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Flipped Classroom Pedagogical Model and Middle-Level Mathematics Achievment: An Action Research Study

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FLIPPED CLASSROOM PEDAGOGICAL MODEL AND MIDDLE-LEVEL MATHEMATICS ACHIEVMENT: AN ACTION RESEARCH STUDY

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DEDICATION

I dedicate this dissertation to my husband who has stood by my side, supported me and encouraged me throughout this entire process. To my children, thank you for being patient with me while I have worked. To my family, especially my mom, thank you for always encouraging me to do my best and to embark on this journey; you always knew one day I would accomplish this great feat and thank you for encouraging me to do it. To my professors, thank you for your honest feedback, wealth of knowledge, and hard work on my behalf. To Dr. Schramm-Pate, thank you for always taking the time to talk with me and help me throughout this entire process; I know I would not have been successful if it were not for you.

ABSTRACT

Flipped Classroom Pedagogical Model and Middle-Level Mathematics Achievement: An Action Research Study describes an integers and rational numbers unit (TIRN) over a six-week period in a seventh-grade flipped mathematics classroom. The identified problem of practice centers on these twenty-three student participants' low achievement on math tests. The purpose of the study is to determine the relationship between a flipped classroom pedagogy and student achievement. The participant-researcher aimed to differentiate instruction for these seventh-grade student-participants using a flipped model that included videos. This flipped classroom pedagogical model allowed for additional time for the participant-researcher to assist struggling student-participants and to foster their learning through the videos. Data collection prior, during, and after the implementation of TIRN, included participant-researcher journal entries, classroom observations; and pre- and post-tests. A t-test was conducted on the test score data. Findings show that overall student-participants improved their score from pretest to posttest. The study uncovered three themes: effect on student-participant understanding, student-participant resistance to new pedagogy, and student-participant attitudes toward flipped pedagogy. A new key question that emerged from the analysis of the data includes: How did the flipped classroom affect students' achievement from this year (2016-2017) compared to last year (2015-2016)? The Action Plan for fall 2017 at this middle school includes weekly teacher in-service preparation sessions for three seventh-grade mathematics teachers to be conducted by the teacher-researcher, for flipped model

curricular development. Additionally, the participant-researcher will create mentoring opportunities within the District for new math teachers implementing the flipped classroom pedagogy as described in this action research study.

Keywords: active teaching pedagogy, flipped classroom pedagogical model

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CHAPTER ONE: RESEARCH OVERVIEW

Introduction

Flipped Classroom Pedagogical Model and Middle-Level Mathematics Achievement: An Action Research Study was conducted by a middle-level mathematics teacher in her classroom at Harrison Middle School in South Carolina. A teacher for seven years and a student of mathematics for almost twenty, the participant-researcher practiced a wide variety of teaching strategies, most of which involved traditional lecture and student note-taking practices. Although this essentialist pedagogical strategy effective with some students, it is not effective with all learners at Harrison Middle School as evident in standardized test scores each year. As a lover of mathematics, the participant-researcher has been very successful in this type of classroom, but noticed other students failing her math class. She began researching, seeking to improve the effectiveness of her mathematics pedagogy and, by extension, her students' scholarly activity including test scores.

Teachers are engaged in a constant search for new activities to grab their students' attention and aid their new understanding in mathematics. Hodges (2006) discussed the fears associated with incorporating new pedagogical approaches and claimed one main reason teachers resist change is "the fear of taking a risk" (para. 1). Often, ideas are not accepted or a nervousness exists in trying something new or outside the box for fear of failure. For several years, researching the idea of a flipped classroom became a

priority for the participant-researcher, mainly due to its requirement of students being actively engaged in all aspects of learning. While lecturing, the participant-researcher frequently felt as though students have no idea what she was discussing or teaching. After lecture, the participant-researcher required students to practice in class and then complete assigned homework to solidify conceptual understanding. This pedagogy rarely allows time for the class to dig deeper or apply new knowledge. The amount of time spent on direct instruction and the amount of material covered during a single school year limited the level of exploration or application of any one skill. Additionally, this method of teaching does not work with the masses of students. Alters and Nelson (2002) conducted a study focusing on teaching strategies and found that "traditional methods may not be the best to promote student learning" (p. 1893). Herreid and Shiller (2013) agreed with the earlier study and stated, "A central theme in all of this activity is the idea that active learning works best. Telling doesn't work very well. Doing is the secret. Active student engagement is necessary" (p. 65).

Standardized test score data for the participant-researcher's students suggested that they are not retaining information taught in class. In order to create active learning, the participant-researcher implemented a flipped pedagogy in her seventh-grade mathematics classroom.

> 'Flipping' the classroom employs easy-to-use, readily accessible technology in order to free class time from lecture. This allows for an expanded range of learning activities during class time. Using class time for active learning versus lecture provides opportunities for greater teacher-to-student mentoring, peer-to-

peer collaboration and cross-disciplinary engagement. (Roehl, Reddy, & Shannon, 2013, p. 44)

In the essentialist classroom, math instruction follows the traditional format: teacher instruction, teacher modeling, and student practice. According to Schwerdt and Wuppermann (2011), mathematics teachers spend approximately 63% of class time lecturing content or modeling problems for students. However, in order for instruction to be effective, students must investigate and be responsible for their own learning. Moore (1997) claimed "students are not empty vessels to be filled with knowledge poured in by teachers; they inevitably construct their own knowledge by combining their present experiences with their existing conceptions" (p. 124-125).

Until this year, the option of a flipped classroom has not been possible at Harrison Middle School due to a lack of the technology required for the flipped pedagogical teaching strategy. For the 2014-2015 year, the participant-researcher's school district purchased iPads for third through twelfth graders. With new technology, this teaching strategy affected all aspects of the classroom, specifically for student understanding. The participant-researcher has observed students recalling information on a short term basis, but when given a cumulative review or assessment, they are unable to recall information easily. This finding is evident in the standardized test scores released by the State Department of Education (2014). Students should remember the concepts throughout the year, especially in math, because the mathematics concepts build upon each other. The lack of retention is a primary reason the participant-researcher implemented the flipped classroom style teaching.

Herreid and Schiller (2013) described every teacher's fight with aiding students in the classroom and requiring students to study on their own. The authors claimed learning happens when students are on their own, watching engaging videos, merging dynamic learning with content mastery (Herreid and Schiller, 2013). For a more detailed explanation of the literature and the theories that grounded the research, please see Chapter Two.

According to the research acquired by the participant-researcher, incorporating aspects of the flipped classroom will affect student achievement. The purpose of this action research study is to uncover a relationship between the flipped classroom style instruction and seventh-grade students' mathematics achievement in an upstate middle school in Anderson, South Carolina. The participant-researcher studied twenty-three seventh-grade students in a mathematics classroom. Of the student-participant population, ten are girls and thirteen are boys; three student-participants qualify for free and reduced lunch. Ninety-six percent of the student-participant population expressed a desire to attend college in the future. The research question formulated is: How will the impact of a flipped classroom type style instruction impact students' mathematics achievement?

Statement of Problem of Practice

This action research stemmed from a major problem observed by the participant-researcher which includes student retention of crucial mathematics concepts. In an attempt to improve math skills, the participant-researcher investigated several strategies that have been created to help student retention. Based on the literature, the participant-researcher determined the flipped classroom approach which incorporates inquiry

activities may improve student learning based on the demographic of students in her classroom. The participant-researcher's past pedagogical strategies have included middle-level students listening to mathematics lectures about facts and applications. After the lectures, the students are required to repeat the facts and applications from the lectures on paper and pencil tests. The participant-researcher engaged in an action research study that included a flipped classroom pedagogical model to enable students to engage in investigation and inquiry in order to improve retention of complex mathematical concepts. The use of iPads in School District One, specifically in middle-level mathematics classrooms, has not been investigated.

Research Question

What is the impact of a flipped classroom pedagogical model on seventh-grade students' mathematics achievement?

Purpose of the Study

The purpose of this action research study is to examine the relationship between a flipped classroom teaching model and student achievement on tests in seventh-grade middle school mathematics. The research was conducted utilizing seventh-grade mathematics classes in an upstate middle school in Anderson, South Carolina. Generally, the participant-researcher desired to uncover an association between the flipped classroom and student achievement.

Research Objectives

The goal was to describe a seventh-grade mathematics classroom that utilizes iPads for instruction and the ways in which the participant-researcher's pedagogical strategies change.

Action Research Methodology Summary

Action research quantitative research design was most appropriate to answer the research question and problem of practice. The participant-researcher desired to uncover a correlation between the flipped classroom teaching style and student mathematics achievement. The best design to implement in order to discover a relationship was a quantitative research design. Mertler (2014) asserted that quantitative research encourages "the action researcher [to] examine whether and to what degree a statistical relationship exists between two or more variables" (p. 97). First, many theories promoted the idea of inquiry-based learning and incorporating the flipped classroom in order to achieve the inquiry-based instruction. Also, the participant-researcher desired to analyze the relationship between the flipped classroom and student achievement specifically in boys and girls as well as subgroups represented at the school: white, African American, Hispanic, and free and reduced lunch. In order to analyze these specific groups and the changes in achievement after being exposed to the flipped classroom teaching style, a quantitative research design was implemented; the independent variable was the flipped classroom model and the dependent variable was mathematics achievement. The data was collected in August through October, Fall of 2016. The participants included seventh-grade mathematics students at Harrison Middle School in Anderson, South Carolina.

Rationale for the Study

As a teacher of diverse students with a variety of learning styles, the participant-researcher has become increasingly interested in creating a classroom climate effective for all students. Several theorists agreed with a metacognitive approach to learning, one

that requires students' conceptual understanding of mathematics topics. Requiring students to be aware of their own learning and to ask questions during the learning process created a student with a deeper understanding of the topic. Bransford, Brown, and Cocking (2000) claimed "a 'metacognitive' approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them" (p. 18). This idea of thinking about one's learning was a main goal in the flipped classroom model utilized in this action research study. Students were required to prepare for learning outside of the classroom, so in class students were able to focus on a deeper understanding of the mathematics topics taught.

The constructivism theory also played a major role in the groundwork for this action research study. Constructivism claims that in order to gain a deep understanding of concepts, one must investigate or "construct" their own learning (Ozer, 2004, para. 1). With the flipped classroom model, students are taught basic knowledge via video, but students must use the information to construct their thinking in solving real-world applications. In the classroom, the student-participants were required to collaborate with other students while applying the knowledge obtained earlier to real-world problems.

Conceptual Framework

The purpose of any action research study is to benefit student understanding positively. Specifically, this action research focuses on changing the current lecture teaching style previously used by the participant-researcher and on replacing it with a flipped classroom model. The participant-researcher has a background of implementing technology in an effort to improve student understanding. Currently, the participant-researcher is an "iTeacher," aiding other teachers with instructional technology needs and

ideas. Incorporating the flipped classroom was a beneficial blend of integrating technology and inquiry learning.

Understanding what flipped pedagogy means was imperative to this study. Student-participants downloaded a video provided on a class iTunes U account. Before the next class, students watched the video and completed the appropriate assignment along with the video; this was the "flipped" aspect of the research study, as the instruction would normally be done in the classroom. When student-participants returned to class the next day, they completed a short, informative assessment to ensure understanding. Based on students' understanding of the material, they were split into groups. The groups vary depending on the concept being taught; however, examples of groups are a tutoring group, practice group, and enrichment group. Students who struggled with the concept from the night before joined the participant-researcher in the tutoring group where she provided one-on-one assistance to ensure complete understanding. Once students had grasped the concept, they joined another group and continued additional activities. The practice group and enrichment groups were similar; one group included basic practice while the other group completed real-world application problems. Real-world application problems required students to employ the knowledge to a problem that exists outside of the mathematics classroom, potentially in a career field.

Each day, students were provided a variety of activities to complete based on the video analyzed the previous night. Activities ranged from basic practice to inquiry projects, keeping in mind the theoretical basis of this action research: active learning, not passive learning. Dale (1969) created a cone of experience that truly explains the why

behind the action research. Dale (1969) claimed "people generally remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they see and hear, 70% of what they say and write, and 90% of what they do" (p. 1). The flipped model allows for more doing rather than hearing.

Based on previously cited theories, the flipped classroom seemed to be an answer to the problem of student understanding in the mathematics classroom. This action research plan was implemented following the above parameters, understanding was measured using various tests, and the data was analyzed to determine if a flipped classroom model can be a remedy for a deeper mathematics understanding.

Action research philosophy

The philosophy of this action research stemmed from a significant problem observed by the participant-researcher: student retention of crucial mathematics concepts. In an attempt to improve this skill, the participant-researcher investigated several strategies that have been created to help student retention. Based on the literature, the participant-researcher determined the flipped classroom approach incorporating inquiry activities was best fit for the demographic of students in her class.

The significance of this study is to determine if a new pedagogy would affect student-participant's achievement. This understanding is noteworthy because the participant-researcher noted a gap in understanding; students were unable to retain the information of rational numbers (TIRN unit) from year to year and were unsuccessful in applying the concepts to real-world contexts. Changing the pedagogy not only forces the student-participants to learn a different way, but also encourages the teacher to teach differently. In addition to the significance, the participant-researcher expected some

weaknesses. Potential weaknesses include an inability to utilize the technology needed to implement the flipped classroom. Additionally, the participant-researcher assumes the student-participants will listen and digest the information on the flipped videos. The potential exists the students will not improve their understanding.

Participant selection

Student-participants ranged in age from eleven to thirteen, all enrolled in a seventh grade mathematics class. Students were randomly placed in classes by school guidance counselors. The participant-researcher chose one class from four taught each day. The class chosen was a grade level class, a class only covering seventh-grade standards. The class chosen was selected randomly.

Research site

All research was conducted at the participant-researcher's school, Harrison Middle School, in Anderson, South Carolina in the fall of 2016. The research was obtained from a seventh-grade mathematics classroom. The school is rural and has had an excellent report card rating from the federal government for several years.

The content area for this case study was seventh-grade mathematics; topics taught were based on the College Readiness Mathematics Standards for South Carolina. The main topics of study include ratios and proportional relationships, the number system, expressions and equations, geometry, and statistics and probability. The majority of the lessons taught were taken from the Glencoe math textbook adopted by the school district.

The school was comprised of a small, close-knit, community that was very involved in student behavior, activities, and academic achievement. Within the student body, there were 26.5% enrolled in the gifted and talented program and 12.9% served

with disabilities (South Carolina Department of Education, 2014). There were 0.5% Asian, 4% African American, 2% Hispanic, 0.1% American Indian, 3% two or more races, .1% Hawaiian-Pacific Islander, and 90% white students (South Carolina Department of Education, 2014). Of all students enrolled in the school, 35% qualified for free or reduced lunch (South Carolina Department of Education, 2014). Also, of the population, 52% are boys, while 48% were girls (South Carolina Department of Education, 2014). The class chosen for research includes twenty-three students, ten females, thirteen males. One hundred percent of the student-participants were white with 96% claiming their future includes a college degree. Thirteen percent of the student-participants qualified for free and reduced lunch.

Data sources

Data was gathered from students in the seventh-grade mathematics classroom of the participant-researcher in Anderson, South Carolina during the fall of 2016. The participant-researcher analyzed the scores from the pretest and posttest (see Appendix A) to determine a correlation between the flipped classroom pedagogical method and students' mathematics achievement. Additionally, students completed an informal survey to determine their feelings toward the flipped classroom pedagogy (see Appendix B) in an effort to triangulate the findings.

