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.

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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