THE FLIPPED CLASSROOM: AN EXAMINATION OF VETERAN TEACHERS' PRACTICES WHEN FLIPPING THEIR CLASSROOMS FOR THE FIRST TIME

A Record of Study

by

JULIE ELAINE MERRILL

Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

Chair of Committee,	Yeping Li
Co-Chair of Committee,	Mario Torres
Committee Members,	Robin Rackley
	Dennie Smith
Head of Department,	Yeping Li

May 2015

Major Subject: Curriculum and Instruction

ABSTRACT

Advances in instructional practices have not kept up with the changing educational needs of today's learners. Ubiquitous technologies permeate students' lives and as such, the traditional classroom is at odds with the needs of digital learners. This research used a case study approach to investigate teacher practices in the flipped classroom. The flipped classroom is a pedagogical model that utilizes technologies to move the lecture outside of the classroom, thereby freeing up class time to allow for practice, collaboration, and extension in a student-centered learning environment. The intent of this record of study was to examine veteran teachers' practices and perceptions when flipping their classes for the first time, and to try to determine the factors that contribute to effective implementation of the model. The findings suggest that teachers perceive that a student-centered learning environment, in which the focus is on learning as opposed to the delivery of instruction, resulted in an increase in student engagement and understanding. Recommendations for further research include examining the model across subject lines and investigating how teachers adjust their practices as they continue with the model in subsequent years.

DEDICATION

Dedicated to my husband Mark

ACKNOWLEDGEMENTS

I first wish to thank my dissertation committee. Thanks to Dr. Yeping Li who freely gave his support and advice. Dr. Li maintained communication and encouragement when I was having difficulties. I was able to complete this research in large measure because of his steady encouragement. Dr. Mario Torres has provided valuable insight through his questions and attention to detail. Dr. Dennie Smith and Dr. Robin Rackley have shared their expertise and given encouragement and feedback over the last years. Thank you all.

I would also like to thank my very first teachers, my parents, Bob and Cindy Stamps. Mom and Dad, without your love, support, and encouragement, this would have never happened. The way you live your lives is a strong testament to the power of education.

Lastly, I would like to thank my children who inspire me to do better—to be more than I am. Their love is unconditional. My granddaughter, Zoey, shows me the love of learning every day and I am so very grateful.

Mostly importantly, I would like to thank my husband, Mark, whose love, encouragement, and inspiration are never-ending. The sacrifices you have made in supporting me to pursue this dream are quite humbling. I could have never done this without you.

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

CHAPTER I

INTRODUCTION

Statement of the Problem

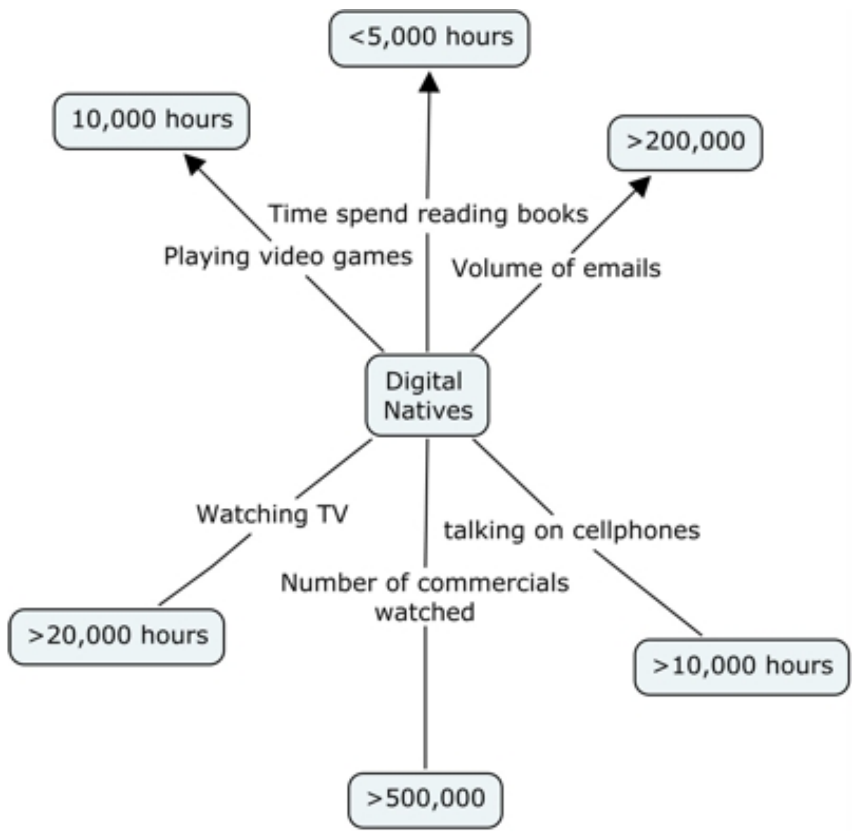
Walking through the halls in a typical high school reveals that instruction has changed little over the past century. In many high school classrooms, teachers stand at the front of the room lecturing while students feverishly scribble down what is being said. Schooling, in both the physical structure and the time-resistant practices, has not progressed into modern times.

Our current educational model dates back to the time in which it was designed: the Industrial Age. During that time, teachers held the key to information and students were looked upon as empty receptacles waiting to be filled with the teacher's knowledge.

However, the needs of today's learners appear insufficiently met by today's educational system (Prensky, 2001, Part 1). Knowing this, it makes little sense for our traditional learning practices to continue when those practices are at odds with the technologies that are altering how people learn (Privateer, 1999). Today's youth do not know what it is like to grow up without Google, iPhones, YouTube, and Facebook. Prensky (2001, Part 1) refers to individuals born into this modern era as "Digital Natives" and stated that these Digital Natives graduate from college having spent 10,000 hours playing video games, 20,000 hours watching TV and that "computer games, email, the Internet, cell phones and instant messaging are integral parts of their lives" (p. 1).

Churches (2012) agrees stating that today's students are shaped by a media-rich environment that is fast, engaging, and immediate. His depiction of the time spent in this environment is shown in Figure 1.

Figure 1. Time Spent With Digital Media



Visual depiction of Digital Natives' Time Spent with Digital Media. Adapted from 21st Century Learning by A. Churches, 2012. Retrieved from http://edorigami.wikispaces.com/21st+Century+Learners. Reprinted with permission.

Today's world is based on instantaneous access to information and knowledge and this Knowledge Age in which we live, is information-driven and globally networked. With this connectivity, Knowledge Age work requires a new mix of skills. In many businesses, jobs that require manual labor and routine thinking skills are eroding into automation, and jobs that involve higher levels of knowledge and applied skills are becoming commonplace. Yet, arguably, the educational structure and practices lag behind in preparing students for the complex world where science, technology, and mathematics are critical components.

There are many dependent learners in our high schools, especially in the fields of mathematics and science. Teachers sometimes struggle to help students make meaning of the content and with the sheer amount of content there is to teach, many find it difficult to find the time to let students explore concepts and learn from mistakes. Because of this, teachers often rely on an information-delivery approach when educating students. In many traditional high school classes, the teacher provides instruction and that instruction is followed by guided practice. After the guided practice, independent or group practice is typical and homework is assigned. Class begins the next day by going over the homework followed by the endless cycle of those same repeated procedures. Inquiry-based learning is put on hold because of the time allotted to checking homework and providing instruction. This time crunch often means experiments, problem-solving activities, or collaborative learning experiences may not be conducted on a regular basis (Trilling & Fadel, 2009).

Research has revealed that students learn best in student-centered environments that thrive on real projects, real problems, and complex discussions (Bransford, Brown, & Cocking, 2000). Those real problems are the messy, ill-structured problems we face in everyday life; yet in a 47-minute class period, there is little time for delving into those rich problems after instruction has been delivered. According to Trilling and Fadel (2009), the three most common teaching practices are filling out worksheets, having students work individually on tasks, and working on tests. These practices leave little time for deep exploration and the opportunity to interact with content.

Recent literature indicates that knowledge is not gained through memorization of facts and figures, but is constructed through inquiry and application and is connected to previous knowledge and personal experiences (Bransford et al., 2000). Educators all know that students walk through the classroom door with varying abilities, backgrounds, and learning experiences. Those teachers that successfully access students' previous experiences are able to provide rich learning opportunities for students to foster their desire for continued learning. Connecting to personal experiences and knowledge, however, requires some individualization.

Teachers are taught that differentiated instruction is necessary in order to access previous knowledge, but putting that instructional piece into action can be problematic. Realistically speaking, when there are 30 (or more) students in a classroom, most teachers find it nearly impossible to truly meet the needs of individual students. Personalization is overwhelming and often times educators end up taking a shot gun approach to teaching—teach as much content in the time allotted and hope that it sticks with as many students as possible (Bergmann & Sams, 2012). In order to be successful and walk away with real understanding, though, students need to be able to interact with the teacher and with each other in meaningful ways that helps them construct their own knowledge. That takes time and in a typical American high school classroom, there is little time for cooperative investigations that engross students in their own learning (Trilling & Fadel, 2009).

With constant press reports on the need for education reform, it seems obvious that our public education system needs to change to support present-day learners. Students of today have the ability to retrieve information faster than in previous generations (November, 2010) and they are demanding a change in education. Generally speaking though, teachers have not been trained in alternative methods of instruction, so a pedagogical shift into unknown territory is a big commitment. However, forward-thinking teachers who realize a need for change are experimenting with new methodologies.

Flipping the classroom is a major pedagogical development that is showing promise in reaching many diverse learners in the classroom. By embracing the use of technology, more class time becomes available and teachers are able to individualize instruction. Teachers are able to interact with every student, in every class, every day (Bergmann & Sams, 2012).

Significance of the Problem

Math and science achievement is of great concern to all stakeholders: administrators, educators, parents, students, and policy makers. These stakeholders know that education in the areas of math and science has been on the forefront of education reform since the Soviet Union launched Sputnik in 1957 (Bybee, 1997). The launch of Sputnik threatened America's superiority and called attention to low-level math and science instruction in public schools, resulting in failure to produce enough scientists and high-level technicians as the reason the United States lagged behind the Soviet Union in the arms race (Pinar, 2004). Klein (2003) states that the quality of math and science education has been deteriorating since the 1980's and cites the continuing publicity about the United States lagging behind other countries in test scores. High achievement in math and science became a national priority and has been a target for education reform ever since. Since mathematics is usually the nemesis that *makes or breaks* a school (based on state testing which is tied to federal funding), the stakes could not be higher.

Numbers indicate that more high school students are enrolling in math and science classes and pursuing online learning opportunities (Armario, 2012). At the same time, once students reach academia, more students are dropping out of math and science majors (Safdar, 2013). Musallam (2010) states that chemistry is a difficult subject to learn and that "the simultaneous conceptual and algorithmic thinking required further intensified the complex problem solving and critical reasoning skills needed for success" (p. 13). That statement applies to more than just chemistry as complex problem solving and critical reasoning are skills that are needed in many technical courses. These are the skills that are also needed outside the school walls.

Mathematics curriculums in many countries emphasize the importance of problem-solving and conceptual understanding (Hiebert & Grouws, 2007). Rich tasks that place differing cognitive demands on students help develop higher order thinking skills and encourage life-long learning. Creating a classroom atmosphere in which children have the opportunity to formulate and solve problems by engaging in dynamic activities helps foster critical thinking skills. Unfortunately, in the United States, problem solving usually means doing word problems and those problems have often been stripped of conceptual understanding (Richland, Stigler, & Holyoak, 2012). High-level tasks can be perceived as being too complex both by students and teachers and, as a result, teachers sometimes reduce the complexity of a task to alleviate students' anxiety. When this is done, the teacher plays into the students' learned helplessness and the cognitive demands of the task are weakened. The task then becomes a more predictable, mechanical form of thinking as it has been reduced to a series of procedures to be performed (Richland, Stigler, & Holyoak, 2012). These problems do not encourage learning in depth with the ability to transfer knowledge to novel situations.

These mechanical types of activities regularly result in frustration on the part of the student since the thinking processes needed to be successful in these activities often have not yet been taught. As a result, *word problems* will continue to be problematic for many of today's learners.

Regrettably, many students tend to view mathematics as a rigid subject based on arbitrary rules and procedures that allow for only one correct answer (Kramarski & Mevarech, 2003). Part of the reason for this view is that mathematics, as well as those science classes that utilize mathematical algorithms, is often taught as a fact-based discipline instead of an expression of ideas. Teachers who teach these subjects in the same way in which they were taught, using the Industrial Age Model, have not yet realized that it is counterproductive to memorize isolated facts that may be eventually displaced through new knowledge and technologies.

Typical mathematics and science classrooms in the United States have a set curriculum to cover, and many times covering this curriculum becomes the focus of instruction. Getting through the curriculum results in superficial understanding; hence the expression “a mile wide and an inch deep”. Many high school courses also tend to be a collection of unrelated topics with no strategies for forming relationships (Pea, 1987) and because of this, college students are often not prepared for the rigors of independent thinking that is required to be successful in a new arena.

In secondary schools, our mathematics courses are focused on memorization rather than reasoning and American culture does not visibly and aggressively support mathematical genius (Jacobs, 2010, pgs. 7-17). Yet mathematical numeracy is more crucial today than ever before. Jerald (2009) defines numeracy as being able to understand quantitative information and to apply mathematics to solve challenging real-world problems. Students must be able to master basic skills and then learn the *meaning* of the calculations in a life-related context (Hazel, 2005). Those who cannot make sense of numbers in their daily lives are at an increased risk in today’s world.