Data collection methods

The participant-researcher actively monitored all activities of the classroom on a daily basis to ensure understanding of concepts taught. The participant-researcher analyzed daily understanding based on quick assessment techniques such as exit tickets and Socrative (an app students will utilize on their iPads). This data was only used to

determine student-participant understanding of mathematics concepts to determine future activities of the class (teacher assistance, skills practice, or enrichment activities). Next, the participant-researcher formally assessed understanding in the form of tests, quizzes, and projects. In an effort to assess growth, a pretest and posttest was administered (see Appendix A). The participant-researcher also kept an observation journal of the students in an effort to triangulate the findings. Additionally, student-participants provided answers to an informal survey, describing their feelings toward the implementation of the flipped classroom pedagogy (see Appendix B). Data was collected in August through October, Fall 2016 at Harrison Middle School in Anderson, South Carolina.

Data collection strategies

The participant-researcher collected data informally on a daily basis using a tool called Socrative. This app provided immediate feedback to the researcher concerning student understanding of certain skills. In addition, data was collected from a pretest and posttest in an effort to analyze growth or regression given certain mathematics concepts. An informal survey was administered on the Socrative app, allowing students to reflect on their learning when utilizing flipped pedagogy in an effort to triangulate the data.

Key words

It is important to note a few key words used throughout this study. Flipped pedagogy is an instructional strategy that utilizes videos as instruction leaving class time for in-depth and application learning. The integers and rational numbers (TIRN) unit is the unit of study in the Action Research study. District One and Harrison Middle School are pseudonyms. For a more detailed list of important key words and phrases, please see Chapter Two.

Summary of the Findings

The summary of the findings culminates in an increase of student achievement as determined by the students' test scores on the pretest and posttest. From the quantitative data collection and the data analysis including a simple t-test, means, and the calculation of the standard deviations, the participant-researcher uncovered an increase in student achievement when implementing the flipped classroom pedagogy. Additionally, overall the student attitudes were positive toward the flipped classroom with a resistance to the new pedagogy when beginning implementation. From the study, three themes emerged: (1) effect on student-participant understanding, (2) student-participant resistance to new pedagogy and (3) student-participant attitudes toward flipped pedagogy. Further results and a detailed explanation of findings can be found in Chapter Four.

Dissertation Overview

In Chapter One, the reader gains an understanding of why the participant-researcher has chosen to focus on this particular problem among middle school math students, as well as a brief overview of how the participant-researcher conducted research, who was included in the research, and how the research was analyzed. In Chapter Two, the reader finds support for the research question as the participant-researcher describes and analyzes literature which scaffolds the research topic. Chapter Three focuses on the methodology of the research in greater detail. The reader discovers the findings of the research in Chapter Four with the summary of the study in Chapter Five as well as a detailed Action Research Plan.

Conclusion

Action research is about observing a problem and discovering ways to correct the problem. Mertler (2014) claimed action research is "any systematic inquiry conducted by teachers, administrators, counselors, or others with a vested interest in the teaching and learning process" (p. 4). The participant-researcher saw the need to address the problem of retention amongst middle school children, specifically in the mathematics classroom. After much research, the flipped classroom was implemented. In an effort to discover a relationship between the flipped classroom and student achievement, the participant-researcher conducted this action research study.

CHAPTER TWO: LITERATURE REVIEW

Introduction

The purpose of Chapter Two: Literature Review, is to support the need for this action research study, *Flipped Classroom Pedagogical Model and Middle-Level Mathematics Achievement: An Action Research Study*, based on the scholarly literature available. Across all educational environments, teachers have an urgency in creating lessons that are truly engaging and informative for students. Several theorists including Dewey (2007), Piaget (1952), and Vygotsky (1978) have presented ideas for classroom look and flow. These theorists started movements like essentialism and progressivism, which have shaped the teaching profession for generations.

Active learning is one in which students take charge of their learning. Herreid and Shiller (2013) noted that, "a central theme in all of this activity is the idea that active learning works best. Telling doesn't work very well. Doing is the secret. Active student engagement is necessary" (p. 65). In the flipped classroom, student-participants are required to direct their own learning by watching videos uploaded and created by the teacher. In this study, videos ranged in content and time, but each required the student-participants to answer questions and then to model and practice mathematics problems while watching the videos. The following day, student-participants determined the learning styles to take place in class based on an informal assessment given. The participant-researcher grouped the student-participants according to performance on the

informal assessment. The activities in each group were tailored to the needs of each student. For example, a student who did not understand the content from the previous night performed poorly on the informal assessment and was placed in a group that was aided in mastering the content from the night before. Alternatively, if a student understood the material and did exceptionally well on the informal assessment, he or she completed real-world mathematics problems or enrichment problems in order to broaden knowledge of the topic. Implementing the flipped classroom allowed this extra time to conduct active learning in the activities and ensured student-participant understanding before moving on to another mathematics concept.

> 'Flipping' the classroom employs easy-to-use, readily accessible technology in order to free class time from lecture. This allows for an expanded range of learning activities during class time. Using class time for active learning versus lecture provides opportunities for greater teacher-to-student mentoring, peer-to-peer collaboration and cross-disciplinary engagement. (Roehl, Reddy, & Shannon, 2013, p. 44)

The participant-researcher's action research implemented the flipped classroom in a seventh-grade mathematics classroom in an effort to focus on the actual learning.

The following literature review focuses on the definition of the flipped classroom style instruction, benefits and disadvantages of implementing the flipped classroom style instruction, and hurdles to overcome when implementing the flipped classroom style instruction. The participant-researcher has observed a retention problem in her classroom. While students understand the math skills covered in class, they do not retain the information after an initial assessment. The participant-researcher observed in her

seventh-grade mathematics classroom gaps in knowledge. Staggering statistics supported the lack of skills in the mathematics among middle school students. Claiborne (2010) claimed, "Just 38 percent of 12th graders were proficient in reading, and only 26 percent were proficient in math. Only 12 percent of African-American boys in 4th grade were proficient in math or reading, compared to 38 percent of their white counterparts who were proficient in reading and 44 percent proficient in math" (para. 9). These general statistics were true of the participant-researcher's student-participants as evident on the school report card released by the State Department of Education (2014). PBS (2015) also provided overwhelming statistics:

> Nine-year-olds with math disabilities have, on average, a first-grade level of math knowledge. Seventeen-year-olds with math disabilities have, on average, a fifth-grade level of math knowledge. Experts estimate that for every two years of school, children with math disabilities acquire about one year of mathematical proficiency. Children with math disabilities often reach a learning plateau in seventh grade, and acquire only one year's worth of mathematical proficiency in grades seven through twelve. (para. 2)

Mathematics concepts build upon one another; a concept learned in one grade will be used in the next grade. For example, in order to be successful in algebra, one must have an understanding of integers and operations with integers. One missed concept can turn into a misunderstanding of several concepts. Sherman, Richardson, and Yard (2014) agreed stating, "Students who are taught in a way that relies too heavily on rote memorization isolated from meaning have difficulty recognizing and retaining math concepts and generalizations" (para 3). After much research, the participant-researcher

has discovered one possible solution to this observed problem by creating an active environment for learning rather than passive learning. Khader (2011) argued, "Research and anecdotal evidence overwhelmingly support the claim that students learn best when they engage with course material and actively participate in their learning" (p. 75). As previously stated, the problem observed by the participant-researcher in her seventh-grade mathematics classroom is the retention of mathematics concepts due to an absence of active learning.

Statement of the Problem of Practice

The observed problem, current student understanding and retention of mathematics concepts, has opened the door for research of possible solutions. After much research conducted by the participant-researcher about several strategies claiming to correct the problem of student retention and mathematics understanding, the flipped classroom pedagogical teaching style was chosen in an effort to discover a correlation between the flipped classroom teaching style and student achievement. The purpose of the action research was to discover a relationship between the flipped classroom teaching style and student achievement/understanding, while the research question formulated is: What is the impact of a flipped classroom pedagogical model on seventh-grade students' mathematics achievement?

Research Question

The research question is: What is the impact of a flipped classroom pedagogical model on seventh-grade students' mathematics achievement?

Purpose of the Study

The purpose of this action research study is to implement a flipped classroom teaching model into one seventh-grade mathematics classrooms in an effort to analyze the benefits or disadvantages of the flipped classroom pedagogical model. Action research is critical to solving the problem of the dramatic decline in mathematics understanding. Katherine Beard (2013) stated:

> For both students and up-and-coming professionals, tests and studies continue to confirm that the U.S. is losing its competitive edge when it comes to math, technology and science. According to the Organization for Economic Cooperation and Development, which surveyed more than 150,000 people age 16 to 65 in 24 different countries, America's results for literacy were disappointing, but mathematics and problem solving proved to be especially embarrassing for a nation that has formerly reigned as a leader of innovation and technology. The U.S. ranked 21 out of 23 countries in math and 17 out of 19 countries in problem solving in the October study. (para. 3)

The participant-researcher's study attempted to foster a greater understanding of mathematics concepts by implementing the flipped model style of teaching.

By implementing the flipped classroom style teaching, the participant-researcher collected and analyzed data in an effort to discover a relationship between the flipped classroom style teaching and student achievement.

Purpose of the Literature Review

This literature review is important because the literature supports the need for this action research, provides suggestions for the participant-researcher to implement, and

supports the type of research design chosen to analyze results. First, the participant-researcher chose literature that supports the claim that this action research is necessary. The participant-researcher has digested much literature, but has only found a few studies that have focused on mathematics content and the seventh-grade classroom. Secondly, the literature analyzed offers suggestions when setting up this action research design process. The history of the flipped classroom found in the research provides a solid theoretical base and several authors claim many benefits to implementing the flipped classroom, as well as uncovering a relationship between putting into the practice the flipped classroom and student achievement.

This literature review is crucial because many classrooms, especially mathematics, are not implementing the flipped classroom and there is much to learn about the logistics of the flipped classroom. Although most of the literature focuses on other content areas, some literature is available focusing on mathematics. From analyzing the literature, the participant-researcher was able to learn from other participant-researcher's mistakes. Other researchers often provide advice for future studies or note aspects of the research that could have been conducted differently. The participant-researcher was able to gain knowledge from the analyzed text and apply the knowledge to this action research. For example, several of the authors described a need for internet at student homes; therefore, a plan was put in place to handle that problem for this action research.

In addition, this literature review is imperative in gaining additional knowledge unlocked by reading and analyzing other researchers' work. When researching, one often finds an article with great information and, from that article, can draw upon the sources

used by other researchers. Westerman (2014), author of "A Half-Flipped Classroom or an Alternative Approach?: Primary Sources and Blended Learning," cited a journalist who has written several articles about the benefits of flipped classrooms. Westerman (2014) provided pertinent information for this action research.

Lastly, the literature review confirmed the need to conduct quantitative research. The literature analyzed endorsed the need for a quantitative approach due to the desire to find a correlation between implementing the flipped classroom and students' mathematics achievement. Due to the logistics of this action research study, the Mertler (2014) text determined quantitative research was the best fit for the research.

The literature review process is crucial when working through the action research process. It provides concrete evidence and rationale for the proposed study. When reviewing the literature, one can determine the need for the study as well as the importance in completing the study. Additionally, the review process confirms the participant-researcher's ideas and beliefs on the action research topic. If conducted thoroughly, the literature review process uncovers additional resources, ideas, and thoughts regarding the action research topic, in this case, flipped classroom pedagogy.

Literature Review

Methodology

This action research followed a seventh-grade mathematics classroom in Anderson, South Carolina in a quantitative research design approach. The purpose of a quantitative research design was to discover a correlation between the flipped classroom and students' mathematics achievement. This action research provided readers with the

successes or failures of implementing the flipped classroom style teaching in a seventh-grade mathematics classroom.

The quantitative research methodology chosen focused on the independent variable, the flipped classroom instruction, and response variable, mathematics achievement. Following the quantitative approach, the participant-researcher desired to discover a link between the flipped classroom model and students' mathematics achievement. Gay and Airasian (2000) defined quantitative research as "the collection of numerical data in order to explain, predict and/or control phenomena of interest" (p. 627). The focus was on one independent variable and one dependent variable; the action research occurred over a six-week period, and the data gathered was numerical in the pretest and posttest collected. In addition, quantitative research methodology focused on active interaction with those being researched. As part of the action research study, the participant-researcher had firsthand experience with the outcome of the action research. The participant-researcher experienced successes and failures of the flipped classroom and had the ability to record those experiences quantitatively in an observation journal. Thirdly, data collection in the quantitative research method lended itself to this action research study. Gay and Airasian (2000) stated that data collection in the quantitative research methodology is appropriate for continuing examination and conferences with students. When implementing the flipped classroom style lecture, constant observation was the key in collecting data. The participant-researcher made observations that focused on the complete understanding of the mathematics material, as well as guide activities throughout the class. Guiding the activities was crucial in ensuring the flipped classroom was effective. Furthermore, allowing student-participants to reflect on their learning with

surveys in order to triangulate the data is supported by Merteler (2014) and was employed.

Burkholder and Hall (2012) also conducted a qualitative methodology, and much can be gained from their research. Although the subject was not implementing the flipped classroom style teaching, Burkholder and Hall (2012) focused on changing certain aspects of their classroom by implementing the flipped classroom. Their data collection methods were somewhat similar to this action research study but Burkholder and Hall (2012) collected data from surveys and observation of student understanding. Burkholder and Hall (2012) were able to find a direct correlation between the new teaching method and student achievement.

Similarly, Casey (2013) guided a qualitative methodology action research in which literacy was intertwined in the mathematics classroom. Casey's (2013) "study was largely qualitative, wherein action research was used to generate knowledge about the redesigning of curriculum projects to take advantage of the unique qualities of social media" (p. 62). There were some similarities in methodologies between Casey's (2013) action research and this action research. Both studies focused on changing a current aspect of teaching in an effort to determine the effects on student achievement. Data collection methods were somewhat different. This action research gained data from observations, informal assessments to ensure understanding, student responses to activities throughout the class, and a pretest and posttest. Casey (2013) focused on online interactions as a source for data collection as well as reflection.

Likewise, Berrett (2012) studied the flipped classroom, specifically "how 'flipping' the classroom can improve the traditional lecture" (p. 2). Berrett (2012)

described a classroom which promotes learning in ways that look very different to those of a traditional classroom. Students were often found outside of their desks, sitting on the floor, actively engaged in the learning process. Berrett (2012) claimed "students cannot passively receive material in class, which is one reason some students dislike flipping. Instead they gather the information largely outside of class, by reading, watching recorded lectures, or listening to podcasts" (p. 2). Berrett (2012) portrayed the flipped classroom as one in which the problem solving, typically completed as homework, is completed in class with the teacher or student's peers. Berrett (2012) also claimed that although the flipped classroom is a great way to get students interested and actively engaged in the content, it is the facilitator who has the power to guide student learning and understanding. Although Berrett (2012) did not complete a formal quantitative action research methodology, much of the information provided is similar to this action research study. First, the delivery methods were similar in allowing students to watch videos on their own time, as a preparation for collaboration in class. Also, activities in Berrett's (2012) study paralleled the activities in this action research; both incorporate inquiry-based, real-world application problems in which students are actively engaged in the learning, as well as activities that promote collaboration. Berrett (2012) found that through incorporating the flipped teaching style, students were more actively engaged in the content and expressed an actual interest in the material being taught. Although Berrett (2012) claimed success with the flipped classroom style teaching, he warned of the downfalls associated with the flipped classroom if not incorporated effectively. Berrett (2012) declared "it can also be very labor-intensive for faculty members who do not have teaching support" (p. 5).

Enfield (2013) conducted a study similar to this action research in that "the purpose of [his] study was to investigate the effectiveness of the instructional approach and, if deemed worthwhile, identify ways to improve upon it" (p. 15). Enfield (2013) decided to execute the flipped classroom as the instructional approach. The methodology of Enfield's (2013) study and this action research study are parallel. Enfield (2013) directed a quantitative methodology in comparing the percentages of certain questions to a survey given to his multimedia college students. Despite challenges along the way, Enfield (2013) concluded "the flipped classroom experiment was a success" (p. 26).

