6

Percent of Strongly Agree and Agree Responses on Pre- and Post-Survey

	Statement	Pre-Survey %	Post-Survey %
1	I communicated a lot with other students regarding the mathematics content.	76.19	97.62
2	I communicated with the teacher often.	80.96	100.00
3	I worked hard to learn the content.	76.20	73.81
4	I learned a lot of new mathematics content in this classroom.	92.86	90.48
5	The learning activities focused on real life applications and improved my learning.	66.67	83.33
6	The availability of course content materials helped me improve my understanding of the content.	85.72	97.62
7	I applied my out-of-class experiences and learned from the practical applications.	42.86	100.00
8	I explored my own strategies for learning.	54.76	52.38
9	I actively participated in all aspects of the course.	76.19	88.09
10	I needed technical assistance for this class.	40.48	61.90
11	The availability and access to technical support and resources helped me improve my learning.	40.48	61.90
12	My desire to learn improved as a result of this course.	85.71	83.33
13	I would choose to take another course like this one.	71.43	78.57
14	This course met my expectations.	83.33	83.33
15	Overall, this classroom played a major factor in my understanding and comprehension of new mathematics content.	90.48	95.24

As identified in Table 5, many of the student participants selected *strongly agree* or *agree* for the statements on both the pre- and post-survey. For many of the statements, this was indicative of a satisfactory student perception with both the traditional and flipped classrooms, thus revealing minimal variations between the two delivery approaches. One important inference recognized for many of the survey statements included a change in the most common response from *agree* with the traditional classroom to *strongly agree* for the flipped classroom. In addition, with the high amount of *strongly agree* and *agree* responses on the pre- and post-survey, Table 6 verified the students' positive beliefs and views of the traditional method and the flipped model of instruction.

Item 16 on the pre- and post-survey asked the student participants to select various aspects of the course that helped to improve their individual learning and comprehension of the content. The choices included: availability and access to online content and course materials; enhanced communication using e-mail and discussion boards; online testing and evaluation; ease of use of the classroom Blackboard site; increased one-on-one time with the teacher; in-class group discussions; group collaboration; and independent practice assignments. The top three choices for both the traditional and flipped classroom environment are displayed in Table 7. In addition, the number of responses for each element is included.

Table 7

Top Results on Pre- and Post-Survey Item 16

Pre-Survey/Traditional (Number of Responses)	Post-Survey/Flipped (Number of Responses)
In-class group discussions (38)	Group collaboration (36)
Group collaboration (25)	Increased one-on-one time with teacher (28)
Online testing and evaluation (20)	Availability and access to online content (27)

The last item on the pre- and post-survey asked the student participants to provide suggestions to help improve the traditional and flipped classroom environments for future students. The most common answers observed on the pre-survey recommending ways to improve the traditional classroom included: more group work, move at a slower pace, and more hands-on activities. The most common answer documented on the post-survey suggesting an improvement to the flipped classroom was the idea of flipping content not as difficult as systems of equations and inequalities.

Unit Test

The teacher-created unit test included Algebra I End-of-Course released test items involving systems of equations and inequalities and was graded based on the district grading scale. Measures of central tendency and distribution, including the mean, median, mode, and range, were calculated to better describe the unit test data. In addition, with the use of an online electronic gradebook, the same assessment given to similar Algebra I sections taught in a traditional approach were accessed and compared to the flipped classroom unit test data. While the flipped model of instruction contained 42 participants, the unit test in the traditional classrooms was given to 40 student participants with similar abilities and characteristics. Results are displayed in Table 8.

Table 8

Unit Test Results

Measure	Traditional N = 40	Flipped N = 42
Mean	80.00	80.38
Median	84.00	82.00
Mode	84.00	84.00
Range	44.00	40.00

The difference among the measures between the traditional and flipped classrooms can be described as insignificant as revealed in Table 8. An independent-samples t-test was conducted to compare performance between students in the flipped model of instruction classroom and those in the traditional classroom environment. There was not a significant difference in performance between those students taught using the flipped model of instruction (M = 80.38, SD = 11.02) and those who were in the traditional classroom environment (M = 80, SD = 11.56); $t(80) = 0.15$, $p = 0.44$. These results suggest similar performance abilities between the traditional and flipped classrooms on the content covered on the unit test.

Qualitative Findings

The qualitative data included student interviews, a focus group session, and notes documented in the researcher's journal. A thematic analysis of the qualitative data was completed and involved searching for themes within the data through a repeated process of capturing keywords, journaling in logs, and coding responses from interviews and observations (Attride-Stirling, 2001). The qualitative data was analyzed and revisited until the point of saturation was reached. Creswell (2008) noted, “Saturation is the point where you have identified the major themes and no new information can add to your lists of themes or to the detail for existing themes” (p. 257).

The following keywords and phrases were found to be repetitive in the interview and focus group transcriptions: actively engaged in learning; attentive; better use of class time; class different from others; exciting; flip easier content; hands-on learning; helpful; independent learning; individualized learning; innovative teaching; interaction; more communication with peers and teacher; more participation; one-on-one instruction; real life examples and projects; refreshing; and technology.

Comparing the keywords and phrases to the researcher’s journal and the review of literature for this action research study, the following emerging themes were identified: active engagement and learning; class time and structure; quality of instruction; collaboration; and communication. Each theme is briefly described below.

Active Engagement and Learning

Several of the student participants commented how the flipped model of instruction encouraged active engagement and increased their participation in the Algebra I classrooms. In fact, all of the participants in the focus group session mentioned how they experienced an increase in classroom participation when compared to class time prior to the flipped model of instruction intervention. In particular, the student participants acknowledged their passive interactions during class lectures and limited communication between their teacher and other peers prior to the flipped model of instruction intervention. Conversely, during the flipped classroom, the students witnessed an increase in their classroom participation and communication, thus promoting a student-centered classroom environment conducive to learning and success.