Lacing economics, statistics, global awareness, and scientific thought throughout our high school classes is more important than ever. With the interconnectedness of the global economy, it is imperative that we infuse learning with problem solving opportunities (Jacobs, 2010, pgs. 30-59). With the current trends in health care and personal finance, individuals are forced to shoulder more risk and responsibility for their own wellbeing. People are encountering more numerical information than ever before and recent research has found that substandard numeracy results in poorer decisions about health issues and puts people at greater risk for financial planning (Jerald, 2009).

According to the Partnership for 21st Century Skills (2008), an interdisciplinary approach to core subjects is essential and within that context, skills such as critical thinking, problem solving of complex open-ended problems, creativity and entrepreneurial thinking, and communicating and collaborating are essential in our increasingly complex world.   Since many subjects (and topics within a single course) are taught in isolation, there is no way to prepare students to be problem solvers if they are not provided with authentic tasks that transcend typical subject and chapter boundaries.   Teaching thinking and reasoning skills is no longer optional. These are the skills that help develop numeracy. They are essential to learning and successfully navigating through our world.

With the rising costs of higher education and the explosion in distance learning, traditional classrooms may be in danger of becoming obsolete. Nagel (2011) reports that online class enrollment is expected to increase by 11.8% in the five-year period between 2010 and 2015. One of the reasons for this increase is because of more affordable technological devices that have resulted in an unlimited availability to the world's information. Since information is no longer a slave to economic boundaries, the Internet has leveled the informational playing field and various technologies are offering a very appealing alternative to traditional education. Distance-learning universities are now commonplace and online charter schools are beginning to make their way into the world of secondary education (Davis, 2011). Instead of ignoring or banning the use of technology, educators in all school districts need to seek out and find ways to incorporate its use in class.

In a traditional lecture, students often try to capture what is being said at the moment the teacher says it. They cannot stop to reflect upon what is being said, and they may miss important points because they are trying to record the instructor's words. Trying to record notes in real time does not allow for reflection and students do not often get to internalize and make sense of what is happening in the classroom. In contrast, the use of video and other prerecorded media puts lectures under the control of the students: they can watch, rewind, and fast-forward as needed. Video also allows students the luxury of learning when it is convenient for them; when they are ready to learn.

Learning is not about plugging information into a predetermined algorithm to produce an answer. Learning is about ideas and making connections. Without lecture in the classroom, more class time can be devoted to application of concepts giving learners more opportunities to interact and make meaning of their work. By providing the time and structure to make connections in the classroom, students may have a greater chance of being successful once they leave high school.

Collaborative learning can encourage social interaction among students, making it easier for them to learn from and help each other. The absence of lecture also frees the instructor to work more closely with students and provides a better opportunity to identify and address any misconceptions in thinking, particularly those that may be widespread in a class.

Vander Ark (2013) states, "In an increasingly competitive world, our schools must move into high-performance mode, and leverage technology to advance education—just as we have used it to advance business" (p. 2). Students need to be able to solve complex problems across subject lines in order to prepare for real, multifaceted problems that exist outside the classroom walls. As various technologies continue to become immersed into our everyday lives, educators are slowly embracing its value in teaching and learning. Some teachers are beginning to realize that legacy practices, no matter how successful they may have been in the past, are no longer working. Different kinds of learners require different teaching methods. This flipped classroom allows for more individualized learning, helps foster social skills through collaborative interactions, and immerses technology into the educational arena.

Purpose of the Study

The purpose of this study is to examine four veteran high school math and science teachers' practices when flipping their classes for the first time. One of the practices being examined is lesson preparation since preparing for a flipped lesson is different from the way teachers typically prepare for and plan a traditional lesson. Another aspect of equal importance is to examine teachers' classroom behaviors and practices to observe what actually happens during class time and to try to determine the factors that contribute to effective implementation.

Organization of the Study

This study is organized into chapters. Chapter I introduces the problem and its significance. Chapter I also presents the researcher's experience and interests and includes the history and background of the flipped classroom. Chapter II is a review of the literature. This chapter incorporates the literature on learning, includes a review of the limited research on the flipped classroom, and discusses the theoretical framework that is built on the basic tenets of the student-centered classroom. The chapter concludes with a discussion of some of the criticisms of the model and how proponents address those concerns. The third chapter details the methodology and describes the rationale for a qualitative case study, a description of the setting and participants, the research questions, data collection and instruments, and data analysis. Chapter IV examines the research findings and Chapter V is a discussion of the considerations for practice, the limitations of the study, the implications for education, and the conclusion.

Research Questions and Methodology

This study is designed to answer the following questions:

1. How is the flipped classroom structured?
2. How do teachers perceive student learning in the flipped classroom?
3. How do teachers perceive their roles and their students' roles in the flipped classroom?
4. What are the factors that contribute to effective/ineffective implementation?

A qualitative case study method approach was used to investigate the research questions. Data were collected through classroom observations, teacher surveys, and teacher interviews.

Researcher's Background and Interest

Education has long been part of my family's history. My grandparents and parents were all educators. I am an educator. I am certified by the State of Texas to teach grades 6-12 in the following areas: English, English Language Arts, Chemistry, and Mathematics. I also hold an EC-12 Principal's Certificate. Despite having numerous certifications, I have spent my entire career teaching mathematics. My love and my passion reside in the teaching and learning of mathematics.

In the early years of my career, I taught middle school mathematics to 7th and 8th graders. Teaching in middle school has its own set of challenges, one of which is the age of the students. I quickly learned that adolescents have a hard time sitting still and needed to be actively involved in class. I endeavored to make my classes very active with stations and used manipulatives on a regular basis. The challenges of making learning rigorous, interesting, and active, formed a lot of my opinions about teaching.

After five years of teaching middle school, I moved to a brand new high school in the same district. Over the course of 12 years in teaching high school, I taught multiple math courses at various levels to well over a thousand students.

During the time I was a high school teacher, I completed my Master's Degree in mathematics at Texas A&M. I was in the first cohort of the online Master's program in

Mathematics and graduated in 2005. After completing my degree, I added a second job to my full-time schedule. I began teaching math classes at one of the local junior colleges. I taught at Collin College for three years, but had to give up that part-time job when I started working on my doctorate.

I took my job as a math instructor very seriously. I was very well aware that what I did in the classroom affected my students' futures and how they felt about and related to mathematics. I was always aware that I was in a position to touch the future.

After 17 years of teaching, a job opportunity came along and I left the classroom. I took a job as the High School Math Instructional Specialist in a different district. In my new role, I worked with teachers to improve instruction, thereby still affecting future mathematicians, just in a different capacity. I served in that capacity for four years before accepting a position as the Secondary Math Coordinator in a large suburban district.

In the fall of 2013, I took a second job teaching a Curriculum and Instruction class to pre-service secondary math teachers at the University of Texas at Dallas. I am back in the classroom and am thrilled to be sharing my knowledge and classroom experience with people that want to teach mathematics. Once again, I find myself in a position to affect the future of mathematics.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Both qualitative and quantitative research on the flipped classroom is very limited. Currently, there is no direct scientific research that establishes whether or not the flipped classroom model increases student learning (Goodwin & Miller, 2013). Bishop & Verleger (2013) note that one possible reason for the limited amount of scholarly research may be that there is no single definition of the flipped classroom. The implementation of the model varies with every user. Even though there is little empirical research on the flipped classroom model, there is some anecdotal evidence that generally consists of teacher reports and results of student interest surveys. K-12 studies are especially weak since the majority of the research that has been conducted has been in the realm of higher education.

Despite the fact that little research is available on the flipped classroom itself, there is a great deal of research that supports the key elements of the model with respect to instructional strategies that engage learners in their education (Hamdan, McKnight, K., McKnight, P., & Arfstrom, 2013). A fundamental feature of this model is the opportunity to increase active learning opportunities during class since more time is available. According to Prince (2004), there is a significant body of research that supports the effectiveness of the active learning strategies in increasing student engagement and achievement.

This chapter will present the definition and history of the flipped classroom and describe its key elements. I will explore the theoretical underpinnings of this model and move to examine the literature on learning. I will briefly review the research on learning and learning with technology and then explore some literature on today's teachers and learners. Active learning and the flipped classroom will be discussed before presenting some of the limited research that is available on the flipped classroom model in the K-12 setting. Finally, the chapter will conclude with criticisms of the model and how proponents answer those criticisms.

The Flipped Classroom Defined

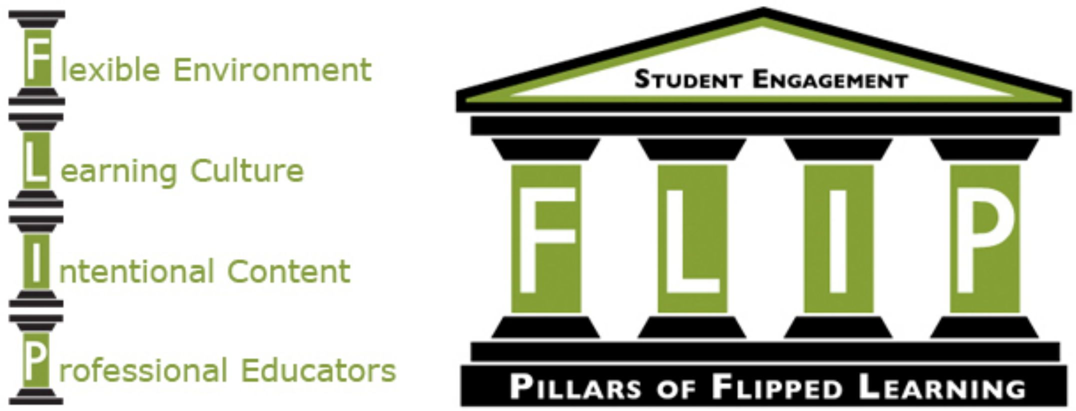
The flipped classroom is a pedagogical model in which classwork and homework are reversed. There is, however, no single model to describe the flipped classroom as the approach varies from teacher-to-teacher and from campus-to-campus. The common element, though, is that instruction delivery takes place outside of the classroom, most often via video. There are multiple ways to convey information to students using video. Teachers can record and narrate screencasts, create videos of themselves teaching, or use videos obtained from Internet resources.

Just as there is no set way to deliver instruction, there is also no set way to structure the sequence. Teachers may use a homework video to introduce a concept or a skill and use class time the next day to practice the newly acquired skills or extend the learning associated with the concept. In contrast, teachers might introduce an exploratory or discovery activity in class and use the homework video to more fully explain the topic or concept.

Some teachers may not use video instruction every day or may not use it at all. Homework instruction not delivered via video may be provided through readings from textbooks, articles found on the Internet, or web-based interactive applets. When video is used part of the time, but not exclusively, this is known as a blended approach. Teachers may use a blended approach when they feel that direct instruction in a face-to-face environment is preferable for difficult topics. In this study, though, all of the teachers flipped their classroom as a true reversal of homework and class work. Homework was assigned as asynchronous, video-based individual instruction and class time was used for working on problems and collaborative learning activities.

While a single definition of the flipped classroom is difficult, educators from Pearson and The Flipped Learning Network (2013) have recently defined the pillars of flipped learning. The pillars, as depicted in Figure 2, represent the unifying themes of the flipped learning experience.

Figure 2. The Four Pillars of Flipped Learning



Visual depiction of The Four Pillars of Flipped Learning showing support for student engagement. Copyright 2014 by The Flipped Learning Network. Reprinted with permission.

The first pillar describes flexible learning environments. Educators often re-arrange their classrooms in order for them to be more conducive to collaboration. The second pillar, Learning Culture, describes a shift from students being the recipient of teaching to the "center of learning" (Hamdan, et al., 2013, p. 3). Intentional Content is the third pillar and describes instructional decisions that must be made by the teacher. Those decisions include what content to teach via video, and the learning experiences will support student success. The last pillar, Professional Educators, describes the importance of the role of the teacher in the flipped classroom, even though their role is "less visibly prominent" (Hamdan, et al., 2013, p. 4).

Theoretical Basis

Bransford et al. (2000) report three key findings about the science of learning:

> To develop competence in an area of inquiry, students must: a) have a deep foundation of factual knowledge, b) understand facts and ideas in the context of a conceptual framework, and c) organize knowledge in ways that facilitate retrieval and application (p. 16).

These findings relate to the underlying concepts behind the flipped classroom. By providing students with the opportunity to use their newly acquired factual knowledge in a classroom setting where they have access to immediate feedback from peers and the instructor, this model helps students learn to organize their new knowledge in such a way that it is more accessible for future use (Brame, 2014).

The theoretical basis used for validating the flipped classroom stems from a substantial body of literature focusing on student-centered learning. Constructivism is considered the foundation for the theories on student-centered instructional strategies, some of which include active learning, cooperative learning, and problem-based learning (Prince, 2004; Grabinger & Dunlap, 1995). Foot and Howe (1998) connect constructivism and cooperative learning to peer-assisted learning. Peer-assisted learning is defined by Topping and Ehly (1998) as, "the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions" (p.1). Foot and Howe (1998) describe cooperative learning as a team effort that includes individual responsibility.