Theoretical base

The flipped classroom pedagogy focused on watching video lecture, and oftentimes answering a few questions, prior to class as homework, and leaving class time as one in which active, inquiry, real-world problem solving takes place. The flipped classroom style teaching encompassed many different beliefs and theories. First, the active style learning stemmed from a constructivist ideology. Jean Piaget (1952) coined the term constructivism, although several theorists before him toyed with similar ideas. Constructivism focuses on active learning, learning from experiences, the teacher as a facilitator, and on how learning happens. "Most constructivists would also agree that the traditional approach to teaching – the transmission model – promotes neither the interaction between prior and new knowledge nor the conversations that are necessary for internalization and deep understanding" (Richardson, 2005, p. 3). Instead, constructivists emphasize student understanding based on an active style learning approach in which the teacher is merely a facilitator in the classroom, claiming that in order to gain a deep understanding of concepts students must investigate or "construct" their own learning

(Ozer, 2004, para. 1). The flipped classroom established the teacher as facilitator. Because the flipped classroom forced all lecture to happen outside of the classroom as homework, the teacher was free to focus on facilitating conversations to ensure understanding rather than lecturing the entire class period.

In addition to the constructivist ideology, the flipped classroom blended some aspects of the behaviorists' principles founded in the late 19th to early 20th centuries, as well as some beliefs of the progressivism theory. Specific aspects of the behaviorists' principles focused on the reinforcement of material, while progressivism seeks to ensure understanding through an avenue of active learning (Schramm-Pate, 2014). The reinforcement piece of the behaviorists' theory was observed when students were required to not only listen to the material on video (the flipped portion of action research), but also to apply the information the next day during inquiry-based, real-world application problems. Progressivism played a part in the delivery methods of the action research itself.

One can argue essentialism played a part in this action research as well, due to the focus of "essential skills and academic subjects" (Schramm-Pate, 2014, para. 7). Because the mathematics classroom must follow a list of standards as a guide of what must be taught in each subject as well as a timeline in which those standards must be taught, essentialism could be argued as a part of all mathematics curriculum. Although the content can be argued as essentialist, the delivery method of the content more closely draws from constructivism, behaviorism, and progressivism.

The work completed in the classroom reflected the theories of Piaget (1952) and Vygotsky's (1978) learning styles. Piaget's (1952) theories focused on the students'

thought process and the ability to express understanding. "In Piaget's work, metacognition, that is, knowledge of one's own thoughts and thought processes, involves both conscious awareness and the capability of communicating one's rationale" (Fox & Riconscente, 2008, p. 378). When implementing the flipped classroom, student-participants were forced to think about their thinking; instead of being told all the needed information, they utilized inquiry skills to discover understanding. Student-participants watched a lecture, but when they came to class, the foundation for enhancing complete mathematical understanding had been set. Bransford, Brown, and Cocking (2000) claimed "a 'metacognative' approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them" (p. 18). This idea of thinking about one's learning was a main goal in the flipped classroom model. In addition to metacognition, Piaget's (1952) beliefs of self-regulation played an important role in the flipped classroom style teaching. Zimmerman (1989) claimed, "Promising investigations of children's use of self-regulation processes, like goal-setting, self-reinforcement, self-recording, and self-instruction, in such areas of personal control as eating and task completion have prompted educational researchers and reformers to consider their use by students during academic learning" (p. 1). Self-regulation was witnessed in the videos utilized in the flipped classroom. Student-participants watched videos at their own pace, rewound the videos, and reviewed information whenever needed--a concept not possible with traditional lecture-style instruction.

Vygotsky's (1978) beliefs of active learning were exhibited in the realm of flipped learning. Vygotsky (1978), like Piaget (1952), researched and implemented the

idea of metacognition and self-regulation, both being crucial components in the flipped classroom. "For Vygotsky, education might support cultural progress, through mastery of existing cultural tools and openness to the development and use of new modes of language activity and new tools" (Fox & Riconscente, 2008, p. 388). This mastery was achieved through the review of the flipped videos provided to students, while the new tools associate the iPad.

Furthermore, the rise of technology had played a part in the history of the flipped classroom. Bishop and Verleger (2013) agreed that technology is a major theme seen in the conjunction with the term "flipped classroom" stating:

> This technological movement has enabled the amplification and duplication of information at an extremely low-cost. It started with the printing press in the 1400s, and has continued at an ever-increasing rate. The electronic telegraph came in the 1830s, wireless radio in the late 1800s and early 1900s, television in the 1920s, computers in the 1940s, the internet in the 1960s, and the world-wide web in the 1990s. (p. 2)

Berger and Trexler (2010) composed a book devoted to incorporating technology into the classroom, something that would not have been possible ten years ago. Berger and Trexler (2010) claimed that "active, engaged learning is one of the major benefits of integrating technology into the curriculum" (p. 11). Technology, when utilized effectively, had the ability to create complete conceptual understanding of mathematics.

Brunsell and Horejsi (2013) researched web tools to support student understanding and found the flipped classroom to be one of the most beneficial technological strategies to improve student understanding. Brunsell and Horejsi (2013)

claimed flipping the classroom "is efficient, improves the life of each teacher, strengthens relationships between teacher/student/parent, improves the quality of teaching, opens up more class time for student collaboration, and provides the time and structure needed to differentiate instruction" (p. 8).

With any new strategy, problems must be addressed. First, the problem of lack of access to technology had to be overcome. For this action research, School District One issued all students iPads in order to download videos to access at home. The videos were uploaded to an iTunes U account; student-participants were asked to download the lesson to their camera roll. This step not only solved the problem of technology, but also access to internet. It was not a requirement for students to have internet at home, as the video downloaded in class.

From Piaget (1952) to Vygotsky (1978), essentialism to constructivism, the flipped classroom has a strong theoretical base. Focusing its efforts on an active learning, the flipped classroom teaching method forced students to think about their thinking, rather than memorize facts. Making this change, the participant-researcher discovered a relationship between the active learning (flipped classroom teaching style) and student-participant achievement.

Historical context

Although the history of the idea of a flipped classroom can be dated as early as the mid-20th century with famous theorists such as Piaget (1952), Vygotsky (1978), and Dewey (2007) spearheading the belief in active learning, Mazur (2007) is credited with the creation of the flipped classroom, which he called peer instruction. Mazur (2007) explained, "peer instruction engages students during class through activities that require

each student to apply the core concepts being presented, and then to explain those concepts to their fellow students" (p. 5). Mazur (2007) wanted to become a facilitator rather a lecturer. Similarly, King (1993) shared the belief in a better alternative traditional lecturing when she wrote *From Sage on the Stage to Guide on the Side*. King (1993) claimed

> The professor is the central figure, the "sage on the stage," the one who has the knowledge and transmits that knowledge to the students, who simply memorize the information and later reproduce it on an exam— often without even, thinking about it. (p. 30)

King (1993) believed that, by moving away from the traditional as explained above to an active teaching strategy, the flipped classroom, students become more knowledgeable in the presented material.

> Active learning usually results in the generation of something new, such as a cause-effect relationship between two ideas, an inference, or an elaboration, and it always leads to deeper understanding. However, students do not spontaneously engage in active learning; they must be prompted to do so. Therefore, we need to provide opportunities for active learning to take place. (King, 1993, p. 31)

These opportunities are found in *Flipped Classroom Pedagogical Model and Middle-Level Mathematics Achievement: An Action Research Study*.

More recently, Lage, Platt, and Treglia (2000) constructed a paper coining the term "inverting" the classroom, a similar concept to the flipped classroom featured in this action research. Lage, Platt, and Treglia (2000) described the inverted classroom as one in which the "events that have traditionally taken place inside the classroom now take

place outside the classroom and vice versa" (p. 32). The inverted classroom described is the flipped classroom as implemented in this action research study. Rather than recording instruction with modeling examples as with the flipped classroom, Lage, Platt and Treglia's (2000) inverted classroom utilizes PowerPoint software and videotapes. The mode of delivery was different, but the idea behind the pedagogical approach was identical. Likewise, the main benefit of Lage, Platt, and Treglia's (2000) design was that "the inverted classroom allows for an introduction of a large component of group work and active learning into the classroom without sacrificing course coverage" in addition to "allow[ing] students of all learning styles to use a method or methods that are best for them" (p. 39). The benefits of the inverted classroom were similar to those of the flipped classroom in that it implemented active learning style approaches.

Salman Khan, developer of Khan Academy, has contributed ideas to the flipped classroom model. Dreifus (2014) described the beginnings of Khan Academy explaining that Khan began the website with the desire to help his cousin with her mathematics skills. Now, the website houses thousands of videos which anyone can access at no cost. In addition to free access, teachers can utilize the videos as part of the flipped curriculum. Students and parents can also access the videos in an effort to review material learned in class. Instead of creating their own videos, teachers can access free videos from the Khan Academy website and use those videos to initiate the flipped classroom style teaching.

The Wisconsin Collaboratory for Enhanced Learning has also created classes to support the ideas of the flipped classroom. "Wisconsin Collaboratory for Enhanced Learning (WisCEL) is a University of Wisconsin faculty initiative that challenges

traditional ideas about effective instructional models, course design, and learning environments" (Wisconsin Collaboratory for Enhanced Learning, n.d.). Students or teachers can join the classes to learn about content or to learn about the flipped classroom as well as other inquiry-based initiatives. "A critical design principle of WisCEL Centers is to use space that students already embrace as 'their own' place to engage informal learning and to marry it with an infrastructure that enables 21st-century, best practices for formal classroom instruction" (Wisconsin Collaboratory for Enhanced Learning, n.d.).

In 2014, Scott (2014) decided to transform the teaching in her all boys' school and begin researching the idea of the flipped classroom. Scott (2014) focused on "three areas needing improvement: reading, writing, and technology" and began attending professional development sessions in an effort to find a solution to her problem (p. 73). After discovering the flipped classroom, Scott (2014) was determined to get her teachers on board with her plan. Instead of holding a regular meeting, Scott (2014) utilized the flipped method and required teachers to

> watch four videos on different aspects of flipping, in assigned groups, review and discuss a case study of a school that has adopted flipped learning, and discuss in their groups how they might create a short digital presentation of what they had learned. (p. 75)

The session proved beneficial for the teachers, with 75% of teachers flipping a lesson and experiencing great results (Scott, 2014).

Tucker (2012) used the flipped classroom in his high school chemistry class in an effort to find time to re-teach absent students. Tucker (2012) realized the strategy was effective for all students, not only absent students, and began utilizing the flipped

classroom on a daily basis. Tucker (2012) claimed "it's not the instructional videos on their own, but how they are integrated into an overall approach, that makes the difference" (p. 82). Tucker (2012) not only required videos to be watched outside of class, but also checked students' notes from the video and questioned their understanding.

Durley (2012) decided to flip her biology classroom after realizing students had other ways of getting information. Durley (2012) claimed that "they didn't have to get the biology from me anymore. They could sit there and look it up on their phone" (para. 2). Since flipping her classroom, Durley (2012) asserted student-teacher interaction had improved, students had become more responsible for their own learning, and the depth of knowledge students were gaining was much higher than before.

Mangan (2013) examined the flipped classroom in a college course and observed several students preferred the flipped classroom over traditional lecture. Mangan (2013) described a situation in which students were unable to retain all information given in a traditional class lecture, but with flipped learning, were able to pause and rewind the lecture as needed. Mangan (2013) claimed that "at colleges nationwide, more and more professors are inverting homework and classroom in this way, using technology to give students a head start on classroom sessions where they can be active student-participants and not just listeners" (para. 9).

Corcoran (2014) asserted that "in 2012 the Flipped Learning Network surveyed 453 teachers who have flipped their classrooms. Sixty-seven percent of the surveyed educators reported improved test scores and 80 percent reported improved student attitudes" (p. 24). Corcoran (2014) suggested not only training students on flipped learning utilizing technology, but also "obtaining parental buy-in" on the idea of flipped

learning as well (p. 25). "Our flipped classroom approach would not have worked if we had simply sent students home with log-in instructions for their parents…We also needed parents to understand the parameters of the program" (Corcoran, 2014, p. 25).

Herreid, Schiller, Herreid, and Wright (2014) conducted a survey amongst science teachers determining their willingness to incorporate videos in their classroom. Although many teachers claimed they would incorporate the videos, "only 20% have seriously integrated the method into their classrooms" because the videos lacked interesting features (p. 79). Still, the researchers believed "the flipped classroom approach – with its reliance on excellent videos – is one solution to this dilemma" of covering too many topics as a teacher and not having the class time to delve deeper into concepts (Herreid, Schiller, Herreid, & Wright, 2014, p. 80).

Westermann (2014) performed a study in an upper level history class determining a correlation between blended learning and student achievement. Westermann (2014) created videos and required students to watch the videos before each class. In class, the students were divided into groups and were scaffolded to a debate based on the prior reading. Westermann (2014) claimed this strategy of instruction has a major benefit: it compels the "students [to] do the lower levels of cognitive work (gaining knowledge and comprehension) outside of class, and focusing on the higher forms of cognitive work (application, analysis, synthesis, and/or evaluation) in class, where they have the support of their peers and instructor" (p. 44).

Talley and Scherer (2013) determined the need for the flipped classroom research due to low grades amongst African American students and Hispanic students in STEM ("science, technology, engineering, and mathematics") courses (p. 339). Their research

described a similar delivery method as this action research study. Talley and Scherer (2013) also developed videos utilizing Doceri and then uploaded videos to YouTube for student access. Students were then quizzed on the given material. Students were also made to "self-explain," a method which "employed higher level thinking skills because students had to explain, interpret, and summarize the material" (Talley & Scherer, 2013, p. 344). Talley and Scherer (2013) applied a quantitative research design approach comparing course performance from a previous year to the flipped classroom implementation year and found "student performance in the course was significantly higher than in a previous semester" (p. 344).

Following a related research approach, Harvey (2014) compared grades from year to year—a year in which the flipped classroom was used and a year in which it was not—analyzing the application of the quantitative research approach. Harvey (2014), influenced by her background in online teaching, decided to implement the flipped classroom in an effort to improve retention in her college Latin students. She found the average test scores when implementing the flipped classroom teaching style to be higher than without and from her research claimed she was "convinced about the value of 'flipped' learning for elementary Latin instruction. I believe as more instructors begin to embrace the concept, the students in turn will benefit enormously and everyone will come to accept it as a normal mode of instruction" (Harvey, 2014, p. 127).

Douglas, Burton, and Reese-Durham (2008) conducted a quantitative methodology but applied a control group and experimental group to compare data. The researchers discovered a direct correlation between the multiple intelligence teaching (flipped classroom) and student achievement (Douglass, Burton, & Reese-Durham,

2008). "The results suggest that performance on a post mathematics assessment for students when exposed to MI (multiple intelligence) show considerable increase when compared to those taught using DI (direct instruction)" (Douglas, Burton, & Reese-Durham, 2008, p. 187).

Also applying a control group, Love, Hodge, Grandgenett, and Swift (2013) studied "student learning and perceptions in a flipped linear algebra course" (p. 317). The researchers analyzed the classes learning from the traditional lecture versus the flipped lecture by administering a survey to test the effectiveness of each type of lecture. Additionally, Love, Hodge, Grandgennett, and Swift (2013) compared midterm exam scores and final exam scores in an effort to discover a direct correlation between the flipped classroom and increased exam scores. Love, Hodge, Grandgennett, and Swift (2013) found "about 96% of students in the flipped section believed the videos helped them learn the material" (p. 323). Love, Hodge, Grandgennett, and Swift (2013) also discovered that

> students within a flipped classroom still performed as well as their peers in a traditional classroom on the final exam, representing conceptual understanding. This result is important since the students in the flipped classroom not only did still learn the necessary mathematical skills from their linear algebra course work, but also enjoyed the classes more (p. 323).