Moreover, documentation in the researcher's journal demonstrated a large amount of days in which the students were actively participating in the classroom activities and enthusiastically involved in all aspects of the classroom happenings. As supported in the journal, a typical day in the Algebra I flipped classroom warranted three groups of students: one group of students entered class and immediately began working on their independent practice problems without the teacher's assistance; a second group of students gathered around the Promethean Activboard and reviewed the content with the teacher; and a final group congregated at the back of the room and viewed the media pieces collaboratively on the classroom computers and their personal electronic devices. The student participants joined one of the three groups on their own initiative based on their current level of understanding and rotated among the groups as needed until they were confident in their abilities to solve the problems independently. Ultimately, the flipped model of instruction provided the student participants an opportunity to be actively engaged in the learning process.

Class Time and Structure

Another theme derived from this action research study involved the unique class time and structure which resulted from the intervention. When compared to the traditional environment, the student participants argued there was better use of class time with the flipped model of instruction. Specifically, the students shared stories of how there were times when they did not feel like taking notes and listening to a lecture on new content. P1 and P2 commented how they were pretending to be involved during the lectures, but were really daydreaming about after school football practice. P3 stated having Algebra class first hour and having to listen to the teacher lecture that early in the day were not effective combinations. With the flipped model of instruction, the students had the luxury of being introduced to new content prior to class and were able to review the media pieces over and over until they fully understood the content being demonstrated. The focus group session revealed many of the students felt the greatest advantage to the flipped classroom was having the ability to replay the videos when they did not have a complete, thorough understanding of the problem solving process. This was certainly an advantage the students did not experience in the traditional classroom environment.

During class, the students worked collaboratively to show the teacher they understood the content. As documented in the research journal, the teacher had the ability to speak to every student in every flipped classroom to determine whether or not the students understood the content being studied. Moreover, with no class time dedicated to lectures, the teacher was able to incorporate hands-on activities and project-based learning structures with real world scenarios to further enhance the students' understanding and comprehension of the content. Students verbalized their enjoyment and eagerness to participate with such activities. With better use of class time and improved classroom management and structure, the flipped model of instruction allowed the student participants the opportunity to demonstrate their understanding and knowledge through various instructional strategies not commonly utilized in the traditional classroom.

Quality of Instruction

When compared to the traditional approach to teaching, the student interviews revealed improvements in the quality of instruction within the flipped classroom. Specifically, the students discussed their preference of the flipped model of instruction over the traditional approach and credited this liking to improved instructional practices. Many of the student participants did not feel direct instruction with lectures and note taking requirements was an effective method of teaching. Instead, the students thought the flipped model of instruction was more effective and applicable because of the variety of teaching practices incorporated within this approach. Some of the practices discussed included: group work, hands-on activities, discovery learning, project-based learning, and real world applications. P3 and P4 shared how they previously thought effective teaching only involved listening to lectures and taking notes; however, after experiencing the flipped classroom, they gained a new understanding of what effective teaching looked like. Ultimately, the students preferred a classroom environment where a variety of instructional practices were utilized rather than one that only used direct instruction with lectures and note-taking requirements.

All of the students felt the use of technology and one-on-one teaching in the flipped model of instruction enhanced the quality of instruction. The interview participants shared story after story of how the use of technology promoted an increase in their level of engagement. P1 verbalized his preference of using technology which caused an increase in his motivation to learn and succeed; P4 stated many of her classes did not use technology so her experience in the flipped classroom was viewed as engaging and pleasing. The students enjoyed viewing the teacher-created media pieces at a time convenient for them and felt having access to the videos 24 hours a day was quite advantageous. P3 mentioned how valuable it was to review the media pieces prior to classroom assessments, a bonus not experienced in the traditional classroom environment. In addition, the focus group session demonstrated the students' satisfaction of having more one-on-one time with the teacher during the flipped model of instruction intervention. Specifically, the students discussed how that additional private time with the teacher confirmed their understanding or need to further study the content. Many times, in the traditional classroom, the students' individual needs and confusion would go unnoticed. In the flipped classroom, the teacher was able to speak with every student in every class and address unique concerns or questions about the current topic being studied.

While the qualitative data showed the flipped model of instruction improved the quality of instruction, the student participants also acknowledged the challenges in flipping difficult content. The student interview participants recognized solving systems of equations and inequalities via the flipped model of instruction were quite difficult and demanding. Not only was a new approach to learning introduced to the students, but content requiring extremely high levels of higher order thinking was also presented to them. The students noted their preference of the flipped model of instruction; yet, they felt the instructional approach should have been introduced to them during easier content in order to promote and facilitate a classroom environment conducive to learning and success.

Collaboration

Collaboration emerged as a major theme while assessing the flipped model of instruction's impact on student engagement and performance in the secondary mathematics classroom. The student interview participants commented on the model's increased use of group work and how it functioned to improve their participation and involvement in the classroom. P5 remarked how the shared support and collaboration by other peers in the classroom helped him build his confidence and improve his understanding of the mathematics content. Additionally, he mentioned the importance of working collaboratively in completing the tasks associated with the hands-on and project-based learning activities. P3 and P6 shared their enthusiasm to finding success in the flipped classroom and credited that success by having the opportunity to work with and learn from their peers on a daily basis. They stressed the idea of having solid teamwork skills helped them find success in other core classes and even in some of their extracurricular activities.

In addition, the student participants in the focus group session viewed group work assignments as far more effective than listening to a lecture and taking notes. The students felt there will always be a time and a place for direct instruction, especially in mathematics; however, they agreed collaborative tasks required each of them to take an active role in the learning process. As stated above, the researcher's journal validated this theme in the daily observance of the variety of groups of students working together to learn and master the content being studied. Distinctly, the flipped model of instruction provided the students with opportunities to work collaboratively and cooperatively in order to improve engagement and performance in the secondary mathematics classroom.