Active learning is portrayed as students being engaged in the learning process by reading, writing, discussing or solving problems (Prince, 2004; Bonwell & Eison, 1991). Thus, active learning encompasses both peer-assisted and problem-based learning approaches. Prince (2004) explains the relationship between these two, indicating that problem-based learning is, “always active and usually (but not necessarily) collaborative or cooperative” (p. 1).

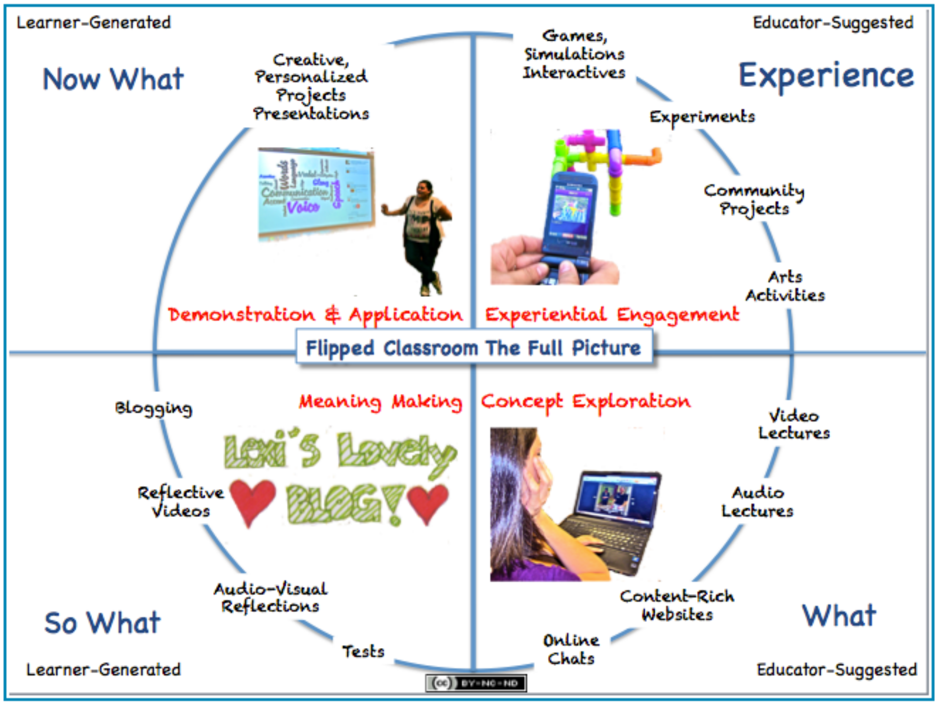
Active learning has been shown to increase student achievement and engagement (Michael, 2006; Prince 2004). Akinoglu and Tandogan (2006) agree reporting, “it was determined that the implementation of problem-based active-learning model had positively affected students’ academic achievement and their attitudes towards the science course” (p.71). Their research also showed that students who engage in active learning had fewer misconceptions.

Student-centered learning theories form the basis for the flipped classroom (Brame, 2014). The literature, highlighting the importance of active leaning, is broad and its importance in the flipped classroom is paramount.

Kolb’s theory of experiential learning (Kolb, 1984) draws from the work of Piaget, Dewey, and Lewin, and the work from these researchers forms the basis of Kolb’s learning styles that includes active experimentation. Gerstein (2011) agrees stating that the flipped classroom is really a “cycle of learning” model that engages the learner. Gerstein identifies four components of the flipped classroom as shown in the graphic in Figure 3. This graphic is often quoted and referenced in flipped learning networks and blogs such as flippedclassroom.org, flippedclasssroom.com, flippedlearning.org, flipperteach.com, etc.

Once the learner is engaged, Gerstein says we move to concept exploration with videos and other multi-media components. After that, reflections occur, followed by a way to use the material learned. While this is not the only sequence of events, it does promote applying knowledge instead of just regurgitating it.

Figure 3. Cycle of Learning



Visual representation of the Cycle of Learning based on the experiential model of learning. Adapted from *The Flipped Classroom: The Full Picture* by J. Gerstein, 2012, Usergenerateded ucation.wordpress.com. Copyright 2012 by Jackie Gerstein. Reprinted with permission.

Key Elements of the Flipped Classroom

There are two basic components to a flipped classroom: the out-of-class instruction, delivered via technology, and the in-class learning experiences. Homework instruction is designed to provide students with basic knowledge and skills. In-class learning experiences are designed to solidify and extend the newly acquired background knowledge. Both components work together to create an overall learning experience that is conducive to student engagement and achievement.

In the flipped model, homework is often a video where students watch a teacher explaining and/or demonstrating some topic or concept. Teachers may make their own videos (typically referred to as vodcasts), using tools such as Camtasia or Screencast-O-Matic, collaborate with a colleague to make videos, or may use pre-recorded videos that are widely available on the internet from such places as Khan Academy or SOPHIA, which are online social education platforms with thousands of free academic videos available for classroom use. Whether the videos are housed on the Internet or in an intranet framework, they can be accessed on any smart phone, tablet, or personal computer (PC). The always-available videos allow students the opportunity to learn when they are ready to learn.

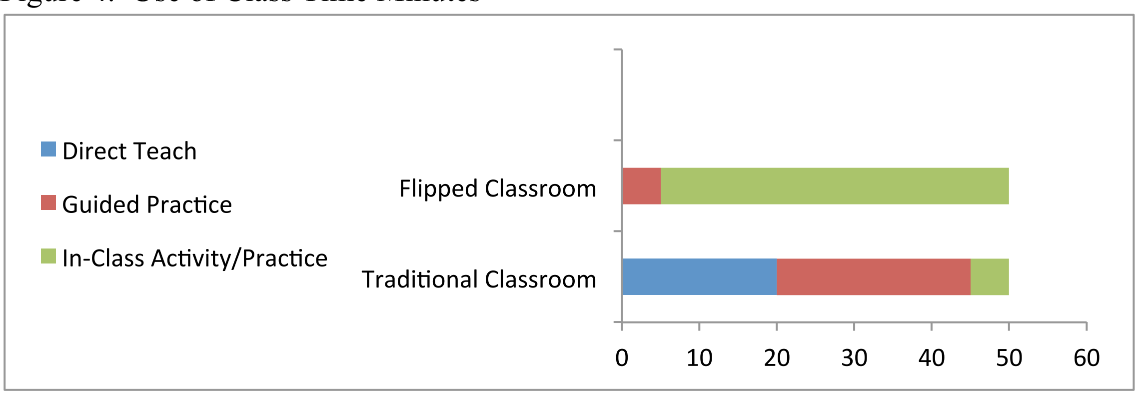
The other part of the flipped classroom takes place within the classroom walls and is a critical component of the flipped classroom model. The student-centered learning theories discussed earlier provide the philosophical basis for the design of the in-class learning activities. These learning experiences must be purposefully designed with specific academic outcomes in mind, to help students transfer background knowledge to novel situations in a collaborative, problem-solving environment.

Since the lecture is taken out of the classroom, teachers have time to work with students on activities, labs, or problem sets. In this manner, students have the teacher present to guide them through any difficulties they may have instead of struggling at home alone. Class time is devoted to students doing the real work of scientists and mathematicians—solving problems.

In the traditional model, homework can take a few minutes or several hours, thus providing for an "infinite" amount of time devoted to studies. But in the flipped classroom, there is a finite amount of time devoted to homework. The amount of homework time can vary slightly, but usually consists of a 10-20 minute video to watch. Bergmann and Sams (2012) suggest a video length of approximately 10 minutes.

Figure 4 depicts the differences in the two models as measured by the Allen Independent School District (Casto, 2012). This model is based on a typical class period which varies in time from 45-57 minutes. The Flipped Classroom model clearly shows the amount of time devoted to in-class activities or practice (which also may consist of group work or exploration) to be much greater when comparing the two different methods. The individual practice time is greatly enhanced in the flipped classroom because the direct instruction piece has been omitted.

Figure 4. Use of Class Time Minutes



Visual depiction of Use of Class Time Minutes. Adapted from Casto, 2012

Bergmann and Sams (2008) described the same results when they first began flipping their classes. They reported a 40-55 minute increase in "Guided and Independent Practice and/or Lab Activity" during a 90-minute class period. These results more than doubled the time they were able to spend working with students.

Brame (2014) lists four key elements of the flipped classroom. The instructor should:

- Provide an opportunity for students to gain first exposure prior to class. Robin Jackson (2009) agrees and discusses her success with pre-teaching subject matter to students.
- Provide an incentive for students to prepare for class. In order to give students incentive, the researcher suggests attaching point values for completing questions based on the video information.
- Provide a mechanism to assess student understanding. This element is tied to the previous element, as the suggestion is for pre-class online quizzes that serve as formative assessment and provide information about understanding.
- Provide in-class activities that focus on higher-level cognitive activities. Class discussions and extension activities that ask students to apply knowledge are key.

History of the Flipped Classroom

The recent press about the flipped classroom model has applied to the K-12 classroom. In the last decade, the model has gained attention through the efforts of

Jonathan Bergman and Aaron Sams and by Salmon Khan of the Khan Academy. The flipped model, however, actually originated in academia. The first published information on this model came from Dr. Wes Baker at Cedarville College in 1982. Baker wanted to cover routine material outside of class via electronic means (Baker, 2000) but at the time, the technological barriers proved to be challenging. Eventually the technology barriers were resolved and Baker was able to post lecture notes online and use them in class. He quickly realized, however, that the students were capable of retrieving the notes themselves and developed a plan to make class time more meaningful. Baker wanted his students to be involved with the material during class time without sacrificing curriculum (Baker, 2011). He presented his ideas in several conferences using the terminology "The Classroom Flip" (Baker, 2011).

To determine whether or not this model was received well by his students, Baker took several surveys. The students reported that they felt they received more personal attention, had more control over their learning, and thought more critically about the material with the classroom flip, so he continued his efforts (Baker, 2011).

In 1990, Harvard professor Eric Mazur coined the phrase "peer instruction" or "interactive learning" (Lambert, 2012) as a way to move the transfer of information out of his classroom. His pedagogical model empowered students to learn at their own pace and take part in conceptual discussions in class. J. Wesley Baker described this as becoming "the guide on the side" (Baker, 2011).

Lage, Platt, and Treglia (2000) created the same classroom model, but called it "inverted," (p. 32) rather than flipped. Their methodology was the same as Baker's and they also measured student perceptions afterward. Again, student reactions were very positive.

The flipped classroom model has recently moved into the by K-12 arena. Karl Fisch, an educator with more than twenty years of experience, changed his approach to teaching. In a recent interview with Daniel Pink, he noted that the seemingly never-ending “lectures in the day, homework at night” had been reversed to “lectures at night, homework during the day” and Pink named the process the Fisch-flip (Pink, 2010).

In secondary education, the flipped classroom model has been popularized by two high school chemistry teachers, Jonathan Bergmann and Aaron Sams (Schaffhauser, 2009). In 2007, these teachers realized they were spending a lot of time re-teaching lessons to students who missed class, so they started recording their lectures. The original intent was for the videos to be used by students who were absent from class, but the teachers quickly realized that many students watched the lectures to study and review for tests (Bergmann & Sams, 2012). Bergmann and Sams began posting their lectures on the Internet and started receiving emails from teachers and students in other districts thanking them for the videos. As the teachers continued to experiment, they found that technology enabled them to put the real work students needed to do back into the classroom. By not spending class time lecturing, the teachers discovered the real meaning of differentiation: working with every child, every day (Bergmann & Sams, 2012).

Perhaps the most notable person in this field is Salmon Khan of the Khan Academy. After Bergmann and Sam’s flipped model began gaining media attention, Khan began hearing from teachers who used the Khan Academy videos to help them as they experimented with the flipped classroom model. Khan claimed that by making class time more interactive, those teachers had used technology to "humanize their classrooms" (Khan, 2011).

Kahn Academy was born out of tutoring necessity. Salman Khan began making videos to help tutor his cousin in math. He started experimenting in 2004, posting the videos on YouTube, not knowing what would happen. Khan Academy quickly grew into what it is today from those simply tutoring videos for Khan's cousin (Khan, 2012). Now there are thousands of videos available on the Khan Academy site. The video library has evolved into an entire learning environment where teachers can assign tutorials and practice exercises. The latest updates even allow teachers to keep track of student progress (Khan, 2011). The video tutorials cover a wide variety of topics ranging from basic arithmetic to advanced physics; however, math and science are not the only subjects that have videos available at Khan Academy. There are also video tutorials that deal with economics and finance as well as the Humanities. Major contributors, most notably the Bill and Melinda Gates Foundation, have made the Khan Academy a worldwide sensation, and because of major contributors, all the videos remain free of charge. The Khan Academy philosophy is "A free, world-class education for anyone, anywhere" (Khan, 2012).

With the rapid rise of ubiquitous technologies, online learning is no longer an anomaly. As affordable technologies become more and more pervasive, educators must leverage the use of technology in the classroom in order to reach learners in our increasingly diverse classrooms. Incorporating various technologies and focusing on well-designed learning activities with specific learning outcomes, may help students develop more interest and become more engaged in our classrooms.

The Nature of Learning

The flipped classroom is not about the videos (Bergmann and Sams, 2012). It is about acquiring knowledge and content experience in a student-centered learning environment. By employing the flipped classroom model, the teacher creates time in the classroom to foster student thinking and learning. Learning is a complicated process with a myriad of variable factors some of which include motivation, environment, interpersonal relationships, and learning styles. According to recent reports (SOPHIA, 2014; Bergmanm & Sams, 2012; Casto, 2012; November & Mull, 2012), the flipped classroom shows promise in addressing some of these factors.