Barreto, et al., (2014) claimed their "working hypotheses in [their] study was that video lectures, assigned as homework, could replace live classroom lectures" and did this by implementing the flipped classroom (p. 34). The methodology utilized followed a similar format to this researcher's study in which student-participants watch videos

outside class, take a quiz and are grouped based on quiz answers in an effort to collaborate with classmates (Barreto et al., 2014). Based on a quantitative analysis, Barreto et al. (2014) determined "inverting the classroom by combining video homework and group problem solving in class leads to overall student success" (p. 38).

Sahin, Cavlazoglu, and Zeytuncu (2014) researched the effects of flipping a college calculus course. Again, the methodology employed is similar to this action research. Students were required to watch videos outside of class and perform on quizzes after watching the videos. Sahin, Cavlazoglu, and Zeytuncu (2014) analyzed data using a quantitative approach, comparing scores from classes implementing flipped classroom and classes not, as well as surveying students asking approval or dislike of the new teaching strategy. Students not only enjoyed the flipped classroom approach, but researchers also found that "students' average quiz scores from flipped classroom sections were significantly higher than students' quiz scores from non-flipped sections" (Sahin, Cavlazoglu, & Zeytuncu, 2014, p. 146).

Although not always coined "the flipped classroom," the teaching strategy has been put into practice for many years. This pedagogy was recognized as creating an active style learning environment. Neshyba (2013) described the idea of the flipped classroom including the purpose behind the flipped classroom perfectly when he stated,

> "Flipping" is a teaching technique that involves abandoning the traditional lecture (or just not relying on it so much) and replacing it with interactive approaches that experiment with technology and require students to gather information outside of class and be prepared to engage the material in class, rather than sit passively listening to a faculty member talk. (para. 2)

The history of the flipped classroom sparked an interest in the participant-researcher and was implemented in order to observe student achievement as associated with the seventh-grade mathematics flipped classroom. Although much research has been accomplished, there was a gap in understanding in the correlation between the flipped classroom and the seventh-grade mathematics students' achievement.

In order to challenge student-participants and foster a deep understanding of seventh-grade mathematics concepts, the flipped pedagogy, a new strategy of teaching, was implemented. Supported by the scholarly research, the flipped pedagogy method has been implemented amongst a group of twenty-three seventh-graders at Harrison Middle School in Anderson, South Carolina.

Key Concepts

This glossary provides definitions of terms associated with the flipped classroom teaching strategy as well as terms associated with the middle school mathematics classroom. The definitions include those found in Merriam-Webster's Dictionary as well as ideas and thoughts of the participant-researcher.

Abstract Knowledge: Knowledge that is all-purpose and not attached to a specific instance. Antonym of concrete knowledge.

Achievement: The process or act of achieving something. In this action research, the process of achieving understanding of mathematics topics.

Active Style Learning: A style of learning in which the student does something in order to gain understanding.

Assessment: The process used to determine the knowledge of a certain topic.

Best Practice: A guide or procedures used in order to ensure positive student knowledge of specific topics.

Collaboration: The ability to discuss problems, ideas, and mathematical concepts with other students.

Cooperative Learning: An interaction between students in an effort to gain understanding of mathematics.

Concrete Knowledge: Knowledge that can be seen or held. Antonym of abstract knowledge.

Constructivism: The ability to construct one's own views or beliefs based on the world around them; specifically, in this action research, the ability to construct ideas based on conversation in the mathematics classroom.

Education: An idea or collection of rules that teachers implement in order to convey the mathematics curriculum.

Engaging: In respect to an activity or lesson, immediately grabbing the attention of students, and/or causing students stay on task throughout the activity or lesson.

Facilitator: One (the teacher) who scaffolds questions in an effort to create a greater sense of understanding of a mathematics topic.

Failure: Not being able to succeed in a given assessment. The absence of success.

Flexible Environment: A classroom in which students are allowed a variety of modes of learning and means of assessment.

Flipped Classroom: When the traditional style lecture is recorded on a video which is watched by students and analyzed as homework, while the traditional homework

(practice and real-world problems) is completed in class in an effort to solidify understanding by the teacher/facilitator.

Formal Assessment: Tests that methodically calculate how well a student has mastered learning results.

Formative Assessment: A tool used to properly assess student's understanding of a given topic. See also informal assessment.

Independent Variable: The variable that is manipulated in an action research methodology.

Informal Assessment: A tool used to assess student understanding of a given topic on a daily basis. See also formative assessment.

Inquiry: The process of seeking answers, asking questions, and investigation in an effort to gain a full understanding of a topic.

Intentional Content: Placing content in the most appropriate context for all students; accessible to all students.

Internet: A global network connecting millions of pieces of data, news and opinions.

Intrinsic Motivation: When students engage in an activity for its own sake.

Inverted Classroom: Another name for the flipped classroom. See also flipped classroom.

iTunes U: A website dedicated to uploading self-made videos in an effort to allow others to download or save the created videos.

iPad: A handheld tablet created by Apple Inc. A mobile device capable of working as a computer.

Khan Academy: A non-profit educational organization that provides free video tutorials and interactive exercises.

Knowledge: Information and a complete understanding of a certain topic

Learning: The process of acquiring knowledge, skills, attitudes or values.

Learning Culture: Student-centered communities of inquiry rather than instructor-centered lecture.

Lecture: An oral presentation, normally directed by the instructor or teacher, projected to teach information to students.

Mastery: The state of true knowledge of a certain concept.

Mathematics: The study of numbers, equations, functions, and geometric shapes and their relationships.

Mathematics Concepts: The "why" or "big idea" of math. For example, when learning addition, knowing why adding works is the mathematics concept.

Metacognition: Awareness and understanding of one's own thought processes.

Objective: The goal of the given lesson.

Observation: The act in which one monitors the activities in the classroom.

Passive Style Learning: A more traditional class consisting of verbal lessons in which students are required to regurgitate information given by the instructor. Antonym of active style learning.

Pedagogy: The method and practice of teaching, especially as an academic subject or theoretical concept.

Philosophy of Education: The beliefs of an educator in regards to student understanding.

Problem Solving: The process of finding solutions to difficult or complex issues.

Qualitative Research Design: Primarily exploratory research used to gain understanding of underlying reasons, opinions, and motivations. Provides insights into a problem and helps to develop a plan of action to address the problem.

Real World Mathematics Problems: Also known as word problems. Used to teach students to connect real-world situations to the mathematics world.

Reasoning: The ability to develop a conclusion from given information.

Response Variable: The variable in a qualitative methodology that is dependent upon the manipulated variable. Also known as the dependent variable.

Scaffolding: An instructional tool utilized by teachers to support learning when teaching mathematics concepts.

South Carolina Mathematics Standards: A set of regulations determining the content to be taught in each grade level.

Student-Centered Learning: An approach to education focusing on the needs of students rather than others in the educational world.

Success: an accomplishment; meeting the requirement of the South Carolina State Mathematics Standard.

Surface Understanding: An understanding of basic skills specifically in the mathematics content.

Teacher: One who directs all aspects of the classroom.

Technology: the application of scientific knowledge for practical purposes.

Understanding: the ability to comprehend material presented.

Video: the recording, reproducing, or broadcasting of moving visual images.

Virtual learning: Designed to spotlight teachers at the facilitator rather than the center of the instruction.

Web: an information system on the Internet that allows documents to be connected to other documents by hypertext links, enabling the user to search for information by moving from one document to another.

Literature Review Topics

The literature review focused on studies similar to this action research study. The participant-researcher digested and analyzed much literature beyond this literature review in an effort to understand the topic of the flipped classroom, benefits and challenges of the flipped classroom, support for the problem of practice addressed in this action research, discovery for the best methodology to follow, and importance of the theory behind the flipped classroom. The literature analyzed supported the need to implement the flipped classroom in an effort to find a solution to the problem of practice, student retention of integer skills. In addition, the literature suggested following a quantitative approach in order to analyze data found when employing the flipped classroom method.

Conclusion

Several articles described the process of the flipped classroom with benefits and results, the majority of the articles do not focus on mathematics or the seventh-grade student. The literature also provided the evidence to support the desire to complete a qualitative research design approach.

CHAPTER THREE: METHODOLOGY

Introduction

The purpose of Chapter Three: Methodology is to describe the action research design used in the study, *Flipped Classroom Pedagogical Model and Middle-Level Mathematics Achievement: An Action Research Study*, which focuses on incorporating flipped classroom style teaching into a seventh-grade mathematics classroom. Harrison Middle School incorporated the flipped model in an effort to improve students' mathematics achievement on the created pre- and posttest. According to both district and researcher records (see results section), these students currently retain information for tests and quizzes, but do not retain the material after the tests are administered. The methods used in the present action research study follow the guidelines set by Mertler (2014) to collect data on one seventh-grade flipped classroom over the fall 2016 term in the participant-researcher's classroom. Observations of students within the model were recorded using field notes and a pre- and posttest was implemented to determine if the flipped model enabled the students to retain more math content after the test was administered. This method of observation, in conjunction with quantitative data, was supported by Mertler (2014). Mertler (2014) claimed quantitative data can "include observational research and survey research" supporting the need for a pre- and posttest (observation of knowledge) and the created surveys to triangulate data (p. 120). Based on research obtained, the flipped classroom style teaching required students to be actively

engaged which significantly increased student understanding and retention of material learned.

Major themes across research included benefits of the flipped classroom as well as disadvantages, definitions of active learning, flipped classroom and traditional learning, and helpful tips to aid in incorporating the flipped classroom style teaching. In addition, the participant-researcher expounded upon support for avoiding specific downfalls observed in the classroom when implementing the flipped classroom teaching strategy. Downfalls noted in the participant-researcher's math classroom included a lack of differentiation, short-term retention of mathematics concepts taught, little attention during class, limited active learning, insufficient understanding of mathematics concepts, and no time for one-on-one tutoring for struggling students.

Roehl, Reddy, and Shannon (2013) explained "the flipped classroom strategy provided an opportunity to address both the concerns. These pathways move toward more powerful learning outcomes, retention of knowledge, and increased depth of knowledge suggest an optimistic future for education" (p. 48). Several authors claimed the flipped classroom provides students with the knowledge they need, at their own pace, allows for differentiation, one-on-one assistance, and the ability to foster a deeper understanding of mathematics concepts. Moon (2005) agreed stating, "To be successful in the 21st century, all students must have not only knowledge and understanding of content, but also the capacity to think critically, analyze, synthesize, and make inferences" (p. 227). Again, researchers agreed that there must be a move away from surface knowledge and that teachers must push students to gain a deeper understanding of the material taught; that push was through the flipped classroom style teaching.

Several researchers have expressed a need for a movement away from lecture style teaching mainly due to student retention rates after the lesson was complete. Rick (2007) claimed, "Retention following lectures is as low as 5 percent after a 24-hour period" (para. 12). Teachers must meet students where they are academically as well as technologically. With the flipped teaching style, students are able to watch the video at their own pace, rewind, take notes, re-work problems, and go back and review the material any time they need a refresher, unlike traditional style teaching when the information is given only once and then students are required to regurgitate the information or apply the concepts. Tucker (2012) claimed, "Flipped classroom teachers almost universally agree that it's not the instructional videos on their own, but how they are integrated into an overall approach, that makes the difference" (p. 82).

This action research followed a quantitative approach to address the research question. The independent variable was the flipped classroom instruction and the response variable was mathematics achievement. Following the quantitative approach, the participant-researcher discovered a correlation between the flipped classroom model and student mathematics achievement.

Purpose of the Study

The purpose of this study was to examine the relationship between a flipped classroom style instruction and mathematics achievement determined by standardized test scores and triangulated by student responses to two surveys (see Appendix B). The purpose of this action research study was to determine if student's mathematics achievement is improved by implementing a flipped classroom pedagogical approach to teaching.

Statement of the Problem Statement

The participant-researcher observed that students in her seventh-grade mathematics classes do not exhibit long-term retention of integer (positive and negative whole numbers and zero) rules (how to add, subtract, multiply and divide with positive and negative numbers). The student-participants were taught integer rules at the beginning of the year and are expected to recall and apply the rules throughout the school year in order to be successful in other mathematics concepts (operations with rational numbers/fractions). The participant-researcher noticed that the student-participants learn the new concepts (ensuring common denominator when adding and subtracting fractions, recalling how to multiply and divide rational numbers), but when given a negative fraction, the student-participants could not apply an accurate application of integer rules, and therefore were unsuccessful in solving the problem (see results of pretest in results section).

Research Question

What is the impact of a flipped classroom pedagogical model on seventh-grade students' mathematics achievement?

Research Objectives

The goal achieved in this study was to relate the flipped classroom style instruction to student achievement as measured by performance on mathematics tests, triangulated by student responses to two surveys.

Action Research Design

A quantitative research design was most appropriate in effectively answering the research question. A quantitative research design is one in which several questions can

be answered including a cause and effect relationship. Using this design, the participant-researcher analyzed the data obtained from the student-participants and determined if a relationship between the independent variable (the flipped classroom model) and the dependent variable (mathematics achievement) exists. To protect the identity of the participants and setting, pseudonyms are used throughout the study.

In an effort to determine the relationship between the flipped model and mathematics achievement, no other new teaching strategies were implemented other than the flipped classroom strategy; other strategies include teacher lecture. Trying to control this aspect of the study suggested a relationship between the two variables.

Student-participants

Student-participants included seventh-graders at a middle school in Anderson, South Carolina. Student-participants were determined by the guidance counselors based on which students were randomly chosen to be in the participant-researcher's class.

The school was comprised of a small, close-knit, community that is very involved in student behavior, activities, and academic achievement. Within the student body, 26.5% were enrolled in the gifted and talented program and 12.9% were served with disabilities (South Carolina Department of Education, 2014). There were 0.5% Asian, 4% African American, 2% Hispanic, 0.1% American Indian, 3% two or more races, 0.1% Hawaiian-Pacific Islander, and 90% white students (South Carolina Department of Education, 2014). Of all students enrolled in the school, 35% qualify for free or reduced lunch (South Carolina Department of Education, 2014). Also, of the population, 52% were boys, while 48% are girls (South Carolina Department of Education, 2014). Within

the class studied, ten students were female, fourteen were male and 100% were white students. 13% of the students in the studied class qualified for free or reduced lunch.

Setting

All research was conducted at the participant-researcher's school in Anderson, South Carolina. The research was obtained from a seventh-grade mathematics classroom comprised of 23 twelve- to thirteen-year-olds. The school was rural and has achieved an excellent report card rating from the federal government for several years.

The community was extremely involved in all aspects of the school and an overwhelming support is offered to teachers and leaders. In addition, parent support of teachers and teacher decisions was high. The Superintendent of Education from the district regularly visited schools, often bringing board members, in an effort to keep all involved in the learning process and to experience the classroom and students.

Building Trust

The participant-researcher has met with students individually to discuss progress throughout the year. Specifically, formal meetings were held after completing the pretest and posttest as well as throughout the year as needed. Other meetings were held based on understanding as determined from formal, posttests and quizzes, and informal, Socrative and exit tickets, and observations of students. These discussions were one-on-one assistance between the participant-researcher and the student-participants to ensure student understanding of integers.