Communication

A final theme demonstrated throughout the qualitative data included the importance of student-to-student and student-to-teacher communication. The focus group session demonstrated students felt communication was improved in the flipped classroom. Compared to the traditional environment, the student participants agreed there were more interactions between their peers and the teacher in the flipped classroom; however, the students agreed the improvements were not extreme. The students verbalized their satisfaction of working with their peers in the flipped classroom by discussing problems, sharing solutions, and validating their thought processes. In addition, all of the student interview participants said they had the opportunity to talk with the teacher each and every class period during the flipped model of instruction intervention. The students viewed this increase in communication as an important contribution to their positive experience with the flipped classroom. While there were improvements in communication with the flipped model of instruction, the student participants viewed those improvements as minimal when compared to communication in the traditional classroom.

Chapter 4 Summary

The results and findings of this action research study were presented in this chapter. Specifically, the quantitative data, including student surveys and a teacher-created unit test, was analyzed using descriptive statistics and an independent-samples t-test. Although the figures illustrated minimal changes between the traditional and flipped delivery approaches, the results showed a positive response to the flipped model of instruction. The qualitative data, including interviews, a focus group session, and the researcher's journal, was analyzed using a thematic analysis. The findings resulted in five emerging themes: active engagement and learning; class time and structure; quality of instruction; collaboration; and communication. The themes were described by using conversations and dialogue from the student participants and were found to promote engagement and performance in the secondary mathematics flipped classroom.

The last chapter presents the conclusion and recommendations of the study.

CHAPTER 5. CONCLUSIONS AND DISCUSSION

Introduction to Chapter 5

In order to address the issue of poor student engagement and performance in the secondary mathematics classrooms at the research site, the flipped model of instruction intervention was implemented over a seven-week grading period to 42 ninth grade students who were enrolled in Algebra I courses. The following research questions were addressed in this study: (a) How does the flipped classroom model of instruction affect student engagement and performance in the secondary mathematics classroom? and (b) How do the students interact in the flipped classroom environment compared to the traditional setting? Since the study focused on the impact the flipped model of instruction had on student engagement and performance and compared student interaction in the flipped classroom to a traditional format, changes in the student participants' perceptions and attitudes were evidenced and evaluated through the completion of a pre- and post-survey, a teacher-created unit test, random interviews, and a focus group session. In addition, the researcher kept a journal to document observations, experiences, thoughts, and insights involving the flipped classroom on a daily basis. This chapter presents the concluding discussion and recommendations for future research. The following areas are included in this chapter: summary of the results, discussion of the results, discussion of the results in relation to the literature, limitations, implication of the results for practice, recommendations for further research, and a final conclusion.

Summary of the Results

Quantitative Results

As identified in Chapter 4, many of the student participants selected *strongly agree* or *agree* for the statements on both the pre- and post-survey. For many of the statements, this was indicative of a satisfactory student perception with both the traditional and flipped classrooms, thus revealing minimal variations between the two delivery approaches. One important inference recognized for many of the survey statements included a change in the most common response from *agree* with the traditional classroom to *strongly agree* for the flipped classroom. This action demonstrated a stronger satisfaction with the flipped model of instruction than the traditional classroom. In addition, with the high amount of *strongly agree* and *agree* responses on the pre- and post-survey, the students' positive beliefs and views of the traditional method and the flipped model of instruction were confirmed.

Furthermore, the teacher-created unit test revealed similar performance abilities between the traditional and flipped classrooms. An independent-samples t-test was conducted to compare performance between students in the flipped model of instruction classroom and those in the traditional classroom environment. There was not a significant difference in performance between those students taught using the flipped model of instruction ($M = 80.38$, $SD = 11.02$) and those who were in the traditional classroom environment ($M = 80$, $SD = 11.56$); $t(80) = 0.15$, $p = 0.44$. These results suggested similar performance abilities between the traditional and flipped classrooms on the content covered on the unit test. While the data illustrated minimal changes between the traditional and flipped delivery approaches, the quantitative results indicated a positive response to the flipped model of instruction.

Qualitative Findings

A thematic analysis involving the qualitative data revealed five common themes among the multiple sources of data: active engagement and learning; class time and structure; quality of instruction; collaboration; and communication.

Active engagement and learning. Several of the student participants commented how the flipped model of instruction encouraged active engagement and increased their participation in the Algebra I classrooms. In fact, all of the participants in the focus group session mentioned how they experienced an increase in classroom participation when compared to class time prior to the flipped model of instruction intervention. Furthermore, the researcher's journal documented a large amount of days in which the students were actively participating in the classroom activities and enthusiastically involved in all aspects of the classroom happenings. As described in the researcher's journal, a typical day in the Algebra I flipped classroom warranted three groups of students: one group of students entered class and immediately began working on their independent practice problems without the teacher's assistance; a second group of students gathered around the Promethean Activboard and reviewed the content with the teacher; and a final group congregated at the back of the room and viewed the media pieces collaboratively on the classroom computers and their personal electronic devices. The student participants joined one of the three groups on their own initiative based on their current level of understanding and rotated among the groups as needed until they were confident in their abilities to solve the problems independently.

Class time and structure. When compared to the traditional environment, the student participants argued there was better use of class time with the flipped model of instruction. Specifically, the students shared stories of how there were times when they did not feel like taking notes and listening to a lecture on new content; instead, with the flipped model of instruction classroom, the students had the luxury of being introduced to new content prior to class and were able to review the media pieces over and over until they fully understood the content being demonstrated. As documented in the researcher's journal, the teacher had the ability to speak to every student in every flipped classroom to determine whether or not the students understood the content being studied. Moreover, with no class time dedicated to lectures, the teacher was able to incorporate hands-on activities and project-based learning structures with real world scenarios to further enhance the students' understanding and comprehension of the content.