Numerous researchers have studied learning and what it means to gain knowledge. Many of their conclusions have reported common themes. Each researcher, or group of researchers, tends to concentrate on a particular area of learning, but overlapping ideas are present in many of their findings.

The acquisition of new knowledge is a continuous process and learning can be both formal and informal. Formal learning typically refers to subject-matter knowledge that is presented in a more prescribed atmosphere with instructor-led material. Informal learning does not follow a set curriculum and occurs anywhere, anytime. Conner (2013) describes informal learning as a lifelong process whereby individuals acquire attitudes, values, skills, and knowledge from daily experiences. Those daily experiences can be intentional or unexpected, as shown in Figure 2. Since learning occurs everywhere, whether it is formal or informal, the entire world has become a classroom.

Figure 5. Formal and Informal Learning

Visual representation of Formal and Informal Learning depicting the different ways in which learning occurs. Adapted from *Introduction to Informal Learning* by M. Conner, 2013. Copyright 2013 by Marcia Conner. Reprinted with permission.

Sarason (2004) defines learning as a process that occurs in an interpersonal context that is represented by an interaction of factors such as motivation, cognition, attitude, affect, and self-regard. He discusses the distinguishing features of formal learning in terms of productive and unproductive learning. Productive learning is created in an atmosphere in which asking questions and seeking new knowledge is normal practice and writes, "productive learning is the learning process which engenders and reinforces wanting to learn more" (p. x). Unproductive learning, on the other hand, occurs in a classroom where questions and novel thinking are not encouraged—thinking and creativity are, in fact, discouraged.

The conclusions reached by Bransford, Brown, and Cocking (2000) are that a scientific understanding of learning includes all of the processes that go into learning. There are six basic areas that relate to students' learning processes: prior knowledge, brain development, active processing, learning for understanding, adaptive expertise, and time spent on task. They also emphasize the five areas that are relevant to teaching and the environments that support learning: social and cultural contexts, transfer of learning, subject matter uniqueness, assessment to support learning, and educational technologies (p. 233). Therefore, learning is a constructive process by which behavior, attitudes, and beliefs are in a state of flux because of extensive, ongoing experiences.

Vasquez (2006) believes that learning is a social process related to cultural and cognitive development, and as such, an individual's culture is a powerful factor in how learning occurs. Since cognitive skills vary in different social settings (p. 46), students need multiple exposures to new subject matter in order to acquire new knowledge or skills. Multiple exposures eventually help turn a novice into an expert, which is a theme also discussed by Bransford et al. (2000).

Both Bransford and Vasquez make reference to Vygotsky's (1978) Zone of Proximal Development (Bransford et al. 2000; Vasquez, 2006). Vasquez interprets this zone as a developmental path taken by the learner, which results from a scaffolding approach. This approach is led by a more-learned individual (teacher or peer), who provides clues and information to help the learner achieve understanding of the task. Bransford defines the zone to be the distance between the actual developmental level, as determined by independent efforts, and the potential developmental level as determined through problem solving under the guidance of a more capable individual. Vygotsky (1978) describes the zone as the gap between the two measurements. This theory implies that social interaction is the basis for cognitive growth, so the communication that transpires in a social setting, assists children in building an understanding of new concepts.

Pellegrino, Chudowsky, and Glaser (2001) relate learning to the four perspectives of differential, behaviorist, cognitive, and situative. In the differential perspective, the differences between what an individual knows and their learning potential are emphasized. The behavioral perspective represents knowledge as being organized around a stimulus-response association. The situative (sociocultural) perspective assesses how learners acquire new knowledge and skills by interacting with others. The last perspective, the cognitive perspective, has to do with how one learns. It involves studying how the brain actually receives and processes information, stores that information, and how and under what type of circumstances the information is retrieved. The authors go on to state that the four perspectives overlap and form the basis for a more contemporary view of learning which is a constructivist approach.

Constructivism is routinely offered as justification for using a student-centered approach and closely aligns to this type of approach (Weimer, 2013). In the constructivist view, students build new meaning and understanding by connecting newly acquired knowledge to established knowledge structures and is often associated with group work (Weimer, 2013). Making connections between new and existing knowledge and building those relationships are essential to learning. In this view, new knowledge is actually built by the learner and is layered upon existing knowledge.

Learning is about making connections and forming networks. Networks are vast, wide ranging, and multi-faceted and can be biological, social, contextual, technological, or a combination of any of these. Networks are formed by face-to-face interactions, but are also currently and rapidly, formed via mobile interactions. Productive learning, as discussed by Sarason (2004), builds new neural networks and provides a basis for building knowledge (Willis, 2010). Productive learning in a formal, situative setting is much more probable in a classroom where there is more time to delve deeper into topics because background knowledge has been established prior to class.

The social aspect of learning is well documented by many researchers. Vygotsky's (1978) social constructivism speaks to the importance of social context for cognitive development. If students no longer sit silently in rigid rows and are allowed collaborate in well-designed learning activities, deep learning and understanding are more probable. Under the direction of a skilled teacher, problem solving and group work will likely lead to the development of the critical thinking and problem solving skills that are needed to be successful in today's world. With more class time available to explore topics in greater depth, the flipped classroom appears to be contributing to greater student understanding.

The flipped classroom model also speaks to motivation, as students are motivated by success. In friendly, supportive learning environments, students are able to build interpersonal relationships, and different learning styles can be addressed using technology, small group work, and more individualized instruction.

The Learner of Today

Today's students are a different kind of learner. They work, write, study, and interact with each other in ways that are very dissimilar to those of previous generations. Unlike youngsters of the past, Digital Natives have never had to relearn anything to be immersed in a digital world. They learned in digital the first time around. They have never known a world that is not digital and unlike most Digital Immigrants, today's learners live much of their lives online, without distinguishing between the online and the offline (Palfrey & Gasser, 2008).

Children raised with the computer think differently than those that learned to embrace technology Prensky (2001, Part 2). Digital Natives are used to receiving information very quickly. They like to parallel process and multi-task. They function best when networked and thrive on instant gratification and frequent rewards (p. 2).

Bransford, et al. (2000) makes three generalizations about learning: learning changes the physical structure of the brain, learning organizes and reorganizes the brain, and different parts of the brain are ready to learn at different times. Brain research confirms that learning adds synapses in the brain and arranges new organizational patterns (Willis, 2010).

Based on the latest research in neurobiology, there is no longer any question that stimulation of various kinds actually changes brain structures and affects the way people think (Prensky, 2001, Part 2). Thinking skills are enhanced by repeated exposure, but the exposure to new technologies has enhanced different parts of the brain than repeated exposure to learning in a traditional fashion. The Digital Natives sitting in our classrooms have a very different blend of cognitive skills than previous generations (Prensky, 2001, Part 1), and those skills, which have weighty implications for learning, and are almost totally ignored by educators (Prensky, 2001, Part 2).

Schools are most often about the past and what has happened up until now, but students raised on new technologies are far less patient with filling out worksheets and listening to lectures (Collins & Halverson, 2009). Students are no longer satisfied with fill-in-the-blank knowledge and frequently become bored with school. This presents a dichotomy between our established system and the students sitting in today's classroom (Prensky, 2008). Nystuen (2009) writes that today's learners are concerned about their futures and that they want to be able to connect their learning to the world in which they live. They want to understand how what they are learning will help them later in their lives. Students are not deeply engaged in even well designed activities unless they think the content is important to their lives (Marzano, 2013).

Hart's research (2008) shows that today's learners prefer hyperlinked information coming from many sources. These learners thrive on interactive learning. She characterizes today's learners as students who:

- are visual learners and prefer to process pictures, sounds, and video rather than text;
- are experiential learners who learn by discovery;
- have short attention spans and prefer bite-sized chunks of content;
- are very social;
- prefer learning to be "just in time";
- need immediate feedback; and
- are independent learners who are able to teach themselves.

Recent literature suggests that Digital Natives are independent learners, yet that appears contradictory to what is seen in a typical classroom. Prensky (2005) states that students today see school as irrelevant to their lives and are totally disinterested in learning. He goes on to say that he recently saw a student's t-shirt in a New York City school that read, "It's Not ADD—I'm Just Not Listening!" (p. 64). Perhaps it is not that our learners are dependent learners, but rather they see no value in the methods we are using to try to educate them.

Summary

Since test scores are the measure we use to quantify learning, Sarason (2004) believes society has a very narrow understanding of what it really means to learn. No matter the public perception though, educators know that IQ scores or grades on exams cannot measure actual learning.

Some instructors are embracing the notion of their changing roles. Other teachers are realizing that they are no longer reaching all their students, but are unsure of the next steps to take. Still others are resisting change and are becoming increasingly frustrated with their students. Prensky (2001, Part 1) relates complaints he hears from educators: "My students just don't _____ like they used to," Digital Immigrant educators grouse. I can't get them to ____ or to ____. They have no appreciation for _____ or _____ . (Fill in the blanks, there are a wide variety of choices.)" (p.2). Even though Prensky wrote his article in 2001, these statements can still be heard echoing through the halls in our secondary schools.

Classroom Environments

Our current educational system operates much in the same as it always has. Teachers deliver instruction in a production-line format and students' academic value is judged by their ability to reproduce information in a time-restricted testing period (Privateer, 1999). It is no longer viable, however, to teach isolated skills and ask students to regurgitate information. To prepare students for jobs that may not even exist yet, students need the opportunity to solve complex problems across the boundaries of typical subjects or chapters in the textbook, and as such, moving from a teacher-centered environment to a student-centered environment is essential.

Teacher-centered environments

Images of teachers found on the Internet portray numerous scenes showing a single figure, typically a woman standing at the front of the room, facing a seated group of students. The standing person is doing most of the talking, dispensing knowledge at a set time, in a set location, and students do their best to absorb the information that is being delivered.

In teacher-centered classrooms, teaching practices are the focus of the class. The central component is instructor-delivered content. Teacher-centered instruction is known as the factory model of instruction (Harris & Cullen, 2010; Jarvis, 2010), and is characterized by the teacher as a lecturer. Lecture is the most common mode of teacher-centered instruction (Brown, 2012) and has been the primary teaching method throughout our educational history.

A second characteristic of the teacher-centered classroom is that assessment of learning also remains in control of the teacher. Students are expected to follow the digest instruction, gain knowledge, and demonstrate mastery on exams. In this environment, the teacher controls the delivery of the content and the methods used to evaluate student learning.

Recent evidence suggests that an incompatibility between a teacher's teaching style and a student's learning style can result in the student learning less. When this happens, the learner becomes less interested in the subject matter. In order to teach a classroom full of Digital Natives and to engage students in learning, teachers can no longer be the “sage on the stage”. Since today’s students think and process information differently than yesterday's students (Prensky, 2001, Part 2), there is little choice but for teachers to adapt to their new learning reality. It seems unlikely that Digital Natives will revert to learning in the ways of their predecessors, so it is necessary for educators to adapt to a new kind of learner. The newly developed cognitive skills of our current learners are forcing a change in classroom practices. Teacher-centered classrooms are giving way to student-centered learning environments.

Student-centered environments

In student-centered classrooms, student learning is the focus. In this environment, the emphases is not on the delivery of instruction but on the experience of learning (Brown, 2012), and students are directly involved in the discovery of their own knowledge. Through collaboration with others, learners engage in experiential learning that is authentic, holistic, and challenging.

Bransford et al. (2000) define student-centered classrooms as environments that pay careful attention to the knowledge, skills, attitudes, and beliefs that learners bring to the educational setting. This definition stands in contrast to the teacher-centered classrooms with which we are all familiar.

Student-centered classrooms constitute a change in philosophy for many instructors. Making the transition from a traditional teaching practice to a learner-centered teaching practice requires a significant change in perspective as the teacher's role changes from content deliverer to architect of learning. Bergmann and Sams (2012) believe that in a student-centered classroom, the balance of power is more equitable as students and teachers work together and this atmosphere of collaboration requires a transformation of the teaching experience.

In order to move to a learner-centered teaching practice, Weimer (2002) states that teaching practices have to change in five ways. Those ways include:

- The balance of power;
- The function of content;
- The role of the teacher;
- The responsibility of learning; and
- The purpose and process of evaluation.

For some teachers, the most challenging of these may be the shifting balance of power because as the classroom power becomes more balanced, the role of the teacher will change. Some instructors may struggle with no longer being the center of attention.

As teachers do less of the work of leading instruction and more of the work of designing collaborative activities, students will have to take more responsibility for their learning. This could be a significant adjustment for students and teachers may have to help them develop the self-directed learning skills that are needed.

When the focus moves from teaching to learning, the function of content also must change. Once content delivery is no longer the major emphasis in this environment, the focus shifts to applying knowledge to solving problems. Fink (2003) suggests that instructors “make better use of out-of-class time” (p. 167) by having students gain first exposure to background knowledge on their own. This speaks to the flipped classroom and student-centered learning environments.

The final point of change that Weimer (2002) makes is the purpose and process of evaluation. She suggests that assessment must be an ongoing process and feedback should be given on a routine, timely basis. More class time allows for meaningful feedback to be provided to the students.