Positionality

Participant-researcher as the research instrument

The participant-researcher was the research instrument as the participant-researcher conducted all activities of the class as well as interpreted and analyzed the gathered data. The participant-researcher realized becoming a teacher-leader must be accomplished in order to produce an effective action research design. The participant-researcher held a philosophy in which becoming a servant leader makes a positive difference in the class. Sergiovanni (2013) asserted "one way in which the servant leader serves others is by becoming an advocate on their behalf" (p. 379). To transition from a teacher to an effective teacher-leader, one must be aware of student's ability and home life to create the "presence" as described by Starratt (2013) and must use this information to ensure students feel as if they have a place, that they are a crucial part of the classroom (p. 55). This ability was crucial in *Flipped Classroom Pedagogical Model and Middle-Level Mathematics Achievement: An Action Research Study*.

Ethics

A code of ethics in the education world was normally an unspoken set of rules: always do what is best for the student; however, the National Education Association (NEA) constructed a code of ethics to be followed by all educators. First, the NEA (2015) has overall expectations for educators:

> The educator, believing in the worth and dignity of each human being, recognizes the supreme importance of the pursuit of truth, devotion to excellence, and the nurture of the democratic principles. Essential to these goals is the protection of freedom to learn and to teach and the guarantee of equal educational opportunity

> for all. The educator accepts the responsibility to adhere to the highest ethical standards. (para. 2)

In addition to overall expectations, NEA had specific expectations related to action research. In flipping the classroom, the focus was on students and improving student understanding. Because the action research was focused on students, it is important to ensure fairness for all students. NEA (2015) states,

> The educator strives to help each student realize his or her potential as a worthy and effective member of society. The educator therefore works to stimulate the spirit of inquiry, the acquisition of knowledge and understanding, and the thoughtful formulation of worthy goals. (para. 5)

As an educator, the participant-researcher strove to ensure fairness for all the students.

Fairness in the action research project was guaranteed by ensuring all students received the same information. Creating the idea of fairness and equity was crucial; in order to accomplish this, the same conditions were provided for all students.

The school district also required educators to be ethical in all classroom decisions. When the shift from traditional teaching to the flipped classroom style teaching occurs, the district office was alerted of this change. Not only because of the change in teaching, but also because action research was being conducted. Any time a teacher researches one's students, the district required the researcher to acquire preapproval from the assistant district superintendent. The assistant superintendent gave permission to conduct research and provided confirmation or disapproval in regards to ethical considerations (see Appendix D).

At the university level, several steps were required to ensure ethics in action research. Before the study began, the participant-researcher successfully completed the Institutional Review Board (IRB) qualifications and received an approval letter for research (see Appendix E). Because the action research plan did not impact the well-being of the students, there were no other ethical considerations. Regarding ethical considerations, Dana and Yendol-Hoppey (2014) suggested that "the ultimate responsibility for ethical conduct as a teacher and a teacher-inquirer resides with you, with the ultimate goal of doing no harm to the students you teach or any other people involved in our inquiry" (p. 155).

The research design yielded the desired outcomes as a result of a transition from traditional lecture to flipped classroom style instruction. The focus was to determine a solution to the problem of student retention amongst middle school math students which causes no ethical implications. The yielded results were achieved by implementing a quantitative research design approach measuring participant-researcher created pretests and posttests, triangulating the data with two student-participant focused surveys. The action research generated desired results without posing any ethical threats.

Insider/Outsider Status

The participant-researcher was considered an insider since the participant-researcher was also the teacher in this action research design. As an insider, the participant-researcher was responsible for creating a classroom climate as one conducive to learning. Pazey and Cole (2013) claimed that leaders "set the tone and climate for the school and dictate to school personnel whether students will be included or excluded" (p. 185). The participant-researcher created an unspoken tone for the classroom. Further,

Barth (2013) asserted that "schools exist to promote learning in all their inhabitants" (p. 200). The participant-researcher ensured each student was learning, promoting a successful school as an insider, focusing on student achievement as analyzed by this action research design. Creating this climate in the classroom laid the groundwork for a successful action research design. Additionally, surveys were conducted, and informal data to guide instruction was collected to support the participant-researcher's status as an insider.

Plan for Data Collection

Data was informally collected on a daily basis using a tool called Socrative. This provided immediate feedback to the participant-researcher concerning student understanding of the taught skills in an effort to determine the next steps in the classroom (which activities to assign). This data was also used to gain understanding of the struggling student-participants in order to provide one-on-one assistance. In addition, data was collected from a pretest and posttest (see Appendix A) in an effort to analyze growth or regression of integer knowledge. The participant-researcher also kept a journal of observations of students throughout the study noting student-participant behaviors while viewing the lessons, as well as student-participant understanding of the integer concepts taught. Data collection was from August through October, Fall 2016 at Harrison Middle School in Anderson, South Carolina.

Plan for Data Analysis

Data was analyzed calculating the mean from each pretest and posttest and comparing the differences in scores. Additionally, a t-test was calculated using the means from the pretest and posttest to determine any statistical difference. In addition to

comparing the scores, the participant-researcher created subgroups to detect a significant increase or decrease in achievement in any subgroup. Students were placed in the following subgroups: male, female, and those qualifying for free and reduced lunch. The participant-researcher disaggregated scores on the basis of gender and socioeconomic groups in an effort to uncover a relationship between the flipped classroom and students' mathematics achievement amongst those subgroups. Additionally, in an effort to effectively triangulate the data, the participant-researcher administered a survey determining the student-participant's attitude towards the flipped classroom pedagogy.

Plan for Reflecting with Student-Participants

The participant-researcher reflected on collected data after teaching each unit (integers and rational numbers). Student-participants were asked to journal about their feelings towards the flipped classroom providing the participant-researcher with an extension of responses in addition to the survey administered. The participant-researcher required the student-participants to reflect on their learning over the last unit (integers and rational numbers), explaining how they learned, what they learned, the success of their learning. Not only was the data gathered beneficial for the participant-researcher in gaining understanding of the effectiveness of implementing the flipped pedagogy, but also for the student-participants in reflecting on their thinking and learning throughout the units.

The participant-researcher created a PowerPoint presentation displaying the results from the calculated t-test using the results from the two pretests/posttests to allow student-participants to see their results when utilizing the flipped pedagogy. The

comments from the survey and reflective journals were included to foster conversation about the effectiveness of the flipped pedagogy.

Plan for Devising An Action Plan

The participant-researcher devised an action plan following the results of the study. This plan included an improvement upon the flipped classroom pedagogy using the data as a guide. In addition, the participant-researcher included a proposal to present to fellow educators describing the action research study with the findings.

Conclusion

This action research discovered a correlation between the flipped classroom and students' mathematics achievement. This action research was a necessity because of the current retention of integers as observed in a seventh grade class. In order to effectively discover the relationship, pretest and posttest scores as well as answers to a student-participant centered survey were analyzed to determine a growth or regression determining the effectiveness of the flipped classroom. A quantitative research design approach was implemented in order to determine this relationship. The student-participants were randomly selected from a rural middle school in Anderson, South Carolina that has an overwhelming community and gatekeeper support. Students were in constant contact with the participant-researcher in an effort to build trust throughout this action research process.

CHAPTER FOUR: FINDINGS & IMPLICATIONS

Introduction

The purpose of Chapter Four: Findings & Implications, is to present the data from a six-week action research study in a seventh-grade math classroom for the dissertation, *Flipped Classroom Pedagogical Model and Middle-Level Mathematics Achievement: An Action Research Study*.

Research Overview

The participant-researcher uncovered a growing epidemic in her school's mathematics classrooms located in Anderson, South Carolina. The identified problem of practice (PoP) for the present action research study was aimed at the inability of some seventh-grade students at this school to retain mathematical content of integers when they were taught within an essentialist framework. Most importantly, this method of instruction had damaged their ability to apply mathematical knowledge to real-world application of math problems such as calculation using rational numbers (see Appendix A for the specific unit of study). The identified PoP revolved around students not being given the opportunity to think for themselves. The traditional pedagogy utilized prior to the action research plan required students to listen to direct instruction and mimic the instruction on tests. The students did not have an opportunity to practice real-world application problems in order to gain a deep understanding of the mathematics concepts. In order to differentiate the pedagogical practices in the seventh-grade math classroom,

the participant-researcher designed a flipped classroom approach to teaching mathematics that requires students to be actively engaged in their learning during the following math units: integers and rational numbers (see Appendix A), rather than passively taking notes and sitting silently while the instructor delivered her lectures. The scholarly literature supported active learning in mathematics classrooms with students in the seventh grade and offered solutions for retention problems that commonly are observed in schools such as the school in this study (Bransford, Brown, & Cocking, 2000; Herreid & Shiller, 2013; Ozer, 2004; Roehl, Reddy, & Shannon, 2013). The purpose of the present study was to describe the flipped classroom pedagogy in the math class that was designed to encourage active learning in mathematics and the retention of math skills from the TIRN units (see Appendix A). Khader (2011) claimed "research and anecdotal evidence overwhelmingly support the claim that students learn best when they engage with course material and actively participate in their learning" (p. 75). Following Khader (2011), the flipped classroom required the student-participants to rely on their prior knowledge and application of skills taught to be successful in this active learning environment. Therefore, data was collected to determine what these students had retained from prior units in math.

The flipped videos were created by the participant-researcher. The videos included rules/processes for operations with rational numbers (for specific area of focus see Appendix A) as well as one teacher-modeled problem. After watching the video, student-participants were given practice problems based on the information gleaned from the video. The practice problems were real-world application problems requiring student-participants to apply the skills to the problems.

Problem of Practice (PoP) Statement

The identified PoP for the present action research study focused on a seventh-grade mathematics classroom at Harrison Middle School, a pseudonym, where the participant-researcher had evidence that passive learning (e.g., lecture, note-taking, standardized testing) was taking place rather than active learning (e.g., constructivist units, manipulatives, and formative assessments) in her classroom. Explicit direct instruction, a passive form of instruction, was not only unsuccessful as deemed by student test scores, but was also boring the students and giving them no opportunity to think for themselves. The participant-researcher believed based on a review of the scholarly literature on teaching to seventh-grade students that the use of these passive learning pedagogical techniques was contributing to the main problem of these students not being able to retain math concepts and to their inability to apply these mathematics concepts to real-world application problems such as rational numbers. Hill (2010) conducted a study in which the norm of explicit direct instruction was challenged with another avenue of instruction. Hill (2010) claims, "In addition to mathematical understanding, I wanted my students to realize that they could learn from and assist one another in learning despite the obstacles and challenges they encountered, including prior lack of success in mathematics classes" (p. 7). The students at Harrison Middle School have not been given an opportunity to think for themselves, so the flipped classroom was implemented to challenge the students. Hill's (2010) study focused on a non-traditional approach to learning despite the push for explicit direct instruction, similar to the situation explained in this action research study.

Research Question

The research question addressed in the present study is: *What is the impact of a flipped classroom pedagogical model on seventh-grade students' mathematics achievement?*

Purpose of the Study

The primary purpose of this action research study was to describe a flipped classroom pedagogical teaching model on seventh-grade students' summative assessment scores in mathematics, pretest and posttest scores; therefore, the research question was devised. The participant-researcher created a design in which the findings would point to an increase or decrease in student-participant test scores after implementing the TIRN unit utilizing the flipped classroom pedagogy. The participant-researcher wanted to directly analyze the test score data as the primary and only source of data collection as the district the school is a part of pushes the importance of high test scores. The secondary purpose was to design a flipped classroom pedagogical model for these students in order to enable them to learn in a constructivist and active environment rather than the traditional essentialist classroom structures to which they were accustomed. The tertiary purpose was to work in conjunction with the student-participants as well as colleagues to design an action plan for seventh-grade mathematics that enables educators, parents, and students to be successful in a math classroom where flipped pedagogy was the norm.

General Procedures for Action Research: Quantitative Design

The action research study followed a quantitative design, as suggested by Mertler (2014), in order to analyze the results of the study. Students were required to complete a

pretest and posttest related to mathematics content of integers and rational numbers. This data was collected from August 2016 to October 2016 at Harrison Middle School in Anderson, South Carolina. After testing was complete, the participant-researcher disaggregated results based on gender and socioeconomic status (see Figures 4.1, 4.2, and 4.3). The participant-researcher kept an observation journal of students while implementing the action research study. The purpose of keeping the journal was to address the issue of students not being given an opportunity to think for themselves. Because test scores are so important to this district, the participant-researcher analyzed the quantitative results in order to argue the flipped classroom success or failure. This study was completed in one classroom with 23 students (n=23) where student-participants took a pretest, completed the flipped classroom units, and took a posttest. The results of these findings are discussed below.

Findings of the Study

Data was collected in the Fall of 2016 amongst 23 seventh graders at Harrison Middle School in Anderson, South Carolina. The study was conducted in one classroom (n=23). A pretest, containing questions regarding integers and rational numbers, was given at the beginning of the unit of study. The participant-researcher then presented video lessons discussing rational numbers. A posttest, containing the same questions as the pretest, was administered at the end of the unit of study. The pretest and posttest was a teacher-made assessment and can be found in Appendix A. Throughout the given timeframe, the participant-researcher collected field notes observing student-participant attentiveness and student-participant questions while working through the flipped video instruction. In an effort to reflect on the data with the student-participants, the

participant-research instructed the student-participants to write in journals including their feelings and attitudes toward the flipped classroom pedagogy. The students were given approximately five minutes each class period to reflect on their learning. The purpose of these reflections was to ensure student understanding while conducting the unit. Because of the importance of test scores in this district, the test scores were analyzed, but the attitudes of the student-participants were taken into consideration as part of the reflection process as well as the Action Plan. For a more detailed discussion of the Action Plan, see Chapter Five.

Additionally, a survey was administered to gauge student-participant thoughts and feelings as well as likes and dislikes concerning the video instruction. Allowing for multiple data sources in an effort to obtain confidence in the findings as suggested by Mertler (2014) is a main focus in determining data collection strategies. All of these data sources were compiled in an effort to polyangulate the data to uncover the impact of the flipped classroom pedagogy on seventh-grade students' mathematics achievement. Again, because of the importance of the test scores to the participant-researcher's district, the quantitative data was analyzed. The qualitative data, the reflections and the surveys, were used only in polyangulating the findings.

The pretest/posttest contained 51 questions focusing on integers and rational numbers as deemed appropriate by the South Carolina Department of Education for seventh-grade mathematics students. Of the 51 questions, 29 questions (56.8%) assessed integer knowledge, while 22 questions (43.2%) assessed rational number information. Thirty-three percent of the test contained word problems, 21.6% stemming from integers and 11.8% evaluating understanding of rational numbers (see Appendix A). In the

survey, student-participants were asked four questions, all accessing their attitude toward flipped pedagogy instruction versus traditional instruction (see Appendix B).