Quality of instruction. The student interviews revealed improvements in the quality of instruction within the flipped classroom when compared to the traditional approach to teaching. Specifically, the students discussed how they did not feel direct instruction with lectures and note taking skills was an effective method of teaching; rather, the students thought the flipped model of instruction was more effective because of the variety of teaching practices incorporated within this approach including: group work, hands-on activities, discovery learning, project-based learning, and real world applications. In addition, all of the student participants felt the use of technology and one-on-one teaching in the flipped classroom enhanced the quality of instruction. While the students noted their preference of the flipped model of instruction, they also felt the instructional approach would have been better received if introduced to them during easier content.

Collaboration. The students commented on the model's increased use of group work and how it functioned to improve their participation and involvement in the classroom. The students also viewed group work assignments as far more effective than listening to lectures and taking notes. The researcher's journal validated this theme in the daily observance of the variety of groups working together to learn and master the content being studied. As noted in the researcher's journal, the students rotated among the groups as needed until they were confident in their abilities to solve the problems independently.

Communication. Compared to the traditional environment, the student participants agreed there were more interactions between their peers and the teacher in the flipped classroom; however, the students agreed the improvements were not extreme. The students verbalized their satisfaction with working with their peers in the flipped classroom by discussing problems, sharing solutions, and validating their thought processes. Ultimately, the students viewed the increase in communication, although small, as an important contribution to their positive experience with the flipped model of instruction.

Discussion of the Results

Regarding the area of student engagement, the results and findings of this action research study indicated students were more engaged, more involved in the flipped model of instruction when compared to the traditional delivery approach. Eighty-eight percent of the students stated they actively participated in all aspects of the flipped classroom compared to 76% in the traditional classroom environment. One of the interview questions asked the students to describe their role in the flipped classroom. Interestingly, all of the student interview participants used the word *active* to answer this question. Some of their descriptions included: actively helping, actively learning, actively listening, actively participating, and actively working. Moreover, the student participants openly acknowledged their passive interactions during class lectures and limited communication between their teacher and other peers prior to the flipped classroom intervention. During the flipped model of instruction, however, the students witnessed an increase in their classroom participation and communication. Thus, the flipped model of instruction had a positive impact on student engagement.

With respect to the area of student performance, the results of the teacher-created unit test demonstrated similar performance abilities between the traditional and flipped classrooms. Specifically, the mean (average) for the traditional classroom was 80 out of a possible 100; the mean for the flipped model of instruction classroom was 80.38 out of a possible 100. An independent-samples t-test analysis confirmed the conclusion that no significant difference in performance existed between those students who were taught traditionally and those in the flipped model of instruction classroom. While the performance abilities appear similar, it was important to note the students verbalized their concerns over the flipped content covered on the teacher-created unit test. Many of the student participants recognized the difficulty in solving systems of equations and inequalities. Such content required high levels of higher order thinking skills, and many of the students felt this content was the most difficult of everything learned during the school year. Not only was a new approach to learning introduced to the students, but extremely challenging content was also presented to them. While the students noted their preference for the flipped model of instruction, they felt the instructional approach should have been introduced to them during easier content in order to lessen the demands and challenges of having to learn both a new approach and extremely difficult content. Unquestionably, the impact of the flipped model of instruction on student performance demonstrated similar results when compared to the traditional approach.

Comparing student interactions in the flipped model of instruction to the traditional environment revealed significant information. As stated above, the students were more actively involved in the flipped classroom than the traditional environment. The researcher's journal documented a student-centered environment within the flipped classroom. The students worked collaboratively among the various groups as they learned from each other by discussing problems, explaining procedures, and confirming answers. The teacher functioned as a facilitator, only guiding and directing when needed. On days when hands-on activities were utilized, the students demonstrated levels of eagerness and excitement not before observed in the traditional classroom environment. One activity required the students to compare the speed at which they wrote with their left hands to the speed of their right hands. This hands-on activity allowed the students the opportunity to develop a conceptual understanding of the three different types of solutions associated with solving systems of equations. Not only were the students able to demonstrate and visualize the three types of solutions, they were also able to interpret and share what those solutions represented in terms of the speed of their left and right hands. In addition, the students were eager to compare their results to others in the classroom. Such actions allowed the students a solid understanding of explaining and interpreting solutions to systems of equations when other scenarios and problems were presented to them.

Interestingly, the student participants responded favorably to the flipped model of instruction; however, their academic performance did not show any significant changes when compared to students taught under the traditional approach. This finding suggested the student participants responded to and enjoyed variety in their Algebra I classrooms. While the flipped model of instruction offered a sound way to modifying classroom instruction, this study did not reveal any significant changes among the students' academic performance when compared to students within the traditional classroom. Thus, depending on the content, the traditional approach may be the most efficient method of instruction; yet, the flipped model of instruction may be the best approach for other content. As evident in this action research study, the use of various instructional approaches in the secondary mathematics classroom has the potential to yield a positive impact on student engagement and performance.

Discussion of the Results in Relation to the Literature

Overview of Research on Student Engagement

As specified in Chapter 2, research indicated a significant relationship exists between student engagement and performance (Fredricks, 2011; Marzano, 2013; Newmann, 1992; Skinner et al., 1990; Steinberg et al., 1996). In this action research study, the identification of student engagement as an emerging theme in the data analysis process was observed. Many students discussed how their level of engagement increased in the flipped model of instruction when compared to the traditional classroom environment. In particular, the review of literature focused on five factors affecting student engagement: (a) teacher support; (b) quality of instruction; (c) peer connections; (d) classroom structure and management; and (e) parental involvement.