Technology and Learning

Today's learners know significantly more about computers than their teachers. They prefer "to access subject information on the Internet, where it is more abundant, more accessible, and more up-to-date" (U.S. Department of Education, 2004, p.4). In a typical high school, however, there is a disconnect between the content taught, the technology tools used, and the 21st century skills needed to apply the content and tools effectively (Hazell, 2005).

The new digital environment demands new learning standards for students in order to create the values and the capabilities to live and learn in a free society surrounded by a world that is connected and increasingly competitive (Texas Association of School Administrators, 2008). The digital environment will also mandate new pedagogies and practices. Moving into the digital age in education means that educators will have to examine the use of various technologies that are used for learning. This will require serious discussion and examination of practices because often times educators wrongly believe that tomorrow's professions will require workers who know how to blog, use wikis, or create podcasts (Ferriter, 2011). The realization that technologies are not an end in themselves but are the tools students use to learn and communicate, will help facilitate those discussions.

Learners acquire new knowledge and skills by interacting with others (Vasquez, 2006). Throughout history, a group of people (e.g. a neighborhood, a classroom, a family, etc.) constituted an individual's social group. Since instantaneous global communication is now possible through various personal digital devices, one could argue that the social net in which anyone operates has expanded exponentially. Social interactions are no longer bound by geographic restrictions as technology has made world knowledge accessible to everyone.

Technology is altering the way people learn and fortunately, there are teachers that embrace change and are beginning to utilize technology to make instructional changes. No technology can replace good teaching, but in the 21st century, where technology has become an integral part of our lives, it is an essential component of good teaching and cannot be ignored (Li and Ma, 2010).

Our changing educational reality now lets us see students as "producers rather than consumers" (Sefton-Green, 2006) of digital media. By utilizing digital media as instructional resources, teachers are helping students to construct knowledge through carefully planned activities that allow them to tap into higher order thinking skills. These teachers are using web-based resources including interactive applets and games, activities, and simulations. Teachers are streaming video content, utilizing videoconferencing, creating wikis and blogs for student use, incorporating mobile devices into lessons, and utilizing interactive whiteboards (Vockley, 2010). If the lecture is taken out of the classroom, allowing time for students to engage in the real work of learning, various technologies can be utilized both during class and outside of class to help students explore the world.

Logic would dictate that since technology has changed the way we learn, the next step would be to change the way we teach. Alternative platforms to our traditional classroom setting are no longer “pie in the sky”, but have become a reality. Virtual learning is upon us and as various technologies continue to become immersed into our everyday lives, it does not make any sense for educators to ignore its value in teaching and learning.

In the last few years, four bills went before the Texas Legislature that deal with virtual learning. S.B. 1483 (2011) and H.B. 3088 (2011) related to the state virtual school network and provided for the establishment of virtual high schools. H.B. 2843 (2011) provided for additional opportunities for instruction through the state virtual school network, and H.B. 3280 (2011) dealt with virtual instruction at public and private elementary and secondary schools. The fact that bills are being introduced to deal with virtual learning is a testament to our changed educational reality.

There is a lot of resistance to virtual learning. Many educators question the legitimacy of online courses, viewing them as inferior, assuming that they cannot be rigorous enough (Rogers, 2000). However, research suggests that there is no significant difference, in terms of effectiveness, between on-line and face-to-face instruction (Zhao, Lei, Yan, Lai, & Tan, 2005). Studies that span over a decade have reached the same conclusions: Students that are immersed in three-dimensional learning with the opportunity to interact with objects in a virtual environment are scoring higher than their counterparts in a traditional "brick and mortar" classroom (Hew & Cheung, 2010; Rogers, 2000).

The advent of puberty marks the moment when large numbers of children become bored with school, becoming resistant to adult authority and hard to teach (Murray, 2010). Those same students who do not engage in the traditional classroom are immersed in the hardware and software of the Knowledge Age and Murray (2010) believes these students are still reachable if we do not insist on traditional classroom practices. Bondelli (n.d.) agrees stating that the traditional classroom "is not the most effective in resulting in actual learning and has many disadvantages that are actually counterproductive to real learning" (p. 1).

In the late 1950's, the U.S. educational system was the envy of the world. Today, elementary and secondary schools no longer appear exceptional. Even the highest performing students do not excel at the same rate as students once did (Peterson, 2010). In his book, *Saving Schools: From Horace Mann to Virtual Learning*, Paul Peterson (2010) traces the rise, decline and potential resurrection of American public education through the lives of six reformers. These reformers sought to customize education to the needs of each child. Virtual learning is a unique way to individualize instruction and is an attractive option to many. The result could be a customized system of education in which families have greater choice and control over their children's education. Individualized education is a greater possibility now, more than at any time since our schools were founded. Virtual teachers have the ability to personalize instruction by creating engaging and supportive online classrooms (Ash, 2010), and highly personalized learning experiences that have long eluded school reformers is now possible.

Alternative education is an essential element of high school reform and that reform must include effective strategies to reengage and reconnect young people who are in danger of failing or who have failed to complete high school (Martin & Brand, 2006). The number of alternative education programs that are designed to target students at risk of educational failure is on the rise (Callet, 2010) and that may be, in part, due to the practices in traditional settings.

Overmyer (2010) writes that understanding some concepts may have been more complicated in a pencil-and-paper era where active lessons, assessments, and corrective feedback were difficult, if not impossible. However, with internet-based resources, teachers are able to provide dynamic lessons and feedback using online videos and software that present the material using multiple representations. This type of learning is much more customized to individual student's deficiencies.

Virtual worlds, such as Second Life, provide a rich environment for learning and exploration that engages students' imagination and interest, and leads to positive learning experiences (Wagner, 2009). Although Second Life was initially developed for gaming and entertainment purposes, it has caught the attention of the educational community and is now used quite extensively in education (Pfeil, Ang, & Zaphiris, 2009). Learning in a virtual world, such as Second Life, contributes to the students' perceived value of learning. This platform offers learning experiences that combine immersion, collaboration and authenticity, and strategically improves expertise, performance, innovation, and community building through formal and informal learning aspects (Chapman & Stone, 2010). Second Life enables students to carry out assignments that are otherwise difficult to undertake and can complete real-world tasks in an environment where failure costs little, but success can be very rewarding (Wagner, 2009). These types of learning experiences can be used in the classroom or assigned outside the classroom as homework.

Socialization is a central function of the early years of education and the physical classroom continues to play an important role (Murray, 2010). But as we move into the virtual educational arena, we must remain conscientious about the needs of students. Those students who are not engaged in the traditional classroom are the same students who are engrossed in the hardware and software of today’s world. These students experience the globalization of learning that is increasingly consisting of personal digital devices that are wirelessly linked to each other and the global information grid (Fletcher, Tobias, & Wisher, 2007). Teachers who are flipping their classrooms have taken the first step toward connecting with these students. By taking the lecture out of the classroom, the teacher is bridging the gap between traditional schooling and the learning needs of students and they are using technology to build that bridge.

Peterson (2010) believes that it is too early to say how technologies and online learning will transform elementary and secondary education in the United States. However, the fact that the topic is now being legislated is a sure signal that alternative methods to traditional learning are being explored on multiple levels.

The Flipped Classroom and Active Learning

In a typical 50-minute classroom, it is important for the teacher to determine what to do with the time available. If classroom lecture was the most desirable teaching method, the vast majority of students would be succeeding. But the simple fact that education reform never leaves the headlines, dictates that change is needed. If the nature of the Digital Learner is the desire to be stimulated and engaged in the classroom (Nystuen, 2009), then spending class time lecturing will not suffice and alternative teaching methods are necessary.

New developments in the science of learning emphasize the importance of helping people take control of their own learning (Bransford et al., 2000). Active learning is a general term for teaching and learning strategies that involve students in the learning process. "Active learning works from the concept that students learn better when they are participating in a learning activity than when they are passive recipients of a presentation of knowledge" (Brown, 2012). Active learning stands in contrast to traditional modes of instruction in which passive learning is the norm. Through a more active approach, learning experiences can be designed that are more effective and interesting. Students can take more responsibility for their education.

Students and their learning needs are at the center of active learning. Active learning provides opportunities for students to interact with content. When students are actively engaged in the learning process, they enjoy increased motivation that can result in greater learning. Involved learners enjoy school and become perpetual learners. With the lecture taken out of the classroom, more time is available for students to experiment, make mistakes, and engage in the messy work of learning. Students become active participants and orchestrators of their own learning.

Doing the work of mathematicians and scientists in class also aids the population of at-risk students. These students often struggle to learn in a traditional classroom setting, but when there are varied learning activities these students have the opportunity to excel. Students become involved in their learning rather than disinterested. Numerous studies have shown the value of active learning, particularly in improving the success rate of struggling learners and minorities (Kagan, 1994; Johnson, Johnson, & Holubec, 1992; Slavin, 1983). When the lecture is removed from the classroom, more time becomes available for students to engage in dynamic learning experiences and become active participants in their learning.

When the classroom is flipped and videos are assigned as homework, students have greater control over their learning. Students can watch the videos when they decide they are ready to learn. The real power of the lecture videos though, is that struggling students can watch the video lectures over and over again, pausing when needed, to understand concepts.

With more time during class, teachers have opportunities to orchestrate discussions in small groups or as a whole class (Bergmann & Sams, 2012). Because of increased time to work with students, teachers can remediate or re-teach concepts in small groups or with individual students (Bergmann & Sams, 2012; Strayer, 2007Lage, Platt, & Treglia, 2000), and a more individualized approach to learning is possible.

A Review of the Studies

Several nationwide surveys have been conducted in the last few years. SOPHIA conducted two recent surveys of teachers who were flipping their classrooms. Over 400 teachers responded to the survey in 2012 and 2,358 teachers responded to the 2014 survey (SOPHIA, 2014). In the first study, more than 67% of teachers reported seeing an improvement in students' grades with 85% reporting an increase in student engagement. The second study showed 71% reporting an increase in grades and 88% seeing a positive change in student engagement (SOPHIA, 2014). Also in 2012, Tom Driscoll of Teacher's College at Columbia University conducted a study of the flipped classroom. The results showed that 100% of the educators surveyed stated their flipped classrooms employed active learning strategies and that student engagement was much higher than before they flipped (Driscoll, 2012). The Flipped Learning Network conducted the most recent study. In that survey 453 educators responded. Of those responding, 67% of them reported improved student test scores (LaFee, 2013). Neither survey, however, reported on the length of time the teachers had been flipping their classrooms so it is impossible to know if time and perfection of the practice is a factor.

Thus far, only two case studies have been published on the flipped classroom in the K-12 arena. Both studies took place in high schools in northern states. The first study took place at Byron High School in Minnesota. In 2006, less than one-third of the students at Byron passed the state mathematics test. In order to address this problem, the math department decided to rewrite the curriculum and flip their classes in 2009 (Fulton, 2012). After flipping, the math teachers' analyzed student data and continuously monitored student achievement. In 2011, the percentage of students passing the state test had increased to 73.8%, and increased again in 2012 to 86.6% (Fulton, 2012). Byron High School was designated a Blue Ribbon School in 2010.

Clintondale High School is located just outside of Detroit in Michigan. Clintondale reports that three-fourths of its students come from low-income families and struggle in school. In order to address high failure rates, 44% in math and 41% in science, teachers and administrators made the decision to flip all of the 9th grade classes in 2010 (Clintondale High School, 2013). The reported result was that the passing rate in math increased from 56% to 69% and in science from 59% to 78% in the first year. Clintondale also reported that not only did graduation rates increased by ten percentage points and discipline referrals declined by 66% (Clintondale High School, 2013), but that student scores are continuing to rise.

The faculty at Clintondale also described being very pleased with the model. Greg Green, principal at Cintondale High School, said his teachers felt good at night knowing they had done something positive for students. Green reported, "the flipped approach frees up classroom time so teachers can help students master topics, deepen relationships, and build critical thinking skills (Clintondale High School, 2013, p. 2).

The Flipped Classroom: Pros and Cons

Combing through the available literature on the flipped classroom has revealed the same basic concerns about the model. eSchoolnews.com and novemberlearning.com are two of the sites that have compiled these concerns and addressed them based on research on learning. These concerns will be listed next and appear in no particular order.

The teacher becomes less important

In the flipped learning environment, teachers become more important than ever (November & Mull, 2012; Sams & Bennett, 2014). Teachers must prepare for class differently and that preparation includes anticipating student questions. Teachers have to prepare rich classroom activities that push student thinking and be ready to spontaneously individualize instruction as they address student misconceptions. Since the responsibility of the teacher and learner is reversed, the teacher's role becomes amplified in the design and execution of learning experiences. "Although video can be leveraged to deliver direct instruction, it does not, and cannot, replace the teacher as the facilitator of learning" (Sams & Bennett, 2014, p. 2).

It is all about the videos

Bergmann, Overmeyer, & Willie (2013) state:

> The flipped classroom is not a synonym for online videos. When most people hear about the flipped class all they think about are the videos. It is the interaction and the meaningful learning activities that occur during the face-to-face time that is most important.

The flipped classroom utilizes technology but it is not about the videos. It is about freeing up class time to personalize and extend learning. Technology is used to leverage personalized instruction.

Student accountability

It is not new that teachers voice concerns over students not doing homework. However, one of the reasons students do not complete homework is because they are bored and see the assignment as busy work that has no value to them, or they do not understand the work that has been assigned (November & Mull, 2012). If students are bored, the teacher can provide resources that help the students make connections to the outside world. Teachers can make the assignments more relevant to student interests. The flipped classroom model addresses the issue of students struggling at home alone, trying to do an assignment. By working through assignments in class, students have an expert in the room with them to help them when they encounter struggles (November & Mull, 2012; Bergmann & Sams, 2012).