Data Interpretation

Table 4.1

Simple t-test calculation for Pretest/Posttest

	Variable 1(Posttest)	*Variable 2 (Pretest)*
Mean	44.56522	27.82609
Variance	17.62055	54.69565
Observations	23	23
Hypothesized Mean Difference	0	
df	35	
t Stat	9.440152	
P(T<=t) one-tail	1.87E-11	
t Critical one-tail	1.689572	
P(T<=t) two-tail	3.74E-11	
t Critical two-tail	2.030108	

Table 4.2

Calculation of standard deviations for variances in the study

Standard Deviation Differences from Pretest/Posttest	5.84821178
Standard Deviation Pretest	7.395650896
Standard Deviation Posttest	4.197684285
Standard Deviation Pretest Males	7.52942944
Standard Deviation Posttest Males	4.150996173
Standard Deviation Differences from Pretest/Posttest Males	5.695252184
Standard Deviation Pretest Females	7.375635566
Standard Deviation Posttest Females	4.458450154
Standard Deviation Differences from Pretest/Posttest Females	6.183310871
Standard Deviation Pretest Free/Reduced Lunch	10.53565375
Standard Deviation Posttest Free/Reduced Lunch	2.516611478
Standard Deviation Differences from Pretest/Posttest Free/Reduced Lunch	11.59022577

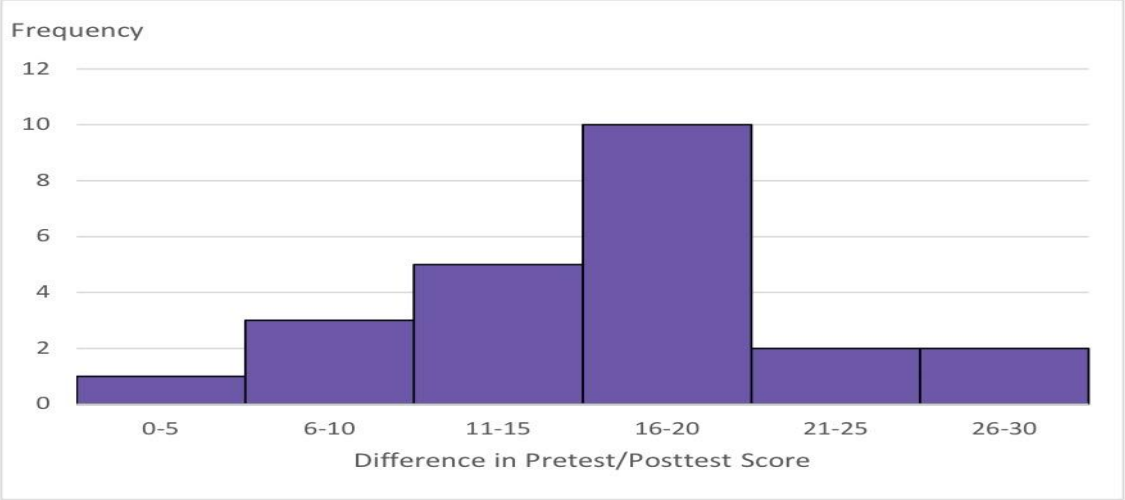

Figure 4.1

Frequency of the differences in the pretest/posttest scores for all students

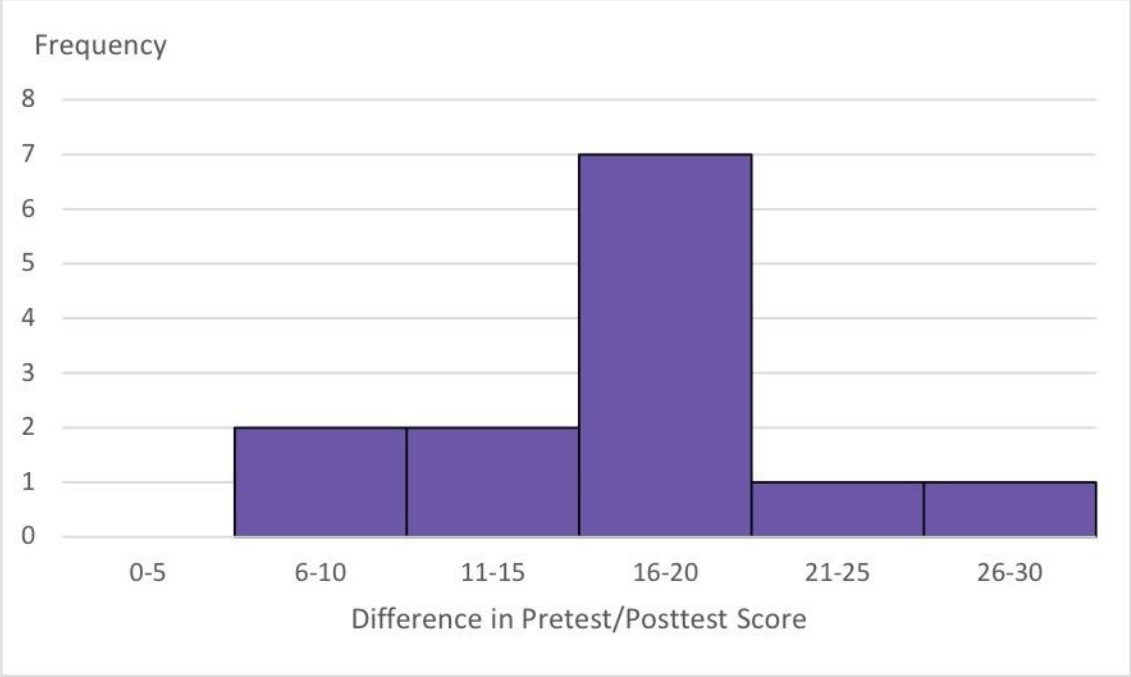

Figure 4.2

Frequency of the differences in the pretest/posttest scores for males

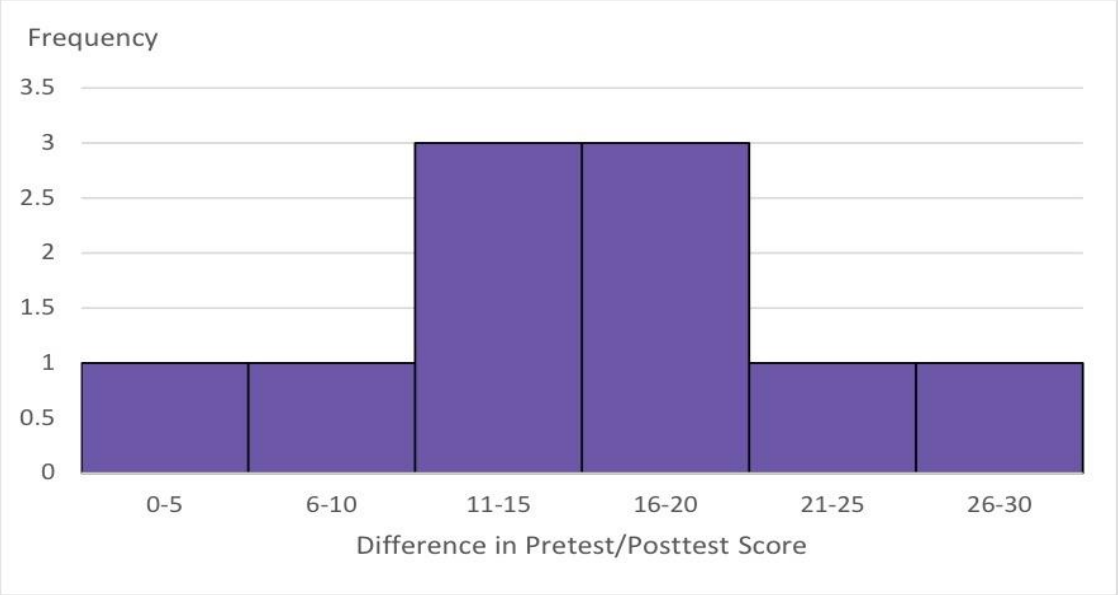

Figure 4.3

Frequency of the differences in the pretest/posttest scores for females

One hundred percent of the student-participants improved their score from the pretest to the posttest. The greatest gain was 29 questions, getting only 17 questions correct on the pretest and 46 questions correct on the posttest. The least gain was 5 questions, with the student scoring 43 questions correct on the pretest and 48 correct on the posttest. The mean number of questions correct on the pretest was 27.8 while the mean number of questions correct on the posttest was 44.6. The average increase from pretest to posttest was 16.7 questions. The scores were also disaggregated in regards to gender and socioeconomic status. The average female student-participant pretest score was 29.2 and the posttest score was 44.9. The average male student-participant pretest score was 26.7 and the posttest score was 44.3. The average pretest score amongst student-participants receiving free or reduced lunch was 27, and the posttest average score was 43.7.

A t-test was calculated to determine if the pretest scores are statistically different from the posttest scores. Note variable 1 as the posttest scores and variable 2 as the pretest scores. A simple t-test was calculated and the results can be found in Table 4.1. The scores were analyzed with an alpha level of .05. Additionally, the standard deviation was calculated for all students as well as each subgroup being reported. These results can be found in Table 4.2. It is important to note the standard deviation differences from pretest to posttest is 5.84 for all students, 5.7 for males and 6.18 for females indicating a small amount of variance from the mean values. Additionally, standard deviation for free/reduced lunch students from pretest to posttest was 11.59. In addition, the disaggregation of scores based on genders can be found in Figures 4.1, 4.2 and 4.3.

Additionally, the types of questions were analyzed, determining how many questions were missed on the pretest versus the posttest when considering word problems. One student improved nine questions, meaning he/she correctly answered nine more word problems when compared to the pretest. Four student-participants improved seven questions, while two student-participants improved six questions. Four student-participants improved five additional word problems. Eight student-participants improved four questions. Two student-participants improved three questions. One student-participant improved two real-world questions; this student missed three of the word problems on the pretest and only missed one on the posttest. One student-participant did not improve at all on the word problems missing three real-world problems on the pretest as well as the posttest.

In order to polyangulate the qualitative data, the participant-researcher administered a survey after the posttest uncovering student attitudes and feelings toward

the flipped classroom pedagogy. Regarding the administered survey, all student-participants expressed they learned well when using the videos in addition to enjoying being able to work at their own pace while utilizing the videos. However, six of the 23 student-participants claimed they preferred direction instruction from the teacher rather than a pre-recorded flipped video lesson. Additionally, the participant-researcher noted a sense of resistance when beginning the new pedagogy. Field notes taken during the action research study noted, after the resistance period of a few days, high student-participant engagement as well as effective student-participant questioning. The participant-researcher noticed questions being asked were effective in scaffolding student-participants to higher level thinking.

Data Analysis & Reflection

Using the analysis of the quantitative data, along with the polyangulation of the surveys and field notes (journal) data, the participant-researcher uncovered three emergent themes: (1) Effect on Student Understanding; (2) Student Resistance to New Pedagogy; and (3) Student Attitudes Toward Flipped Pedagogy.

Table 4.3

Research Themes

Journal and Survey Themes	Subordinate Themes
Effect on Student Understanding	Student retention Student understanding
Student Resistance to New Pedagogy	Student fear in trying something new Students wanted to be given the information (direct instruction)

Student Attitudes Toward Flipped Pedagogy	Student engagement Self-paced instruction

Theme One: Effect on Student-Participant Understanding

In order to conceptualize the effect on student learning, the participant-researcher administered a pretest and a posttest as well as a survey and journal entries by student-participants. From the pre/posttest, the average gain was an increase of 16.8 questions correct. Not only does this statistic evidence an effect on student learning, but the survey provided great insight on student learning as well. The following information was gathered from student-participant survey data. The data was collected electronically and kept confidential on the participant-researcher's password protected computer. When asked his/her opinion of the flipped lessons, one student claimed "I like learning with videos because everyone gets to go at their own pace and you can go back when studying if you want." Another student-participant echoed the thoughts of the previous mentioned student stating "it helps me to see how to do it." Out of 23 student-participants, six students said they did not enjoy the flipped classroom pedagogy and that they felt explicit direct instruction was better. Direct instruction, a pedagogical method developed by Engelmann (1999), focuses on teacher instruction while students take notes and learn directly from the teacher; in this pedagogy, the teacher is instructing while students are passive in the classroom learning environment.

One student explained his thinking by saying "While the videos are ok, I like direct instruction and taking notes more." Several student-participants commented on the ability to re-wind, re-watch, and work at their own pace as an advantage to the flipped

classroom. One student-participant wrote she liked the flipped lessons because she "could re-watch, so you fully understand." This piece affected student retention. Because the student-participants were able to watch at their own pace, and re-watch if necessary, students were able to retain the skills learned as evidenced in their journals, surveys, and test scores. Jean Piaget (1952), pioneer of the constructivist approach to learning and teaching, claimed the best way to instruct was to ensure the teacher became a facilitator in the classroom, rather than one who would present information for students to regurgitate. After analyzing the comments, the participant-researcher noted the flipped classroom had created this constructivist environment as evident in the student-participant responses. One student-participant claimed the flipped classroom helped her remember the material because she was able to "play them at home when doing HW."

Additionally, the participant-researcher posed the question in the daily journal "do you feel you learned well when using the videos?" and 22 student-participants claimed they did. One student wrote "I learned ok." The student-participant who claimed she "learned ok" wrote in her journal that "I couldn't ask questions so if I didn't understand at the beginning of lesson I was confused for the rest of the time." These comments underline the progressive approach to learning. The participant-researcher desired to ensure understanding through an avenue of active learning. As evidenced here, the student-participants were not accustomed to the active learning environment, but after some acclimation, were able to learn, as 22 student-participants claimed in their reflection journals.

Theme Two: Student-Participant Resistance to New Pedagogy

The model revolves around the beliefs of active learning as coined by Dewey (2007). Dewey (2007) discusses the idea of new education, progressive education, one in which the lessons "emphasize(s) the freedom of the learner" (p. 22). The "freedom of the learner," as coined by Dewey (2007), is one of the themes uncovered in this study. The student-participants were accustomed to being given all information needed to be successful on tests, so removing direct instruction caused uncertainty and resistance toward the flipped pedagogy. When analyzing the participant-researcher's field notes, a theme was uncovered at the beginning of the implementation. Several student-participants mentioned being uncomfortable with the video lessons claiming they wanted to "just be given the information" rather than having to watch a lesson. Bransford, Brown, and Cocking (2000) state "a 'metacognitive' approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them" (p. 18). Taking control of their learning was an attribute that caused anxiety amongst the student-participants. The fear of not being able to immediately ask questions and having to delve into the content in order to gain understanding was evident in the journals compiled by the participant-researcher for the first couple of days. Student journals also reflected this fear with many student-participants claiming they did not enjoy the flipped lesson for the day because they were unable to get direct feedback from the participant-researcher when working. One student-participant wrote "I couldn't ask questions when I wanted to and I needed more examples."

In addition to the fear of new pedagogy, in the beginning of implementation, several student-participants commented direct instruction is the pedagogy they preferred because they wanted to "just be told what to do." The desire to be given the content so the student-participant could be successful was a hurdle the participant-researcher had to jump. Encouraging the student-participants to continue with the flipped pedagogy was an ongoing task for the first few days of implementation. Several student-participants claimed with flipped pedagogy they "didn't really have extra help." These observations coincide with the metacognition theory pioneered by Piaget. With the flipped classroom, student-participants are required to think on their own. Piaget established a learning environment in which students' thought processes and the ability to express understanding was the key in learning, a concept underlined by this action research plan.

Theme Three: Student-Participant Attitudes Toward Flipped Pedagogy

Another theme weaving through the findings of this action research plan was the student-participant attitudes toward flipped pedagogy. First, the participant-researcher noticed an increase in student-participant engagement when utilizing the flipped classroom pedagogy. The participant-researcher noted an increase in student-participant questioning and the ability to scaffolding student-participant understanding. The student-participants also wrote of their engagement when using the flipped classroom pedagogy. Berger and Trexler (2010) studied the effects of incorporating technology in the classroom and noticed higher student engagement when utilizing technology in the classroom. Additionally, the researchers found technology incorporation created an environment in which students were able to contextualize the content ensuring complete understanding of concepts. One student-participant claimed "I like it because it showed

the work and you could work while watching." Not only were the student-participants engaged in class, but several student-participants claimed the flipped classroom pedagogy encouraged at-home engagement. One student stated "you could get them at home so you can study."

In addition to the increase of engagement, the participant-researcher noticed the student-participants enjoyed the flexibility with self-pacing. Several students commented they enjoyed being able to work at their own pace. One student-participant stated "I could stop it whenever I needed to, or go back when I wanted." Another student-participant claimed "I liked the fact that this would be replayed." Mazur (2007), founder and pioneer of the flipped classroom, noted this feature of the flipped classroom and claimed the flipped classroom would encourage students to apply their knowledge to other activities and concepts. The application and the knowledge are all evidenced in the findings in this action research plan.