Teacher support. Research suggested a meaningful relationship exists between teacher support and student academic engagement and performance (Akey, 2006; Birch & Ladd, 1997; Connell & Wellborn, 1991; Cothran & Ennis, 2000; Fredricks, 2011; Furrer & Skinner, 2003; Klem & Connell; 2004; Ryan & Patrick, 2001). Even though this action research study addressed the issue of student engagement, teacher support was not found to be an emerging theme in the flipped model of instruction classroom. While the researcher acknowledged the importance of teacher support, only one student discussed teacher support in her interview. Similar to the results identified in Ryan and Patrick's (2001) study, P6 discussed how teacher support in the flipped classroom promoted more student-to-teacher communication and more student-centered learning. P6 noticed how the teacher's role changed in the flipped classroom compared to the traditional approach. With less lecturing occurring in the flipped classroom, the teacher was able to speak to every student in the class and informally check for understanding and comprehension. Furthermore, according to P6, the teacher implemented multiple hands-on activities allowing the students to showcase their knowledge and understanding of the content being studied.

In contrast to the findings of Birch and Ladd (1997), where teacher support was found to have a negative effect on student engagement, P6 felt the increase in teacher support accompanied with more communication with the teacher enhanced her learning experience in the flipped classroom. In particular, P6 shared how her traditional mathematics classroom only involved teacher communication via lectures; however, in the flipped classroom, P6 was able to speak more with the teacher and was able to witness the teacher's concern over her understanding and progress.

Quality of instruction. The review of literature suggested the quality of instruction received in the classroom was also a predictor of student engagement and performance (Dotterer & Lowe, 2011; Fredricks, 2011; Marzano, 2013; Newmann, 1992; Shernoff et al., 2003). As identified in Chapter 4, one of the emerging themes in this action research study was the quality of instruction received in the flipped classroom. Similar to the findings of Dotterer and Lowe's (2011) study of fifth grade students, the students in the flipped model of instruction classroom felt their engagement was improved due to the interesting and meaningful activities completed throughout this study. P1 stated:

> The teaching I received in the flipped classroom was very different from what I received in my previous math classes. One way it was different was with the many activities I completed. In my previous math classes, I mostly took notes and watched my teacher complete problem after problem on the board. The class would ask questions, and the teacher would answer. In the flipped classroom, I watched the videos before class and completed fun activities in class with the help of my classmates and teacher. We would ask each other questions and learn from each other. That was one of the biggest changes I was part of in the flipped classroom (student interview, March 12, 2013).

In addition, P2 verbalized his enjoyment of the various activities completed in the flipped classroom. He felt the hands-on activities involving real world scenarios allowed him to showcase his ability to use the content in an environment outside of the classroom.

This was a direct similarity to the findings of Shernoff et al. (2003) in which activities involving real world applications supported increased student engagement and performance.

Furthermore, the use of technology in the flipped model of instruction also enhanced student engagement and performance. P4 stated:

> The use of technology in the flipped classroom helped to improve the instruction I received. Many of my other classes did not have a good use of technology, so my experience in the flipped classroom was way more exciting and fun. I felt the biggest advantage of the flipped classroom was having access to the videos and other media pieces 24 hours a day. Many times, in my previous classes, I missed small steps or did not have a good understanding of how to solve the entire problem. With the videos in the flipped classroom, I was able to rewind and replay as much as I needed in order to understand the material (student interview, March, 12, 2013).

These findings were parallel to those identified in Sheehan and Nillas' (2010) study of advanced high school mathematics classes.

Peer connections. The review of literature acknowledged peer connections as a factor affecting students who were striving for academic success and who were academically engaged (Fredricks, 2011; Furrer & Skinner, 2003; Perdue et al., 2009; Steinberg et al., 1996). Closely related to the research involving peer connection, two themes, collaboration and communication, were found to be major factors of student engagement in the flipped model of instruction classroom. Similar to the results of Perdue et al. (2007), the flipped model of instruction promoted strong connections to peers via communication and collaboration skills aimed at improving the students' level of engagement. P3 and P6 shared their enthusiasm to finding success in the flipped classroom and credited that success by having the opportunity to work with and learn from their peers on a daily basis. They stressed the idea of having solid teamwork skills helped them find success in other core classes and even in some of their extracurricular activities.

While some studies contended the notion that peer connections did not affect student engagement at all (Goodenow, 1993; Ryan et al., 1994; Wentzel, 1998), this action research study did not find that view to be true in the flipped secondary mathematics classroom. The student participants commented how their engagement and performance improved as a result of the increased communication among their peers. In addition, compared to the traditional environment, the student participants agreed there were more interactions between their peers and the teacher in the flipped classroom. The students also verbalized their satisfaction of working with their peers in the flipped classroom by discussing problems, sharing solutions, and validating their thought processes.

Classroom structure and management. The review of literature indicated the organization of the classroom structure and the classroom environment as a forecaster of student engagement and achievement (Akey, 2006; Fredricks, 2011; Marks, 1995, 2000; Shernoff et al., 2003). This was also an essential theme in the flipped model of instruction classroom. The researcher's journal documented increased engagement in the student-centered classroom environment. In particular, the students were actively participating in all aspects of the classroom happenings. From the hands-on learning activities to the independent practice times, the students were eager to participate and demonstrate their solid understanding of the content being studied. P3 commented:

> It is not that I thought listening to my teacher and taking notes in my Algebra I class was lacking; all of my math classes were taught this way. I have always taken notes, studied those notes, and made good grades in math; but, when my teacher flipped my Algebra I class, I was amazed at how much my motivation and excitement grew when I had the chance to work with my friends during big projects and hands-on learning activities. These strategies really helped me improve my understanding of the content (student interview, March 13, 2013).