Another consideration for teachers to build accountability is to use an online component. November and Mull (2012) discuss building online quizzes or a discussion board where questions and answers can be posted, and connect these to the videos. Teachers can use a discussion board to pose thought-provoking questions for students to consider as they view the videos.

Teachers do not always have the time and expertise to produce videos

Teachers wanting to flip their classrooms do not have to begin by making their own videos. Many videos are available on the Internet and teachers can start using these while they experiment with different ways to make their own videos. Greg Green (2012) agreed, stating that he wants the best teachers possible at Clintondale High School and as such, he does not care if the videos are produced on campus or if they come from the other side of the world.

Teachers working together can greatly reduce the amount of time dedicated to producing videos. Teachers can alternate who records the video lessons or they can work together with each one having a different role to play.

If teachers want to make their own video lectures but are afraid they may not have the technical expertise, there are options available. Classroom document cameras are usually equipped with a recording feature so the teacher might teach a lesson and simply record the steps as she is working out a problem. Other teachers or the campus or district technology specialist can help the teacher explore other options. There are also many apps available for tablets that are very simple to use. Apps such as ShowMe, Educreations, and Doceri are free and are easy to use. A little investigation on the part of the teacher can determine the software that she is comfortable using.

Equity of access

Flipped classrooms use technology and when considering the use of technology for educational purposes, equity and accessibility must be considered. Since students have different needs, schedules, and circumstances, there is not just one solution to the problem of equity. Karen Cator (2013), former director of the Office of Educational Technology in the U.S. Department of Education stated:

> We are facing a **digital learning gap** in America – yet another divide between the haves and have nots. One that we must close as decisively and quickly as possible so the opportunity to learn in school and throughout life is open to everyone, not just a few. The problem with our schools is not lack of excellence. It's lack of equity.

The American Psychological Association (2014) determined that socioeconomic status (SES) is the measure of a combination of factors that include education, income, and occupation, and that SES is commonly defined as social standing or class. An examination of SES as a continuous variable reveals inequities in access to and distribution of resources (APA, 2014).

Warschauer, Knobel, and Stone (2004) declare that the gap is narrowing between those families that have access to technology and those families that do not. In a study they conducted in six California high schools, it was found that in the three high-SES high schools, 99% of the students had computers at home and 97% of them had Internet access. In the three high schools that are labeled low-SES schools, 84% of the students had computers at home and 72% had access to the Internet. The researchers also report that the divide between these figures is decreasing every year. Increasingly affordable technologies are helping to bridge this gap, however, as long as there are issues with access, teachers must be prepared to not only address them but also to work to find solutions.

In considering what it means to be equitable, it must be determined what each student needs to be successful. Durley (2013) stated:

> Equity is not about providing the exact same education for every student. Equity is about determining what each student needs to be successful and providing those conditions. Technology is a variable I can make up for, by offering alternative times and places, to access videos.

In order to provide alternate times and places, teachers can make arrangements with the school library to allow students to come before or after school to use computers to watch videos. Videos might also be accessed in the teachers' classrooms before or after school. Public computers are available in libraries and community centers and teachers might reach out to those places to make arrangements for technology access. Students could be encouraged to watch videos via a smart phone in groups with friends at lunch, in the evenings, or at other convenient times. There are ways to make information accessible if educators work to find solutions.

If the school does not have many computers, teachers can write grants to buy more computers. Butrymowicz (2012) relates the story about a teacher in Oregon that wrote a grant to put six computers in her classroom. She wanted to flip her classroom and knew that none of her students had computers at home. Once the grant was received and the computers were bought, the teacher flipped her classroom. Currently, the teacher uses the bank of computers as one of the stations that her students rotate through. The students watch the video in class and rotate through other stations using that background information to complete assignments.

If the issue is not the lack of a computer, but lack of access to the Internet, several options are available. Teachers may make content available on flash drives or burn DVD's for the students. Often times, these can be purchased with school funds and students can return them to be re-recorded for the next video.

There are ways to successfully implement the flipped classroom all while addressing the issue of equitable access. Teachers and/or administrators, who are determined to find solutions, can work together to find answers to this problem.

Summary

Knowledge is not memorization of facts and figures, but is based on learning that is constructed through inquiry and application. That learning is connected to previous knowledge and personal experiences. Learning and knowledge are intertwined (Rotherham & Willingham, 2009). The Knowledge Age requires knowledge generation, not just information delivery, and schools need a "culture of inquiry" (21st Century Skills, 2010). However, time devoted to active learning and inquiry is missing in many classrooms as teachers often feel there simply is not enough time in a 50-minute class to *waste* on activities. In contrast, the flipped classroom model provides a platform for students to construct knowledge through active learning in the classroom environment.

Recent literature reveals that prior knowledge, metacognition, and transfer of learning are necessary and important parts of the learning puzzle. Many experts also seem to agree on the multiple processes upon which learning depends; yet cognitive scientists have yet to actually define what it means to learn. The flipped classroom offers promise in helping teachers reach students in a learner-centered environment that is conducive to learning.

CHAPTER III

RESEARCH METHODS

Introduction

Over the years, a variety of methods have been used to explore educational issues. The quantitative studies have examined data, but the qualitative studies have employed such methods as observations, interviews, and focus groups. The nature of the problem in this study dictated that qualitative methods such as interviews and observations be used in order to fully understand the phenomenon of these teachers flipping their classrooms.

Many modern theorists have expounded on the use of qualitative studies. Denzin and Lincoln (2005) believe that qualitative research is a "field of inquiry" (p. 2) and that qualitative researchers attempt to make sense of phenomena that is studied in its natural setting. Stake (2005) refers to this inquiry as "discovery learning" (p. 454) and Creswell (2007) agrees and discusses exploring issues or problems through qualitative research. Qualitative research is preferable when researchers make interpretations from what they see and hear and this approach is directly connected to the researcher's background and history (Creswell, 2007).

After comparing various qualitative research designs, a case study seemed the most appropriate method and the study was structured in this manner. Both Stake (2005) and Yin (2009) base their approach to case study on a constructivist paradigm. This paradigm is built upon the premise of making cognitive connections and the social interactions that result (Vygotsky, 1978), and one of those social interactions is the close collaboration that occurs between the researcher and the participant. The following section is a more detailed justification for using a qualitative case study design.

Rationale for Qualitative Case Study Design

Several reasons exist for supporting the rationale behind using a case study approach. I chose the case study method because it emphasizes an issue that needs to be explored. As more and more teachers begin flipping their classrooms, I wanted to understand what was involved in the actual implementation of the model.

A case study approach is useful when there is a clearly identifiable case with boundaries (Creswell, 2007). I chose a collective case study (Stake, 2005) because I had multiple cases (four teachers) and needed to describe and compare their classroom practices to provide insight into the flipped classroom.

A qualitative case study approach was the best choice since I was collecting data in in the classroom, which was the natural setting. It allowed me to observe what the teachers and students were doing in the classroom as it was happening.

Being that a qualitative case study approach is holistic in nature and not bound by a more rigid protocol, I was able to use an inductive process to build patterns from the "bottom-up" (Creswell, 2007, p. 38). Themes began to emerge as more data was collected.

Yin (2009) stated that a case study design should be considered when: (a) the focus of the study is to answer "how" and "why" questions; and (b) the behavior of those involved in the study cannot be manipulated. Both of these apply to my study.

Prior to the selection of the qualitative case study method, I had considered a mixed-methods approach since I was collecting both qualitative and a small amount of quantitative data. I thought providing both types of data would provide a richer understanding for my study. However, I did not have an extensive data collection (Creswell, 2008), nor did I need the quantitative data to explain the qualitative data. In the end, I did not feel that this approach adequately supported my research questions.

Yin (2009) states that a case study is an empirical inquiry that investigates contemporary phenomenon in its real-life context (p. 18). Case studies are used in many situations to contribute to the general knowledge of individuals, groups, or related phenomena. Since this method adds two sources of evidence, direct observation and personal interviews, it seemed the best approach.

Case Study Methodology

A case study is a type of ethnography (Creswell, 2008), which is a qualitative research procedure for describing and interpreting shared patterns and beliefs that develop over time. Creswell (2007) defines case study research to be the exploration of an issue through one or more cases within a bounded system (p. 73) and views it as a methodology. Stake (2005) disagrees and posits that a case study is not a methodology, but a choice of what is to be studied. Other theorists have defined a case study to be a strategy of inquiry, a methodology, or a comprehensive research strategy (Denzin & Lincoln, 2005). The majority of researchers doing casework actually call their studies by other names (Stake, 2005), but the focus in this type of research is to answer the epistemological question about what can be learned about the case (p. 443).

Creswell (2007) outlines a general procedure for conducting case studies. His protocol includes:

1. Identifying a case and its boundaries;
2. Collecting data from multiple sources such as observations and interviews;
3. Analyzing data and providing a detailed description of each case (which emerges through the data collection) and themes within each case;
4. Providing an analysis across cases; and
5. Interpret the analysis and report the meaning of the case. (p. 74)

As suggested by Creswell (2007) and Stake (2005), the protocol for this qualitative case study was based on defining the cases to be the four teachers and the issue being studied was their classroom practices and beliefs about their students when flipping their classes during the first year of implementation.

Research Questions

This case study was designed to address the following questions:

1. How is the flipped classroom structured?
2. How do teachers perceive student learning in the flipped classroom?
3. How do teachers perceive their roles and their students' roles in the flipped classroom?
4. What are the factors that contribute to effective/ineffective implementation?

The nature of these questions provided an opportunity to explore teachers' individual and collective classroom experiences and discover their beliefs about student learning and the changing classroom roles.

Setting

The district in which this study was conducted, has many highly qualified teachers. According to the Texas Education Agency (TEA, 2013), Section 1119 of The No Child Left Behind Act (NCLB) focuses on improving teacher quality. The act requires all teachers who teach core subjects, including the arts, civics and government, economics, English, foreign languages (other than English), reading or language arts, geography, history, mathematics, and science, to meet specific competency and educational requirements. Teachers are required to be highly qualified if the teacher is the teacher of record, providing direct instruction to students. Highly qualified teachers must: (a) hold at least a bachelor's degree; (b) be certified to teach in Texas; and (c) demonstrate competency in their core academic subject area.

There are almost 4,000 teachers in this district with approximately 34% of them having advanced degrees. More than one-fourth of the teachers have 11-20 years of teaching experience, with the average experience being 11 years. There are many highly qualified teachers here and one of the teachers participating in this study received the district's Teacher of the Year Award.

The study took place over a 6-week period during the spring of 2013. Each teacher participating in the study flipped every class in which the same subject was taught. For example, if a teacher taught Algebra II and Geometry, and the teacher decided to flip Algebra II, then every class of Algebra II was flipped. Classroom observations were conducted in every class period that was flipped.

The study was conducted in a large suburban school district in Texas on three different high school campuses. This district has a total of 70 campuses and covers approximately 100 square miles. Students in ten different cities are served by this school district and they number over 55,000. Because of this expanse, the demographics fluctuate from one side of the district to the other. Overall, the district's population is 41% white, 23% Hispanic, 21% Asian, 11% African American, and 4% two or more races. The Economically Disadvantaged population numbers at 26%. The Limited English Proficient (LEP) population is 12.0%, and almost one-fourth of all the students (23%) make up the At-Risk population.

Generally speaking, the Economically Disadvantaged students are children who qualify for free-and-reduced lunch because of family income. The At-Risk population are those students who are considered "at risk" for having undesirable life outcomes (e.g., dropping out of school). Kominski, Jamieson, and Martinez (2001) say there are seven risk factors that contribute to children struggling in school. Those factors are:

- having at least one disability;
- being retained in grade at least once;
- speaking English less than "very well";
- not living with both parents;
- living in poverty;

- having parents who emigrated to the U.S. in the past 5 years; and
- living in a family where neither parent is employed.

The authors also note that while none of the risk factors listed include any mention of race or ethnicity, African American and Hispanic students make up the largest percentage of students who are deemed at-risk in most American schools.

The first high school in this study will be known as High School A. This high school is less diverse than the other high schools and has a population that is 56% White, 12% Hispanic, 18% Asian, 10% African American, and 4% two or more races. Both the Economically Disadvantaged and At-Risk populations are about 13% of all the students, which is less than the other schools in the district. There are over 2,750 students that attend this school and they are all in grades 11 and 12.

The second high school, High School B, is more diverse and has over 1,100 students. This campus serves students in grades 9 and 10. The demographics are listed as 23% White, 41% Hispanic, 21% Asian, 12% African American, and 3% two or more races. Of the students in this school, 45% of them are listed as Economically Disadvantaged and 13% are in the At-Risk category.

The last high school in the study is High School C. This high school has over 3,000 students in grades 11 and 12. This high school enjoys a diverse population of students. Here, the demographic breakdown is 40% White, 26% Hispanic, 18% Asian, 14% African American, and 4% two or more races. The Economically Disadvantaged students comprise 28% of the student population and 17% are At-Risk.