These three themes were the findings for the action research study as supported by the quantitative data collection as well as the polyangulation of the survey and journal entries. The effects of the flipped classroom pedagogy on student achievement, the purpose of this action research, is evident in the student understanding findings, the student resistance findings, and the student attitude findings.

Reflective Stance

Mertler (2014) claims reflection is a vital piece to the action research design process. Throughout this entire action research study, the participant-researcher reflected on the design, assessment, and analysis of the action research and findings continuously with herself as well as fellow colleagues. In addition, the participant-researcher reflected

with the student-participants concerning the design of the plan, the flipped pedagogy and the student-participant attitudes toward the new pedagogy.

The participant-researcher reflected on the action research plan with herself first, reflecting on the daily activities of the class as well as her reflection journal completed each day. Secondly, the participant-researcher reflected on the process with the student-participants. The participant-researcher discussed the results of the pretest/posttest with the student-participants, discussing what was successful and what was not successful. Additionally, the participant-researcher reflected on the results with two fellow math teachers/colleagues. The reflection included a discussion of the possibility of implementing the flipped classroom pedagogy in all seventh-grade mathematics classroom for the next school year, 2017-2018. Lastly, the participant-researcher discussed the possibility for in-service training with the district instructional technologist after reflecting on the findings from the action research study.

To begin, the participant-researcher informed all involved of the action research design as well as an overview of that action research plan. First, the participant-researcher wrote letters to District One and Harrison Middle School administration asking permission as well as providing a detailed plan (as detailed in Chapter One) of the action research design process. Second, the participant-researcher described the new pedagogy and design process to student-participants as well as their parents. This interaction took place during schedule pickup, August 2016. Schedule pickup is a time in which parents and students visit the school to pick up the student's schedule for the school year. In addition to picking up the schedule, parents and students are allowed to visit classrooms to meet the teachers and discuss expectations for the class as well as

discuss the classroom environment. Additionally, the participant-researcher reflected on the design process with the student-participants the first day of school before beginning the TIRN unit (August 2016). The student-participants were given a detailed plan including an explanation of the flipped pedagogy, journal expectations, and dates for the implementation of the action research plan.

In addition to the reflections given prior to implementation, reflections occurred throughout the entire action research process. Student-participants were asked to reflect after each lesson. This reflection was completed as a note on their iPad and not only served as an avenue for the student-participants to reflect on their learning, but also was crucial for the participant-researcher. Each flipped lesson was approximately 15 minutes long and the reflection time given was approximately five minutes per class. Because these files were visible to the participant-researcher, the participant-researcher was able to read each reflection and alter the assignments if needed. The assignments were altered if student-participants did not gain knowledge from the flipped pedagogy. Student-participants would work one-on-one with the participant-researcher until the student-participants gained the knowledge needed to be successful on the application problems.

Additionally, the participant-researcher was able to informally analyze the journals in order to polyangulate the finding at the analysis stage of the action research process. The reflection journals were only taken after each daily lesson and student-participants were given approximately five minutes to complete the journal reflections. In addition to the daily reflection journals, the student-participants reflected via survey after the TIRN unit. The student-participants were asked a series of questions based on their attitudes towards the flipped classroom pedagogy (Appendix B). These reflections served

as an important complement to the qualitative data collected in the pretest/posttest and also served as a tool in order to better interpret and polyangulate the data. The journal reflections and the survey data were compiled in an Excel spreadsheet that was stored on the participant-researcher's password protected computer. In addition, pseudonyms (student 1, student 2, etc.) were given to each student-participant to protect their identity.

Because of the district's push for high test scores, the participant-researcher wanted to discover if the flipped classroom pedagogy had a positive or negative effect on student-participant achievement as scored by the pretest/posttest. After the action research plan was complete, the participant-researcher reflected on the analysis of the data in order to answer the research question. Additionally, the participant-researcher spent one class period with the student-participants in order to reflect on the action research design, the findings, and the effectiveness/ineffectiveness of the flipped classroom. The participant-researcher created a PowerPoint presentation of the analysis of the data including an analysis of the pretest/posttest scores, student attitudes toward the flipped model based on the survey answers, and the plan for continuing research. The participant-researcher gained insight from the reflection of the plan for continuing research from the student-participants including suggestions for changes to the action research design. The detailed action research plan is included in Chapter Five.

Interpretation of Results of the Study

Data Interpretation

The data indicated the flipped classroom pedagogy had a positive effect on student understanding of content included in the TIRN unit of study. In all of the other classrooms at Harrison Middle School, teachers are implementing Explicit Direct

Instruction, so the students feel confident in learning this way. In fact, student-participants noted resistance when asked to learn a different way because they have not been given the opportunity to learn any other way. Additionally, the fear that test scores will not improve is a major factor in not changing the direction of teaching at Harrison Middle School. The current district pushes high test scores and discusses the importance of test scores to the point of teachers not wanting to branch out and experiment with new pedagogy. Because of the reasons discussed previously, the flipped classroom pedagogy is groundbreaking.

To determine the effects, the participant-researcher administered a pretest before beginning the flipped classroom pedagogy focusing on skills and content from the TIRN unit and a posttest after finishing the unit. The pretest and posttest contained 53 questions. Quantitative data was collected through the pretest/posttest and triangulated through student-participant journals and surveys as well as reflections and journals by the participant-researcher.

From the findings, three themes emerged: (1) effect on student understanding; (2) student resistance to new pedagogy; and (3) student attitudes toward flipped pedagogy. The 23 student-participants were asked to complete the flipped classroom lessons each day and then journal their thoughts of the lesson and their feelings toward the flipped classroom pedagogy. Additionally, the participant-researcher noted themes as she was monitoring the activities of the class as well as journaling the successes and failures for each day. Richardson and Yard (2014) claim "students who are taught in a way that relies too heavily on rote memorization isolated from meaning have difficulty recognizing and retaining math concepts and generalizations" (para. 3). The flipped classroom depends on

inquiry learning rather than memorization and requires student-participants to learn by way of video.

The views upheld by Piaget (1952) and his idea of the constructivist theory and ensuring the teacher become the facilitator rather than the focus of instruction underlined this action research plan. The findings coincided with the beliefs of Piaget that students would learn best when in an environment in which students were required to think on their own rather than be given all content. Based on the findings from this action research study, the flipped classroom pedagogy did have an impact on student achievement and is evident in the analysis of the findings.

Answering the Research Question

The research question was: *What is the impact of a flipped classroom pedagogical model on seventh-grade students' mathematics achievement?* To answer this question, the participant-researcher followed a quantitative action research design outlined by Mertler (2014). The pretest/posttest quantitative data was gathered along with journals, surveys and reflections by the student-participants and the participant-researcher in an effort to polyangulate the collected data.

As observed by the participant-researcher, traditional pedagogy has failed students in their understanding, but the flipped classroom allowed for student engagement and understanding. Student-participants noted an improvement in engagement when utilizing the flipped classroom pedagogy, with one student claiming "I liked being able to see the work being done, and solve it myself." Khader (2011) asserts "research and anecdotal evidence overwhelmingly support the claim that students learn best when they engage with course material and actively participate in their learning" (p. 75). Although

this statement is true, students at Harrison Middle School are required to memorize factoids and regurgitate the information rather than being given an opportunity to make meaning of the content in a relational way to their own experiences.

The data composed and examined indicated the flipped classroom pedagogy had a positive impact on seventh-grade students' mathematics achievement. The following question emerged from the findings and implications: How did the flipped classroom effect students' achievement from this year (2016-2017) compare to last year (2015-2016)? This key question was reflected upon and discussed in detail with the student-participants as well as taken into consideration when formulating the action plan.

Conclusion

The participant-researcher has concluded that the flipped classroom pedagogy has a positive effect on students' mathematics achievement based on the data gathered in this action research study. The quantitative data was used to answer the research question: *What is the impact of a flipped classroom pedagogical model on seventh-grade students' mathematics achievement?* In addition, in an effort to polyangulate the findings, the participant-researcher conducted a survey and required student-participants to journal their attitudes toward the flipped classroom pedagogy. Three emergent themes were uncovered when analyzing the quantitative data: (1) the effect on student understanding; (2) student-participant resistance to new pedagogy; and (3) student attitudes toward flipped pedagogy. The results presented in Chapter Four are utilized in Chapter Five to create and discuss an action plan.

CHAPTER FIVE: SUMMARY & CONCLUSIONS

Introduction

This action research study was designed to uncover a relationship between the flipped classroom pedagogy and student-participant mathematics achievement. The participant-researcher noticed a lack of in student engagement and retention of mathematics skills. Based on the scholarly literature and theorists such as Piaget (1952), the participant-researcher created an action research plan involving a new pedagogy called the flipped classroom. The problem of student retention pointed to a plethora of scholarly literature suggesting the creation of an active learning environment, similar to the constructivist approach to learning, in order for students to gain a complete understanding of mathematics skills and concepts.

Research Question

What is the impact of a flipped classroom pedagogical model on seventh-grade students' mathematics achievement?

Purpose of the Study

The purpose of this action research study is to determine the effectiveness of the flipped classroom pedagogy on students' mathematics achievement. The study followed 23 seventh-grade students in Anderson, South Carolina. The study focused on student-participant achievement as determined by a pretest/posttest as well as polyangulation of data from journal reflections and survey questionnaires.

Summary of the Study

The participant-researcher conducted a qualitative action research plan gathering data from a pretest/posttest administered before and after the TIRN unit. The seventh-grade mathematics student-participants were asked to complete each lesson and after each instructional day, reflect on their learning. The class makeup included a flipped video lesson, a Socrative assessment, individualized, differentiated groups for enrichment of the content, and a reflective journal. After the TIRN unit, student-participants were administered the posttest as well as a survey to complete regarding their attitudes toward the flipped classroom pedagogy.

The quantitative data showed all students improved their scores from pretest to posttest. Although the quantitative data showed an overwhelming positive response, the participant-researcher desired to polyangulate the data with student-participant journals and answers from the survey (see Appendix B). Based on the analysis of student-participant responses, the participant-researcher determined there exists a relationship between student-participant mathematics achievement and the flipped classroom pedagogy.

Although the student-participants were successful with the pedagogy, the participant-researcher noticed a good deal of resistance to the new pedagogy. Student-participants noted in journals and survey questions the desire to be given all information rather than participate in active learning and inquiry learning. Some student-participants had no desire to practice metacognition rather wanted to have their hands held; becoming independent learners was a big obstacle of this action research study. The participant-

researcher discovered creating a new mindset was crucial in preparing these student-participants for high school and beyond.

The literature concerning independent learners and creating independent learners stems from active learning. Theorists such as Piaget (1952) and Dewey (2007) paved the way for active learning, but in the participant-researcher's school, these practices have been disregarded. In order to provide a solution to the problem of practice, the low retention of mathematics concepts amongst seventh-grade students, the participant-researcher determined active learning was worth researching and created an action research plan to implement active learning in the classroom. Cleary and Zimmerman (2004) conducted research involving middle school students and their motivation to be successful. The two researchers determined in order for students to become independent learners they must first practice active engagement and reflection in the lessons. This action research plan called for student-participants to become active learners in the video lessons and enrichment activities and required student-participants to reflect daily on their learning.

Snow (2010) researched application of language as it relates to the science content. She found that students were able to pronounce words and were fluent when reading, but their comprehension was absent. Snow (2010) determined that in order for students to gain concrete understanding of concepts, they must become independent learners. Creating this learner-centered environment is echoed by Meece (2003). Meece (2003) claims "in the learner-centered framework, students are viewed as active participants in learning and co-constructors of knowledge" (p. 111). This action research

focused on active learning and fostering student independence, a crucial skill for high school and beyond.

Key Question

The key question that emerged from the findings and implications is: how did the flipped classroom effect students' achievement from this year (2016-2017) compared to last year (2015-2016)? Again, in the school year 2015-2016, the participant-research used a direct instruction approach to learning while in the 2016-2017 school year, the flipped classroom pedagogy was implemented. In order to answer this question, the participant-researcher will analyze data gathered from the SC READY standardized test scores from 2015-2016 and 2016-2017 school years. The analyzed scores will be dissected from the TIRN unit specifically and the analysis will take place in the summer of 2017. The analysis is cyclical in answering and addressing the PoP, discovering students who were unsuccessful in retaining and applying rational numbers. The participant-researcher will gather data from the School District One (pseudonym) testing coordinator in order to analyze the findings.

Action Researcher

The participant-researcher is a curriculum leader in the data collection, analysis, and reflection process as the information gathered will be used to guide instruction throughout classrooms in the seventh grade at Harrison Middle School (pseudonym). A hurdle the participant-researcher anticipates is the resistance to change. Often times, when a new idea is presented, it is difficult to elicit participation because of the work required to make the change as well as change itself. Additionally, the participant-

researcher is concerned the other teachers are complacent in their teaching strategies and will not want to participate in the flipped classroom pedagogy.

The participant-researcher's role as an insider/outsider was primarily teacher as the insider and data analysis coordinator as the outsider. The participant-researcher worked alongside the student-participants in conducting the Action Research Study, reflecting on the study and data gathered from the study, and creation of the Action Plan for future research. As an insider, the participant-researcher conducted all the activities of the classroom while implementing the design process.

As an outsider, the participant-researcher acted as a data analysis coordinator, collecting, organizing, analyzing, and interpreting the data as an outside participant. The importance of collecting, organizing, analyzing, and interpreting the data as an outsider is to ensure no bias interweaves into the findings. The data analysis and reflection was achieved as an outsider in order to reflect and analyze with no bias. The findings, presented in Chapter Four, are calculated and interpreted with no bias to indicate a true and accurate definition of the results of this Action Research Study.

Action Plan

The action plan focuses on working with other teachers and district employees in order to implement the flipped classroom throughout School District One. The participant-researcher desires to empower employees with the knowledge of the flipped classroom as well as the data found supporting the need for the flipped classroom pedagogy. In addition, the participant-researcher wishes to reflect on the data in order to create a seamless transition from traditional pedagogy to flipped pedagogy. Before reflecting on the action research design, the participant researcher desires to answer the

question that emerged from the research question: How did the flipped classroom effect students' achievement from this year (2016-2017) compared to last year (2015-2016)? The participant-researcher desires to analyze the data, specifically from the standard strands from the TIRN unit, gathered from the SC READY State standardized test. This reflection will take place during the 2017-2018 school year as test scores come available. Additionally, the participant-researcher will reflect on the findings with the other three seventh-grade math teachers at Harrison Middle School.

After analysis and reflection of the scores, the participant-researcher will present the data along with a complete action plan to the employees from Harrison Middle School. Once the information is shared, the participant-researcher wants to gain insight from the teachers and employees of the school in order to make the action plan effective. The participant-researcher will encourage reflection as the changes are suggested and made. The participant-researcher expects the reflection process and tweaking of the action research plan to take several months, but hopes to implement one flipped unit in the entire seventh-grade by the second semester of the 2017-2018 school year. Again, after implementation, the data will be collected and organized; all four seventh-grade mathematics teachers from Harrison Middle School will reflect on the plan and process.

The cyclical process will provide insight to the successes and failures of the action research design and will provide an opportunity for the four math teachers to reflect on data from all seventh-grade students, as the Action Plan was n=23. The reflection process will include the district instructional technologist in hopes of sharing the findings district wide. In the summer of 2018, the participant-researcher plans to meet with the district instructional technologist to schedule a professional development session

for the other math teachers throughout School District One. The action research plan is directed at creating teachers who are comfortable with implementing the flipped classroom pedagogy and the reflections associated with this implementation.