Parental involvement. The literature review also revealed the impact parental and family involvement had on student engagement in the classroom (Connell & Wellborn, 1991; Farkas & Grolnick, 2010; Furrer & Skinner, 2003). While the researcher acknowledged the connection between parental involvement and academic engagement, the only documentation of parental involvement in this study was displayed in the researcher's journal. At the beginning of the study, after permission forms were distributed, the teacher received numerous e-mails and phone calls regarding the study. The teacher decided to upload a frequently asked questions (FAQ) page to the classroom Blackboard site. This resource provided parents and guardians with additional information regarding the flipped model of instruction and details about this action research study. The researcher noted all of the parents who made initial contact about this research opportunity were excited and were willing to be directly involved with their child's progress throughout the duration of this action research study. A letter discussing the results of the study was also mailed to the parents and guardians of the student participants.

The Theory of Constructivism

At the core of active student engagement and student-centered classrooms is the theory of constructivism. As dictated in Chapter 4 and the discussions in this chapter, the students responded favorably to the flipped model of instruction classroom and its ability to allow students to “interact purposefully with the content” (Weiss & Pasley, 2004, p. 25). Moreover, the students had the opportunity to build on their previous knowledge of solving linear equations to arrive at valid conclusions as to how to solve systems of linear equations in the flipped classroom.

Some characteristics of the flipped model of instruction classroom describing its constructivist nature included: student questions were highly valued; students primarily worked in groups; assessment of learning occurred through teacher observations and student projects; student-centered environment; high amount of student-to-student communication; interactive technology use; students were active seekers of knowledge; and students were actively engaged in all aspects of the classroom. Such features as observed and utilized in the secondary mathematics classroom proved to be an effective approach to teaching and learning.

The students felt the student-centered environment was an effective approach to teaching and learning. P1 stated:

> The flipped classroom placed a great amount of responsibility on me [the student]. Before flipping, like in all of my other classes, the responsibility was always on the teacher to present the material in a way that helped me find success.

> However, the flipped classroom allowed the students the opportunity to guide their own personal learning. For the first time ever, I felt like I was not only responsible for my own learning, but also for my classmates. This change in responsibility really helped me see the importance of being actively involved in the classroom (student interview, March 12, 2013).

P3 added:

> The flipped classroom was a positive experience for me and my classmates. We enjoyed working and learning from each other and found it exciting to see everyone take pride in their own personal work and learning. Personally, I found it very rewarding when my classmates asked me for help on solving a problem or for advice on the different projects we completed. I gladly took the role of tutor, one I had never had the chance to be before being a part of a flipped classroom (student interview, March 13, 2013).

P2 and P6 shared how they used their previous knowledge of solving linear equations to discover methods and approaches to solving systems of equations. P6 said, “It was a cool experience to use my old smarts to build and develop my new smarts” (student interview, March, 13, 2013). P2 added, “It was fun to watch the videos in the flipped classroom and see that connection to old content I already understood” (student interview, March, 12, 2013). As evident in the interview conversations, the students responded favorably to the flipped model of instruction and its use of student-centered approaches to learning.

This action research study demonstrated a positive response to strategies supporting the theory of constructivism. Noticeably, constructivist practices require more work from the teacher than traditional methods. Therefore, teachers need to be strong in their content areas, consciously away of their classroom management skills, and have an understanding of the culture of their classroom environment to be truly successful at implementing constructivist practices.

Flipped Model of Instruction

As transcribed in Chapter 2, research on the flipped model of instruction was extremely limited and could be best described as mixed in terms of its effectiveness as determined by the student participants (Baker, 2000; Johnson & Renner, 2012; Lage et al., 2000; Strayer, 2007). Similar to the findings of Baker (2000) and Lage et al. (2000), the student participants in this action research study demonstrated a positive reaction to the flipped model of instruction classroom. The students commented how this instructional approach encouraged active engagement and increased their participation in the Algebra I classrooms. In addition, the students responded favorably to learning from their peers and found the media pieces to be effective learning tools.

Unlike Johnson and Renner's (2012) study, where the students did not fully embrace the flipped classroom expectations dues to a failed implementation attempt, the flipped model of instruction was implemented successfully in this action research study, and the student participants responded accordingly. As described by P2, the flipped model of instruction proved to be effective for him. P2 stated:

> The idea of flipping was very interesting to me. Even though lectures and note taking skills were helpful to me in my other classes, this new way of teaching gave me a completely new way to think about learning. First, I was in control of my own personal learning. This was something I never experienced before. If I

> did not totally understand graphing systems of equations, I did not have to move on to solving systems using substitution or elimination; instead, I could review the videos until I understood it completely. The flipped classroom also gave the students better use of class time, especially with no time spent on lectures and taking notes. Hands-on activities and projects were completed to help my understanding of systems of equations. These activities were fun, exciting, and hard all at the same time. Finally, I was always busy in the flipped classroom. If I was not watching videos and learning content, I was completing practice problems with my classmates or working to complete a real world application activity or project. All in all, I found the flipped classroom to be very useful (student interview, March 12, 2013).

Strayer (2007) argued the flipped classroom was "better suited for certain classrooms and courses than others" (p. 198). The findings of this action research study revealed a positive response to the flipped model of instruction in the secondary mathematics classroom. The student participants were eager to participate in the classroom activities, and all verbalized their contentment if the instructional approach were to continue. While Strayer documented feelings of unsettledness among the flipped classroom students, the students in this action research study did voice their concerns over flipping content as difficult as systems of equations and inequalities. Many of the student participants felt their performance could have improved more if they could have been exposed to the flipped model of instruction during easier content. Students commented on the challenge of having to learn a new instructional approach and extremely difficult content at the same time.