Participants

The present study began July 2012. Allen Independent School District hosted a symposium on the Flipped Classroom and brought in Jonathan Bergmann as the keynote speaker. Numerous teachers had expressed interest in finding a better way to reach their students and many were interested in exploring the flipped classroom. Because of limited space, I was given 12 spots to take math teachers to the conference. The 12 teachers chosen were teachers that wanted to try his model and committed to taking part in my study.

When the school year began in August of 2012, the district in which this study took place blocked many of the websites that teachers used to host videos. District officials wanted teachers to use the internal platform to host all classroom materials. That platform was in the process of being updated and redesigned, resulting in massive technology problems. As a result, all but one of the teachers told me they could not fight the technology issues and decided not to flip their classrooms. I did not hear from the one teacher, so I assumed he had also dropped out.

At this point, I was unsure of how to proceed. After several months I discovered that one math teacher and two science teachers were flipping their classes. The math teacher happened to be the one that went to the symposium in Allen; he had just not contacted me one way or the other. All three of the teachers had found ways around the technology issues by using outside sources. I realized that math and science share many student issues so I made the decision to expand my study to include science.

I wanted to have two math and two science teachers in the study, so I decided to ask a math teacher at a different school if he would consider flipping his classroom and participate in my study. Knowing the initial time commitment, I was worried about asking him, but he had always been very open to trying new ways of reaching his students and he eagerly agreed to start the process and participate in this study. Three weeks after the study began, I got an email from him saying, “You have changed my life. If you hadn’t asked me to participate in this, I would have never known how awesome this is for kids. I love teaching! Thank you!”   My worries had been for naught.

When the study actually began in the spring of 2013, a total of four teachers were participating--two math teachers and two science teachers. These teachers were the only teachers in the district who were flipping their classes at the time and all four eagerly volunteered to participate in the study.

Math Teacher A

Math Teacher A teaches in High School A. He is a white male in his early 40’s with 10 years teaching experience. This teacher was a personal trainer before becoming a teacher. At the beginning of his teaching career, he taught math classes in middle school and coached football. When I first met Math Teacher A, two years prior to beginning this study, he had just been transferred to a high school and was going to be teaching Algebra II for the first time. He confessed to me that he was unsure of himself because his knew his content knowledge was weak. He is certified to teach mathematics but his Bachelor’s Degree is in Kinesiology.

The year before this study began, this teacher made a commitment to himself to grow as a professional educator. He quit coaching and concentrated all his efforts on learning mathematics and how to teach it in the most effective manner possible. He began thinking about a future with leadership roles and wanted to grow as an educator. Math Teacher A teaches two sections of Algebra II and four sections of Honors Algebra II and flipped both of his on-level Algebra II classes.

Science Teacher B

Science Teacher B teaches at High School B. He is a male of middle-eastern descent and has eight years teaching experience. This teacher is in his mid-30's and holds a Bachelor's Degree in Composite Science and a Master's degree in Science Education. Science Teacher B is the Department Chair in his high school and was named District Teacher of the Year in 2013 (the year he flipped his classes). He teaches Biology and Honors Biology and flipped all six of his classes.

Math Teacher C

Math Teacher C teaches at High School C. He is a white male in his mid-50's and has been teaching for three years. This teacher has a Bachelor's Degree in Engineering and spent ten years working as an engineer before leaving that profession to become a teacher. Math Teacher C attended an alternative certification program to become a teacher after he left the corporate world. He teaches Algebra II and Honors Algebra II. He flipped all four of his on-level Algebra II classes.

Science teacher D

Science Teacher D is a white female in her early 40's and has been teaching for 18 years. She also teaches at High School C. She has a Bachelor's Degree in Composite Science, a Master's Degree in Education and was working on her Principal Certification at the time this study was conducted. She is the Department Chair at her high school and is interested in moving into Administration. She teaches AP and IB Environmental Science classes and flipped all six of her classes.

Data Collection and Sources of Evidence

The data collection was based on several primary resources. These resources included participant observations, participant surveys, and participant interviews. Each of these resources provided rich data that contributed to gaining an overall understanding of how the teachers prepared for and viewed their experiences with the flipped classroom.

Participant observations

The first source of evidence was classroom observations. A total of thirty-six classroom observations were conducted over a six-week period of time in the spring semester of 2013. I observed each class period that was being flipped on two separate occasions. A total of four observations were made in Math Teacher A's classrooms. Science Teacher B flipped all six of his classes and I observed his classes a total of 12 times. Math Teacher C flipped four classes, resulting in eight classroom observations. I also made a total of twelve observations in Science Teacher D's classroom.

Each classroom observation lasted the entire class period, which was 50 minutes in length. The observations were loosely scheduled in advance so the teachers were able to let me know if there was a quiz, a scheduled fire drill, or any other anomalies that might affect the observations. As a result, no encroachments on time were observed.

During these observations, I assumed the role of "complete observer" (Merriam, 1998, p. 110), and did not interact with the teacher or students. I sat in the back of the room and recorded what was happening in the classroom.

Participant surveys

Surveys went out midway through the study and again at the end of the study. The surveys were sent via email. The participants were asked if they preferred to return the surveys by email or if a hard copy pick up was preferable. All four elected to return the surveys by email.

The surveys were used to gain an initial understanding of the teachers' viewpoints. They served as a support for the qualitative data and helped to provide a more comprehensive understanding.

Participant interviews

Interviews are the most common, and sometimes the only, form of collecting data in qualitative studies (Merriam, 1998). The interviews allowed me to explore the participants' views and feelings, which is information that observations cannot reveal. The interviews also gave the teachers a chance to clarify, expand, and confirm or correct what I had gleaned from the observations.

Participant interviews took place after all of the observations had been completed. The interviews took place in each individual teacher's classroom during his/her conference period on a date selected by the teacher. All interviews were recorded and transcribed.

Data Instruments

Data instruments were created based on the research questions. Since the flipped classroom model had never been used in this school district, these were the questions I wanted answered as a means to help me and other teachers understand what was involved in flipping a classroom during the first year of implementation.

After reading Bergmann and Sams (2012) book, I outlined four broad categories that would address my research questions. Those categories were: teacher planning, classroom behaviors, community reaction, and reflection on teaching. The questions for the survey and the interview were developed next based on what Bergmann and Sams (2012) reporting learning from flipping their classrooms. The closed-ended survey statements and the open-ended interview questions were written to explore the broad categories under my research questions. These instruments were developed and were used consistently over the six-week period in which this study was conducted.

Participant observations

I used Creswell's (2008) Observational Fieldnotes description when compiling the elements to create my observation log. Those elements included using both descriptive and reflective fieldnotes enabling me to "record the essential information about time, place, and activities observed" (p. 224). The first of these elements was the descriptive fieldnotes. This was a description of "events, activities, and people" (p. 225). My observation instrument was broken into five-minute intervals to record the teachers' actions and classroom events. I also recorded student time-on-task in ten-minute intervals. I made note of the physical surroundings, the individual teacher's actions, the activity that the students were being asked to participate in, and student engagement and reaction to the teachers' directions.

The second element was that of reflection. This was used to record my personal thoughts and insights as I observed each class. After I left the class, I reviewed the log and carefully reflected on what I had seen. At that time I made additional notes if my reflections yielded any new thoughts and feelings about the observation.

Participant surveys

The second instrument I used was a participant survey that measured teacher attitudes. The survey instrument was constructed using Likert items. The surveys included items that dealt with the day-to-day operations of a classroom, but were tailored to the flipped classroom model.

The survey instrument was structured using Creswell's (2008) descriptions and examples. According to Creswell (2008), when designing your own instrument researchers should write different types of questions, including personal and attitudinal, and use strategies for good question construction such as using clear language and making sure answer choices do not overlap. The last item Creswell (2008) suggests is performing a pilot test of the questions. It was not possible to test pilot the questions with teachers flipping their classrooms since there were only four teachers in the district using that model. I did, however, give the survey to two non-participating science teachers and asked them to take the survey to check for any erroneous questions or ambiguities.

The survey was broken into four domains to address the research questions. Those domains included: Lesson Planning, Classroom Practices, Student Performance/Engagement, and Reflection. The first and second domains speak to the structure of the flipped classroom and how teachers perceive their roles, which ties to three of the research questions. The third domain related to the second research question. The last domain, Reflection, was important to the global understanding of how teachers viewed the overall process.

Participant interviews

The interview questions were open-ended questions written to explore the various aspects of what was involved in this teaching shift and to help answer the research questions. The interview questions were an attempt to gain a more thorough understanding of classroom practices and were split into four domains. Those domains were: Planning and Preparing, Classroom Strategies and Behaviors, Community Reaction, and Reflection on Teaching. The purpose of the interview questions was to offer additional insight that could not be gained from classroom observations and to fully explore the aspects of this model from the teachers' point of view.

Data Analysis

Introduction

I used a variety of techniques to understand and interpret the data from this case study. I first explored the use of technology to conduct a computer analysis of the qualitative data. Several programs were investigated including Dedoose and *Hyper*RESEARCH. After examining the features of these programs, I decided not to use a qualitative data analysis computer program. There are two reasons I made this decision. First, Creswell (2008) states that a hand analysis may be preferable when analyzing a small database (less than 500 pages). With only four participants, I had a very small database, so a hand analysis began to make sense. Second, I wanted to be involved with the data and explore the personal notes I had made. I decided a hands-on approach was best and conducted the analysis myself.

I began the process by conducting a preliminary exploration of the data to get a general sense of the main ideas and to look at organizational structures. I re-read the Fieldnotes and transcriptions of the interviews twice, making notes in the margins as ideas came to mind. The third time I read, began the coding process. This process is known as the constant comparative method and involves breaking down data into discrete units (Lincoln & Guba, 1985). The goal of this process is to assist the researcher in developing theoretical insights. Lincoln and Guba (1985) state "the process of constant comparison stimulates thought that leads to both descriptive and explanatory categories" (p. 334).

Creswell (2008) describes the coding process as a way to make sense of data.

Codes are labels that provide a means to separate data into categories, code the categories, and examined the codes to identify patterns. The coding process allows the researcher to narrow data into a few themes (Creswell, 2008). The use of codes allowed me to make connections between the various forms of data collected.

After analyzing the data using the constant comparative method, the data were triangulated to verify my analysis. Stake (2005) states that triangulation is a process of using multiple viewpoints to clarify meaning. By looking at the data from various perspectives, I attempted to "secure an in-depth understanding of the phenomena in question" (Denzin & Lincoln, 2005, p. 5). This process allowed further reflection and a thematic analysis to help me to potentially identify the common actions of the participants with regard to the flipped classroom model.

Participant observation analysis

The participant observation analysis included a thorough review of all notes taken during the classroom observations. The observation notes were given to the participants for comments, additional descriptions, and for verification of accuracy. After accuracy was confirmed, I began the coding process to identify potential themes. Ideally, this confirmation and analysis aided in the reliability of the research findings.

During the course of the classroom observations, student time-on-task was measured. Time-on-task was noted in the logs by recording the number of students on task during class at ten-minute intervals. Those numbers were converted to percentages and broken down for each teacher.

Participant survey analysis

The surveys were written as a Likert scale. In this survey, each Likert item had responses that were assigned numbers from one to five with one being “Not at All” and five representing “To a Great Extent”. The categories in Likert items express a “greater than” relationship and the number assigned to each category is arbitrary yet Likert scales imply theoretically equal intervals among responses. Creswell (2008) states that Likert scales are often “treated like both ordinal and interval data in educational research” (p. 176) and different researchers have their own preferences. Since ordinal scales provide response options that ask participants to rank their preferences, I examined the data as ordinal data.

Descriptive statistics was used to identify overall trends in the data and help provide an understanding of measures of central tendency, variability, and to offer insight as to how one score compares to another. Measures of central tendency include mean, median, and mode. Standard deviation, range, and inter-quartile range (IQR) were calculated and compared to look for variability. The IQR measures how spread out the data points in a data set are and is used with the other measures of central tendency to build a complete picture of a data set’s tendency to cluster around its mean. Percentiles were also calculated as a measure of relative standing.

For the final analysis of the Teacher Survey, the survey was split into two parts: one category was teachers of mathematics and one category was science teachers. This was done to see if teacher perception differed in the two subjects.

The Participant survey was given at two different time intervals in an attempt to ensure reliability. The first administration of the survey was three weeks after the study began. The second time the participants filled out the survey was three weeks later after the observations had been concluded.

Participant interview analysis

The participant interviews took place after all observations had been completed. The interview questions were open-ended questions designed to elicit elaboration on the part of the participant. The questions were sent to the teachers, via email, ahead of time so they would have time to gather their thoughts. I asked the questions in the order they were written, but the interview proceeded as a discussion between two people with follow-up questions being added for clarification. At the end of the interviews, the participants were given a chance to add any additional information if they so desired.

All interviews were digitally recorded and hand-written notes were made to ensure I captured the true intent of the participant's comments. After reviewing these recordings several times, verbatim transcriptions were made. The transcriptions were subsequently submitted to the participants for any corrections or clarifications. After receiving confirmation of the accuracy of the transcription, the data was compared, analyzed, and coded.

Summary

The data analysis process began by listening to the digitally recorded interviews while re-reading the transcribed texts and making notes. This was done to make note of the tone and inflection of the participants' voices to try to capture the true intent of their words. I then reviewed the Observational Fieldnotes and made initial notes before the coding process began.

The next step was to review the data gathered from the Participant Surveys. I calculated means and standard deviations to explore patterns between participants' responses.