First, the participant-researcher will reflect on the action plan as a whole as well as the findings. This reflection will begin in July 2017 and will continue through August 2017. Within this reflection, the participant-researcher will gather data from the SC READY State standardized test and analyze the mathematics standards associated with the TIRN lesson to uncover a relationship between those standards and the flipped classroom. This reflection and analysis will be added to the gathered data from this action research plan and the other data gathered from the quantitative pretest/posttest as well as the polyangulation of data gathered from the journals and surveys by student-participants.

Secondly, the participant-researcher will compile all information into a PowerPoint presentation in order to effectively voice the findings from this action research study. The presentation will first be shared at Harrison Middle School amongst the other three mathematics teachers. The participant-researcher desires to create an environment in which teachers feel empowered and knowledgeable of all aspects of the flipped classroom. The presentation will include data gathered from the action research design as well as directions and examples on how to incorporate the flipped classroom. This presentation is scheduled for August or September 2017. Next, the participant-researcher will offer quarterly trainings on the flipped classroom in order to ensure complete understanding of the new pedagogy. The quarterly trainings will allow for a cyclical reflection process as suggested by Mertler (2014) and an environment in which teachers can share struggles and successes they are facing in the classroom. Because the

participant-researcher is only focusing on seventh-grade mathematics teachers, the scheduling should not be a problem, as the teachers at Harrison Middle School have been participating in Professional Learning Communities (planning together to create common assessments and activities). Because of the familiar weekly meetings, the reflection process and presentation of data will fit into the schedule seamlessly; the Professional Learning Communities take place each Tuesday.

In December 2017, the participant-researcher will hold a reflection meeting to which all teachers and the district instructional technologist are invited. The meeting will be held to note successes and failures of the flipped classroom pedagogy. The participant-researcher plans to organize the gathered information and make adjustments as needed to the flipped classroom pedagogy. All adjustments will be made by January 2018 to begin the second semester of school with a finalized action research plan to be implemented in all four seventh-grade mathematics teachers' classrooms at Harrison Middle School. Again, the process will follow the cyclical approach to research design as developed by Mertler (2014) and will follow the reflection process after gathering and analyzing data from the 2017-2018 school year.

In July 2018, the participant-researcher will attend a meeting with the instructional technologist for School District One to discuss the findings of the action research plan. The findings will include those uncovered in this action research plan as well as the changes made and new discoveries by the seventh-grade mathematics teachers at Harrison Middle School. From this presentation, the participant-researcher hopes to be encouraged to continue her trainings to the other middle schools beginning with math classrooms, starting in August 2018. The participant-researcher plans to provide

professional development sessions quarterly made available to all middle-level math teachers in School District One for the year 2018-2019. In addition, the participant-researcher will discuss successes and failures as well as tips and tricks for other teachers as they strive to create an active learning environment by implementing the flipped classroom pedagogy.

Suggestions for Future Research

The participant-researcher desires to delve into the effects of the flipped classroom with at-risk students and will make this a priority beginning in August 2019. The participant-researcher plans to follow the action research plan with a special needs class to uncover the impact of the flipped classroom pedagogical model on seventh-grade special needs students' mathematics achievement. Following the same cyclical plan as suggested by Mertler (2014), the participant-researcher will complete this action research plan with students below grade level to determine if the flipped classroom will have an effect on the students' learning in mathematics.

Additionally, the participant-researcher plans to complete the action research design with other content areas to determine if the pedagogical approach is appropriate for other class contents. The participant-researcher will begin with seventh-grade students from Harrison Middle School in August 2019 and gradually implement the flipped pedagogy to all middle school students at Harrison Middle School.

The key question that arose from this action research was: How did the flipped classroom effect student achievement from this year (2016-2017) compared to last year (2015-2016), but the participant-researcher desires to follow the student-participants through high school, to determine if the skills learned during the flipped classroom

pedagogy were learned behaviors or if the students quickly forgot the skills. This further research is crucial as the problem of practice is the retention of skills and creating students who cannot learn on their own. Further research will be gathered determining the effectiveness of the skills learned from the student-participants.

Educational Change

Because the PoP focuses on the inability to retain mathematics concepts within the current pedagogy, the participant-researcher desires to facilitate educational change amongst the seventh-grade classrooms at Harrison Middle School. The goals of this change include an enhanced ability to learn in the mathematics classroom, increasing the role of the teacher as facilitator in the classroom, and overall improvement on standardized test scores. As mentioned before, this change is sure to bring about resistance, but, in the hopes of mentoring teachers and providing training directed toward the flipped classroom pedagogy, the resistance is expected to be low.

On the first day of the mentoring session, the participant-researcher will question the pros and cons of the flipped classroom. Because of the push of higher test scores from the state, district, parents, and federal government, a change in pedagogy is uncharted territory; the participant-researcher expects resistance when introducing the flipped classroom pedagogy as well as during implementation. When discussing new pedagogy with other teachers, the participant-researcher notices most teachers have the mentality of "if it's not broke, don't fix it." This action research plan challenges the norm and requires students to become active learners.

Utilizing the teacher as a facilitator is a new concept most teachers are unsure because of the unknown effects on students' test scores. This action research clearly

details the findings of improved test scores when implementing a flipped classroom pedagogy. Drawing on the teachings of Piaget (1952), Vygosky (1978), and Dewey (2007), this action research changes the thought of education requiring students to become active learners and using the teacher as a resource rather than a source of all information. As stated previously, requiring students to think about their own thinking will not only impact their achievement, but will also prepare the students for college and beyond.

Conclusion

The purpose of this action research study was to determine the impact of the flipped classroom on students' mathematical achievement. The action research design took place in the upstate of South Carolina at Harrison Middle School in School District One. The participant-researcher desired to complete this study due to an observation of students' low retention of mathematics skills as well as an observation of a passive learning environment. After much research and analysis of educational theorists, the participant-researcher determined to implement the flipped classroom pedagogy in order to answer the research question: What is the impact of the flipped classroom pedagogical model on seventh-grade students' mathematics achievement?

The participant-researcher conducted a quantitative research design in which data was collected from a pretest/posttest as well as polyangulating the data by means of reflective journal entries by the student-participants and the participant-researcher and survey questionnaires. The analyzed data uncovered an impact on students' mathematics achievement in that all student-participants increased their score from pretest to posttest.

Although the student-participants were resistant to the change of instruction, the data showed a positive impact.

Because of this relationship, the participant-researcher determined to create an action plan which includes implementing the flipped classroom pedagogy throughout all seventh-grade mathematics classrooms by the school year 2018-2019. In order to successfully incorporate a fully implemented pedagogy, the participant-researcher must empower teachers in their knowledge and ability to teach utilizing the flipped classroom pedagogy. The participant-researcher plans to hold weekly training sessions through established Professional Learning Community meetings as well as quarterly reflection meetings to create a cyclical process in the action research design. Further research will focus on an implementation in the special needs classrooms as well as following up with student-participants from 2019-2020.

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APPENDIX A-PRETEST AND POSTTEST

Chapters 3-4 Pretest – Integers and Rational Numbers

Write an integer for each situation.

1. 5°C below 0

2. a loss of 15 yards

Solve each expression.

3. $|4| + |-6|$ 3.

4. $|-8| - |-3|$ 4.

5. The upper atmosphere of Neptune can get as cold as –218°C. The inner core of the planet can be as hot as 7,000°C. What is the difference between the two temperature extremes?

Solve each expression.

6. –11 – (–3)

7. –25 + (–12)

8. -8 – 6

9. -15 + 8

10. Jenny said that 4 – 7 would equal 3, and that 11 – 18 would equal 7.

She made the same mistake in both problems. What was the mistake?

11. Which of the following statements about these real world situations is not true?

A. A $100 check deposited in a bank can be represented by +100

B. A loss of 15 yards in a football game can be represented by – 15

C. A temperature of 20 below zero can be represented by – 20

D. A submarine diving 300 feet under water can be represented by +300

Write an equation to represent the situation and solve.

12. The sum of two integers is -44. One integer is 15, what must the other integer be?

13. At 8 A.M., the temperature was 13ºF below zero. By 1 P.M., the temperature rose 22ºF and by 6 P.M. dropped 14º F. What was the temperature at 6 P.M.?

Evaluate each expression if x = –4 and z = –3.

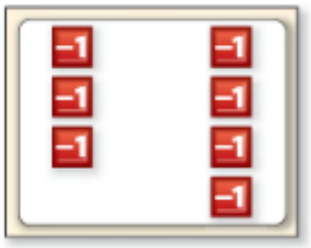
14. 20 - x

15. 7 + z

Write the expression that is modeled and then find the sum.

16.

17.



Tell whether the following expressions will be positive or negative.

18. -192 ÷ 12 _____ 19. (-6)(1)(-9)(5) _____

Solve the following equations.

20. -3 x 4 = _____ 21. -2 x -6 = _____

22. (-20) ÷ (-5) = _____ 23. 40 ÷ (-8) = _____

Solve each expressions if x = -4 and y = -3

24. 20 ÷ x = _____ 25. -2(3y) = _____

Write an equation to represent the situation and then solve.

26. Suppose the temperature is dropping 2 degrees each hour.

How much will the temperature change in 9 hours?

27. The enrollment at Wren Middle has dropped by 64 students _____

over a 4-year period. What is the average yearly change in enrollment?

Write an expression and solve.

28. The sum of two integers is -12. One integer is 3. _____

What does the other integer have to be?

29. At 8 A.M., the temperature was 13°F below zero. _____

By 1 P.M., the temperature rose 17° F and by 6 P.M.

dropped 11° F. What was the temperature at 6P.M.?

30. The number of yards a football team moves _____

on the field can be represented using

the expression | 6 |+ | -2 |.

How many yards does the football team move?

31. Which of the following statements _____

about these real-world situations is not true?

A. A $100 check deposited in a bank can be represented by +100

B. A loss of 15 yards in a football game can be represented by -15.

C. A temperature of 20 below zero can be represented by -20.

D. A submarine diving 300 feet under water can be represented by +300.

Write each fraction or mixed number as a decimal. Use bar notation if the decimal is a repeating decimal.

32. $\frac{2}{3}$ 32. _____

33. $-2\frac{3}{4}$ 33. _____

Write each decimal as a fraction or mixed number in simplest form.

34. −0.2 34. _____

35. 68.25 35. _____

Compare each set if fractions with <, >, or = to make a true sentence.

36. $\frac{4}{5}$ __ $\frac{9}{10}$ 36. _____

37. $-\frac{10}{15}$ _____ $-\frac{5}{14}$ 37. _____

38. BASEBALL The pitchers for the home team had 12 strikeouts for 32 batters, while the pitchers for the visiting team had 15 strikeouts for 35 batters. Which pitching team had a greater fraction of strikeouts?

Add or subtract. Write in simplest form.

39. $-\frac{2}{3}+\frac{4}{9}$ 39. _____

40. $2+7\frac{11}{12}$ 40. _____

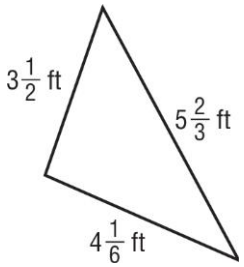
41. $-\frac{3}{5}-\frac{1}{5}$ 41. _____

42. $3\frac{4}{5}-2\frac{1}{3}$ 42. _____

43. Jacob spent $3\frac{3}{4}$ hours on homework yesterday while Courtney spent $2\frac{1}{4}$ hours on homework. How much more time did Jacob spend on homework than Courtney?

44. Tom practiced piano $1\frac{1}{3}$ hours on Monday and $\frac{5}{6}$ hour on Tuesday. How much did he practice in all those two days?

45. Find the perimeter of the figure.



Multiply. Show all work!

46. $-\frac{1}{7} \times \frac{1}{5}$

47. $\frac{3}{8} \times \left(-\frac{2}{7}\right)$

48. $5\frac{1}{4} \times \left(-4\frac{2}{3}\right)$

49. HIKING A hiker averages $6\frac{3}{8}$ kilometers per hour. If he hikes for $5\frac{1}{3}$ hours, how many kilometers does he hike?

Divide. Show all work!

50. $5 \div \frac{3}{5}$

51. $-\frac{7}{8} \div \frac{5}{6}$

52. $-3\frac{4}{9} \div \left(-2\frac{1}{3}\right)$

53. Mrs. Lau rolls out 33 inches of dough to make noodles. If the noodles are $\frac{3}{8}$ of an inch wide, how many noodles will she make?

APPENDIX B-SURVEY

Please provide honest answers to the following open-ended questions. Reflect on your learning during the integer unit.

1. What did you think about the video lessons for integers?

2. Did you like the videos better than direct instruction by your teacher?

3. Do you feel you learned well when using the videos?

4. Did you like being able to work at your own pace during class while using the videos?

Please provide honest answers to the following open-ended questions. Reflect on your learning during the rational numbers unit.

1. What did you think about the video lessons for rational numbers?

2. Did you like the videos better than direct instruction by your teacher?

3. Do you feel you learned well when using the videos?

4. Did you like being able to work at your own pace during class while using the videos?

APPENDIX C-DISTRICT APPROVAL

Anderson School District One
P.O. Box 99
Williamston, SC 29697

Mr. David C. Havird, Superintendent
Telephone: 864-847-7344/864-235-8768
Fax: 864-847-3543
asd1.schoolwires.com

March 2, 2016

To Whom It May Concern,

I give approval and support to Cassandra Leo to pursue her research in the Ed.D program through USC. This research will provide helpful information to Anderson School District One with our one to one digital initiative.

Sincerely,

Jane Harrison

Assistant Superintendent

A Tradition of Excellence

APPENDIX D-SCHOOL APPROVAL

WREN MIDDLE SCHOOL
1010 Wren School Road
Piedmont, SC 29673
Telephone: (864)850-5930
Fax: (864)850-5941
http://www.anderson1.k12.sc.us/schools/wrms

March 2, 2016

Dear Committee,

Cassondra Leo, seventh grade math teacher at Wren Middle School, has permission to complete her action research project in accordance to the Ed.D. in Curriculum and Instruction degree program. I give my permission for Mrs. Leo to complete this research and to distribute any permission forms that may be needed to complete this study.

Sincerely,

Robin R. Fulbright
Principal

RRF/drgi

APPENDIX E-IRB

APPROVAL

OFFICE OF RESEARCH COMPLIANCE

INSTITUTIONAL REVIEW BOARD FOR HUMAN RESEARCH
APPROVAL LETTER for EXEMPT REVIEW

This is to certify that the research proposal: **Pro00057730**

Title: *Action Research: How Will the Impact of a Flipped Classroom Type Style Instruction Impact Students' Mathematics Achievement*

Submitted by:
Principal Investigator: Cassondra Leo
College of Education
Instruction & Teacher Education / Curriculum Studies
Wardlaw
Columbia, SC 29208

was reviewed in accordance with 45 CFR 46.101(b)(**1**), the referenced study received an exemption from Human Research Subject Regulations on **7/26/2016.** No further action or Institutional Review Board (IRB) oversight is required, as long as the project remains the same. However, the Principal Investigator must inform the Office of Research Compliance of any changes in procedures involving human subjects. Changes to the current research protocol could result in a reclassification of the study and further review by the IRB.

Because this project was determined to be exempt from further IRB oversight, consent document(s), if applicable, are not stamped with an expiration date.

Research related records should be retained for a minimum of three (3) years after termination of the study.

The Office of Research Compliance is an administrative office that supports the University of South Carolina Institutional Review Board (USC IRB). If you have questions, contact Arlene McWhorter at arlenem@sc.edu or (803) 777-7095.

Sincerely,

Lisa M. Johnson
IRB Manager