Change Management

As an action research study, the need to understand change management was also of vital importance for the successful execution and future continuation of the flipped model of instruction intervention. As described in Chapter 2, the change management process for this action research study was based on the theory of emergence. According to Wheatley and Frieze (2006), emergence occurs in three stages: networks, communities of practice, and systems of influence. This action research study led to the development of a network among the mathematics teachers at the study site as they worked to change the current instructional practices in the mathematics classrooms. Also, a community of practice was established by bringing together teachers within the school district who were willing to work together to change the current instructional practices to see improvements in engagement and performance in the secondary mathematics classrooms. In particular, the results of this action research study were shared with all of the high school teachers within the district at the end of the year mandatory meeting. Finally, the system of influence could potentially occur when the teachers in the community of practice focus their instructional reform efforts toward surrounding districts and the entire state.

According to Wheatley and Frieze (2007), communities of practice are becoming a common process in schools and districts. At the research site, there was a need to improve student engagement and performance in the secondary mathematics classrooms. With the work of one teacher, several other mathematics teachers joined together to solve this specific issue and other problems within their organization. Such actions have led to several school wide changes. One change involved the start of "Technology Tuesdays," an after school professional development time where multiple teachers meet in the library to learn about emerging technologies in education. At times, teachers observe new instructional strategies involving technology; other days, the teachers work on enhancing their classroom Blackboard sites. This innovation is proving to be an effective professional development opportunity.

Another change observed as a result of this action research study involved more productivity in the mathematics departmental meetings. In the past, the meetings were controlled by the department head and entailed little to no input from the staff teachers; topics mostly focused on grades and curriculum. Currently, there is more collaboration and communication from all of the staff members during the meetings. There is evidence of detailed discussions involving methods and approaches to improve current classroom practices such as innovative instructional strategies and universal classroom rules and procedures. In addition, there is a strong support system within the department encouraging a network to build and create sustainable change in the area of secondary mathematics education.

Limitations

After reviewing the results of this action research study and relating the data to the review of literature, the following limitations were recognized:

1. The researcher acknowledged the limited time frame of the project. Even though the student participants responded favorably to the flipped model of instruction during the seven weeks of implementation, there is a need to confirm these findings with a longer, more extensive research study. By conducting such a study, more comprehensive quantitative data and more descriptive qualitative data can be collected and analyzed to gain a deeper

understanding as to how the flipped model of instruction affects student engagement and performance.

2. One of the emerging themes observed with the flipped model of instruction was the quality of instruction. Specifically, the students mentioned how the use of technology helped to improve their engagement and performance in the flipped classroom. According to Kuykendall et al. (2010), the novelty effect is the tendency for performance to initially improve when technology is instituted. If the novelty effect was indeed a factor in this action research study, future research must be designed to determine at what point the technology loses its effect and improvement is based solely on the flipped model instructional strategy. In connection with the previous limitation, a more extensive study with a longer time frame would provide this valuable information.
3. The analysis of student performance was limited in this action research study as well. The student participants verbalized their concerns of having to learn both a new instructional approach and challenging content requiring high levels of higher order thinking skills. Many of the students suggested the flipped classroom should have be introduced to them during easier content, allowing them more time to focus on the content and less time on the routines and procedures of the new classroom environment.
4. A final limitation of this action research study involved the implementation of the flipped model of instruction in only one teacher's classroom. As discussed in Chapter 3, the one classroom teacher was also the researcher of this study

and the one who taught the student participants in the traditional classroom environment. In particular, the researcher's goal was to effectively teach the subject matter at hand regardless of the approach. Thus, the design of the traditional classroom environment may have been just as effective as the design of the flipped classroom environment given the common subject matter taught in this study. By conducting a more extensive study involving more classroom teachers, the findings and results of this study can be further investigated.

Implication of the Results for Practice

The results and findings of this action research study have multiple implications for the future of mathematics instruction. First, the NCTM (2009) encouraged educators to place great emphasis on student-centered learning strategies and approaches where the students have the opportunity to be actively engaged in the content being presented, thus improving performance and achievement in the secondary mathematics classroom. This action research study yielded promising results involving the flipped model of instruction and improved student engagement. The student participants mentioned how they experienced an increase in classroom participation when compared to their experience prior to the flipped classroom intervention. In particular, the student participants acknowledged their passive interactions during class lectures and limited communication between their teacher and other peers prior to the flipped model of instruction intervention. Conversely, during the flipped classroom, the students witnessed an increase in their classroom participation and communication, thus promoting a student-centered classroom environment conducive to learning and success. As encouraged by the NCTM, a student-centered environment was endorsed in the flipped classroom where the students were actively engaged in all aspects of the classroom happenings.

The results also implied the benefits of hands-on and project-based learning activities in terms of student engagement and performance. With no time dedicated to lectures, the students experienced improved use of class time by being able to complete various hands-on activities and project-based learning structures with real world scenarios to further enhance their understanding and comprehension of the content. The student participants verbalized their enjoyment and eagerness to participate with such activities, thus increasing engagement in the secondary mathematics classroom. With better use of class time and improved instructional practices, the flipped model of instruction allowed the students the opportunity to demonstrate their understanding and knowledge through the various activities not commonly utilized or observed in the traditional classroom.

Recommendations for Further Research

The following recommendations for further research were recognized in this action research study:

1. There is a need to replicate this study at a more extensive level with a longer time frame in order to confirm the positive results and findings noted in this study. The lack of significant changes may be due to the fact the flipped model was implemented in a single classroom with a single instructor. Thus, there is a need to examine how the students respond to a longer duration of the flipped model of instruction. In addition, there is a need to verify Strayer's (2007) argument the flipped classroom was "better suited for certain

classrooms and courses than others" (p. 198) by studying more secondary mathematics classrooms as well as other discipline areas, in other settings, and with other instructors.

2. It is necessary to further investigate the flipped model of instruction in order to determine if the novelty effect is a contributing factor to improved student engagement and performance. A longer, more extensive study would address this issue.

Conclusion

In many of the secondary classrooms across the country, students are passively engaged in the mathematics content, and academic performance can be described, at best, as mediocre. In the influential book, *The World Is Flat*, Friedman (2005) claimed secondary mathematics achievement is on the key predictors of a nation's long-term economic potential. With such influence, the National Council of Teachers of Mathematics (NCTM, 2009) encouraged educators to place great emphasis on student-centered learning strategies and approaches where the students have the opportunity to be actively engaged in the content being presented, thus improving performance and achievement in the secondary mathematics classrooms.

This action research study sought to bring about improvements in student engagement and performance through the use of the flipped model of instruction in the secondary mathematics classroom. Since this study focused on the impact the flipped model of instruction had on student engagement and performance and compared student interaction in the flipped classroom to a traditional format, changes in the student participants' perceptions and attitudes were evidenced and evaluated through the completion of a pre- and post-survey, a teacher-created unit test, random interviews, and a focus group session. In addition, the researcher kept a journal to document observations, experiences, thoughts, and insights involving the flipped classroom on a daily basis.

Results and findings indicated students were more engaged, more involved in the flipped model of instruction when compared to the traditional delivery approach. Students in the flipped classroom experienced quality instruction that was student-centered and student-focused. The flipped classroom allowed for improved use of class time utilizing various instructional strategies, including hands-on activities and project-based learning structures. While the students noted their preference of the flipped model of instruction, similar performance abilities were demonstrated between the traditional and flipped classrooms. The need to further investigate the impact of the flipped model of instruction on student performance was recognized. Moreover, the need to conduct a more extensive study with a longer time frame and more classroom teachers was also addressed.

A Prezi file was created to share these results with various stakeholders at the research site including administration, staff, students, and parents. The file was embedded within the teacher's classroom Blackboard site for quick viewing and ease of use. The Prezi presentation was also shared with the district's high school mathematics teachers at the end of the year meeting. The teachers were excited about this instructional strategy and asked many questions about implementing it in their respective classrooms. A summer professional development opportunity was scheduled for the high school mathematics teachers to learn how to use a Promethean Activboard to record videos for use in the flipped model of instruction. In addition, as required by the district's Assessment, Research, Special Services, and Accountability department, the researcher submitted a final report discussing the results of the study.

While current research on the effectiveness of the flipped model of instruction is extremely limited, this action research study provided additional, valuable information regarding the model's impact on student engagement and performance. Even though the flipped model of instruction is a relatively new instructional approach, it certainly has the potential to be deemed effective in terms of improving student engagement and performance in the secondary mathematics classroom.

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APPENDIX A. SURVEY INSTRUMENT

From *Differences in Student Knowledge and Perception of Learning Experiences Among Non-Traditional Students in Blended and Face-to-Face Classroom Delivery* (Doctoral dissertation), by J. Araño-Ocuaman, 2010. Available from ProQuest Dissertations and Theses database. (UMI No. 3432383). Adapted with permission.

Statements **In my Algebra I class…**		Strongly Agree	Agree	Not Agree or Disagree	Disagree	Strongly Disagree
S1.	I communicated a lot with other students regarding the mathematics content.					
S2.	I communicated with the teacher often.					
S3.	I worked hard to learn the content.					
S4.	I learned a lot of new mathematics content in this classroom.					
S5.	The learning activities (assignments and projects) focused on real life applications and improved my learning.					
S6.	The availability of course content materials helped me improve my understanding of the content.					
S7.	I applied my out-of-class experiences and learned from the practical applications.					
S8.	I explored my own strategies for learning.					

S9.	I actively participated in all aspects of the course.					
S10.	I needed technical assistance for this class.					
S11.	The availability and access to technical support and resources helped me improve my learning.					
S12.	My desire to learn improved as a result of this course.					
S13.	I would choose to take another course like this one.					
S14.	This course met my expectations.					
S15.	Overall, this classroom played a major factor in my understanding and comprehension of new mathematics content.					
S16.	Which part of the course did you like most that helped you improve your learning? ______ a. Availability and access to online content and course materials ______ b. Enhanced communication using email and discussion boards ______ c. Online testing and evaluation ______ d. Ease of use of the classroom Blackboard site ______ e. Increased one-on-one time with teacher ______ f. In-class group discussion ______ g. Group collaboration ______ h. Working on the assignments and class work by myself ______ i. Other (please specify):					
S17.	Please provide suggestions to help improve the flipped classroom for future students.					
S18.	Any other general comments about the flipped classroom:					

APPENDIX B. INTERVIEW QUESTIONS

1. What were your thoughts when you first heard about the flipped classroom?
2. Did you experience any problems with the flipped classroom?
3. How would you describe your role as a student in the flipped classroom?
4. What did you like most about the flipped classroom? Least?
5. What do you consider to be the benefits of a flipped classroom?
6. How did the flipped classroom impact your learning?
7. Do you have any suggestions for improvements?
8. If you learned that your teacher decided to continue the flipped classroom, what would your reaction be?
9. If you had to sum up your flipped classroom experience in one word, what would it be?

APPENDIX C. FOCUS GROUP SESSION QUESTIONS

1. What did you think of the flipped classroom?
2. What are the advantages of the flipped classroom? Disadvantages?
3. How did the flipped classroom impact your learning?
4. Describe a day in your flipped classroom.
5. If a friend were considering taking a flipped classroom course, what would you say to them?
6. How do you feel about continuing the flipped classroom?
7. Would you consider the flipped classroom to be an effective teaching strategy?
8. Is there anything else you would like to say about why you support or do not support the flipped classroom?