After going through all of the data to get a general sense of overlapping themes, the coding process began. Following this phase, data were subsequently re-analyzed until reaching saturation. Creswell (2007) believes saturation occurs when further analysis of the data yields no new information. Numerous iterations of data comparisons continued until I was confident I had reached saturation. This process resulted in a small number of codes.

Creswell (2008) endorsed the use of triangulation as a way to validate findings. Triangulation helps to clarify meaning by presenting multiple perspectives (Stake, 2005). Data collection and analysis were compared in this way in an attempt to ensure the reliability of the study and assist in the potential validity and replication of further studies.

Reliability, Variability, and Ethics

Reliability and variability

Creswell (2007) considers validation to be a process in qualitative research and sees it as a strength because of the researcher's time in the field. He believes that closeness of the researcher and participants add accuracy to the study (p. 207).

Reliability can be addressed with detailed fieldnotes and a good-quality recorder for recording, resulting in accurate transcriptions (Creswell, 2007, p. 209).

Participant observations can be very valuable, but their subjectivity could pose a possible threat to reliability and validity. Because of this, I took the safeguard to minimize the risk by using triangulation to compare data collected from multiple instruments. Stake (2005) states that "no observations and interpretations are perfectly repeatable" (p. 454), but that triangulation helps to elucidate meaning through multiple perspectives.

Before beginning the study, I consulted with my committee co-chair, Dr. Yeping Li, and asked him to review and comment on the instruments I intended to use in this study. This was done to help ensure validity.

I also used standard procedures (Creswell, 2008) when collecting data to help eliminate any potential bias. When conducting observations, I used the same instrument each time, taking notes in five-minute intervals. Since I was a non-participating observer, I always sat in the back of the room so students were not facing me. The surveys were delivered to each participant via email, with instructions to ask any clarifying questions, if needed. Each interview used the same instrument and was recorded using the same instrument to ensure an accurate transcription. All interviews took place in the individual teacher's classroom on a date of the teacher's choosing. Since the interviews took place during the teacher's conference period, the time remained consistent as we had a maximum of 50 minutes for the interview.

The surveys were given twice as a check for reliability. Surveys were delivered to the participants midway through the study and again at the end of the study. Conducting the survey twice, at different time intervals, was done as a means to help ensure reliability.

Ethical considerations

The approval for this research was obtained from the Internal Review Board at Texas A&M University. There were two aspects of concern for this study: informed consent and subject confidentiality.

This study involved observing and interviewing human subjects, so it was necessary to obtain informed consent. Informed consent is a statement that participants sign before participating in research. This consent guarantees certain rights to the participants, including the right to withdraw at any time, their voluntary participation, and any known risks (Creswell, 2008). For this study, written consent was collected from each teacher prior to the beginning of any data collection.

Case study work involves personal views and circumstances (Stake, 2005) so participant confidentiality was my major ethical concern. Each participant was assured there would be no personally identifying information used in this study. In order to fulfill this obligation, each participant was assigned a letter designation to reduce the risk of potentially revealing his or her identity. Each participant's location was also given a letter designation. The participants' names and locations were not recorded on any documents; only the letter designations were used.

Throughout the course of this study, I attempted to acknowledge my own subjectivity and bias. As a constructivist who believes in experiential learning, I had to acknowledge that my personal experiences as a teacher may cause some lack of objectivity. Creswell (2007) stated that any possible bias on the part of the researcher should be acknowledged and explained to note any possible ramifications in the narration.

CHAPTER IV

RESEARCH RESULTS

Introduction

The purpose of this study was to examine veteran high school math and science teachers' practices and perceptions when flipping their classrooms for the first time. The first part of the study examined teacher practices through the lens of teacher preparation and classroom behaviors. The second part was to uncover teacher perceptions of student engagement and achievement in the flipped classes as compared to what they had observed in their classes prior to flipping them. The research questions were answered from classroom observations and from responses to interview and survey questions.

Research Findings

In order to provide a complete picture of the results, outcomes will be presented in two ways. First, findings will be grouped by the research questions. The theme will be represented under the context of the research questions and will be described through selected quotes from the transcriptions and examples from classroom observations. Second, to provide support, the survey results will be discussed.

My research questions consisted of the following:

1. How is the flipped classroom structured?
2. How do teachers perceive student learning in the flipped classroom?

3. How do teachers perceive their roles and their students' roles in the flipped classroom?
4. What are the factors that contribute to effective/ineffective implementation?

Several commonalities were noted as I began analyzing the data. When examining the interview transcripts, common themes emerged through the coding process. However, those commonalities were not supported by the classroom observations. The data from the Observational Fieldnotes also revealed some common themes, but they were not supported by the interviews or surveys results. Since I could not triangulate the commonalities between all three sources of data, I did not consider these topics to be overarching themes. One major theme, however, was brought out through the triangulation process. All data revealed the classroom environments to be student-centered and not teacher-centered. I will now explore this theme in context of the research questions with examples from classroom observations and interviews with teachers.

Research question #1: How is the flipped classroom structured?

The interviews revealed that teaching practices had changed in the way lessons were prepared. Teachers indicated they had to anticipate questions and problems as they were preparing for a lesson. This process required a great deal more thought about the lesson than they had previously experienced, as they had to learn to become very efficient and concise in their lectures and they had to determine the most important points to record. The teachers commonly reiterated phrases such as, "so much more thought that goes into how I present it" and "student-centered thought process".

Because of the deliberate thought put into preparing for the lessons, all the teachers stated they felt this process made them better teachers.

Participant videos. All of the teachers in this study made their own videos. Science Teacher B made his videos using Camtasia Studio and posted them to a private YouTube channel. Science Teacher D made her videos using a free software program and recorded them using the camera on her laptop. Math Teacher A created his videos using doceri, which is an ipad app. This app hosts the videos on its website, but this teacher also posted them to YouTube. Math Teacher C made his videos with a free software program and recorded them using his laptop. He posted his videos to Weebly, which is a site that was initially available in the district but was subsequently blocked at the beginning of the school year.

Because of the district's technology policies, YouTube is blocked for students so students cannot watch videos on campus unless they are using a device that the teacher had logged on to. Weebly is also blocked, but it is blocked for both teachers and students. The doceri site is not blocked and students can access those videos on campus. Subsequently, in all but Teacher A's classes, students were not able to watching videos in class and had to find off-campus resources to watch them via the Internet.

The math teachers' videos averaged between 10 and 15 minutes in length. Science Teacher D's videos were not more than 15 minutes long, but Science Teacher B reported that his videos were between 30 and 45 minutes long. Teacher B explained that his videos were longer because they spanned multiple days. Students in these classes had the opportunity to watch the video in its entirety, or watch segments of the video over multiple days during the unit. Teacher B reported that even though the videos corresponded to approximately 15 minutes per night, he intended to work on reducing their length going into his second year of flipping his classrooms.

Math teachers made more than double the number of videos that the science teachers made. Math Teacher A had only been flipping his classes for about six weeks when this study was conducted so he had only made a limited number of videos. He reported that he thought that number was approximately 30 videos. Math Teacher C, who had been flipping his classroom for the entire year, had made 96 videos as of the time he was interviewed, whereas Science Teachers B and D had made only 42 and 44 videos respectively.

It is not surprising that the quantity of math lecture videos greatly outnumbered the total science videos. In a typical math class, a new skill is routinely taught every day; therefore, a new video is necessary for every lesson. For example, if the broad topic is finding slope, there would be a video on finding slope from a graph, another video on finding slope using an equation, still another on finding slope from two points, etc. In the science classrooms, however, the videos dealt with units of study. For example, in Biology one of the units was on DNA so the video presented background information about DNA. Students engaged in multiple activities and laboratory experiments over a two-week period, yet only two videos were made for the entire unit.

Math Teacher C and Science Teacher D did a brief reference to the video before beginning the day's activities. The math teacher went through one problem on the board, asking questions about how to work it. The science teacher asked a series of extension questions. Her questions were not fact-based questions, but probing questions that assumed the students had a certain knowledge base gained from watching the video lecture, and then extending that base to a "What would happen if…" scenario. In every observation in these two teachers' classes, this practice took between five and seven minutes.

The other two teachers had a different approach. In the interviews, they both reported that they "jumped right in" with the day's activities. Classroom observations supported this claim as students immediately got to work once they heard the directions and picked up any needed materials. These two teachers felt that if they recapped the videos, then the students who had watched them had "lost any sort of validation" for doing what they were supposed to do.

Teachers A and B stated that they strategically constructed the student groups knowing that at least two students in each group consistently watched the videos. Both teachers felt like the peer pressure from the prepared students had a substantial impact on the students who did not come prepared. Science Teacher B stated:

> I want them to feel uncomfortable with the idea of being given a high level task and not being prepared. And I think that kind of pressure and the pressure of the remainder of the group with the kids that were ready and not being happy with the one that's not really, kinda kept that edge a little—to push them a little more to try to be more consistent with the videos.

Both of these teachers noted that peer pressure was much more effective than pressure from the teacher. Peer pressure did not eradicate the problem of those few students who did not come to class prepared, but it did help with their level of classroom performance. Classroom observations supported this idea on two occasions when students were observed chastising a group member for not contributing. Because of seeing this reaction in multiple classes over a long period of time, both these teachers indicated they thought this strategy was working well.

The teachers all reported different numbers of students who came to class not having done their homework. Teacher A noted about 70% of his students came to class prepared on a regular basis. Teacher B reported that 80% of his on-level students were prepared and about 95% of his honors students came to class ready to work. The third teacher, Teacher C, indicated he thought his numbers were somewhere in the 30-50% range, noting that the students who did not watch the video were the same ones who would not have done homework anyway. Teacher D said that not all of her students came ready on the first day, but because her video spanned multiple days, about 95% of them had watched the video by the deadline. All of the teachers indicated that many students told them they watched the videos, or re-watched them, before the end of the unit to help prepare for the test.

Teacher A started class right away and had any unprepared students watch the video on their smartphones while working in class. Since Teacher A's videos are posted on doceri, students were able to access them while on campus. Observations in this class revealed that every student in Teacher A's had a personal device to access the videos. On one occasion, when a student had left his smart phone at home, the teacher accessed the video on his personal ipad and handed it to the student to watch. During the interview, the teacher revealed that while this was unusual, he occasionally had to loan a student one of his devices to watch the video in class.

Student-centered classroom. All of the classrooms in this study had desks grouped together in groups of four to encourage collaboration among the students. As students came into class, took their seats, and waited for class to begin, the similarity to the traditional classroom ended. Instead of beginning a lesson, these teachers gave a few directions about the activity or assignment and the students began working. The time that would have been spent on direct instruction was devoted to students who were engaged in discussions, problem solving, or other learning activities that had been designed by the teacher.

Problem-solving activities were frequently observed in the science classrooms. Tasks would be given that utilized the background knowledge gained in the videos and students had to extend that learning to new situations. Students were observed working together to try to collectively apply their newly gained knowledge to novel situations. In the DNA unit, for example, students had to apply their understanding of DNA to try to determine characteristics and traits of various life forms. What traits may have been found true for one life form might not work for another life form and they had to determine why this was true and defend their decisions. Science Teacher B discussed his preparation for these kinds of activities and stated that he designed the lessons with "a student-centered thought process with higher-level application sorts of activities where they're actually using that knowledge and immediately jumping into something". This was also observed in Science Teacher D's classroom as all of her activities were extensions of the video lectures. She was frequently observed asking questions like, "What would happen if you changed this one piece of the puzzle? What would happen to the environment if …?" In her interview, she stated that application of knowledge is "an excellent way for students to gain a better understanding of the material".

In the math classrooms, observations revealed students working together in groups to solve problems. In the first year of flipping, the math teachers truly reversed the classwork and homework. Students worked in groups to solve problems. The worksheets were practice problems designed to mimic the ones they had seen on the video. The math teachers were aware of this and actively talked about enriching their classroom activities in the next year. Math Teacher A stated, "I need some more creativity in what I'm doing in the classroom."

All of these teachers spent the entire class period working with each student, or groups of students, to answer questions and provide assistance when necessary. The survey results support this observation. The question in the Classroom Practices portion of the survey that dealt with more time to work with individuals and more time to support student learning each had median scores of 4.50 with very little variability. This shows an alignment of teacher perceptions and classroom observations.

As the teachers moved around their classrooms, it occasionally became necessary to bring the whole class together to address common difficulties or areas of confusion. After a whole class discussion, which consistently lasted between three and five minutes, the students would resume their work and the teacher would resume the supporting role. At no time were the teachers observed lecturing.

Since these were veteran teachers, all of them had experience in knowing where students have trouble with a particular topic or concept. If the information in the video dealt with a particularly difficult topic, the teachers sometimes gave a brief recap of the video before allowing students to begin their work. This practice was rare and was only observed three times. In each of these times, the recap lasted less than five minutes.

The structures of the flipped classroom consist of up-front teacher preparation, a collaborative learning environment, and well-designed classroom activities. When these elements are all present, learning is maximized.

Research question #2: How do teachers perceive student learning in the flipped classroom?

Student learning was explored from two different aspects: student achievement and student understanding. As for student achievement, Math Teacher C and Science Teacher D reported that grades were “about the same” as in previous years. Math Teacher A and Science Teacher B, however, indicated that overall averages were a little better than in previous years, but that the gains were modest. Each teacher stated the increases were not more than a couple of points in overall averages. However, Math Teacher A stated that with some of his students, he saw a sharp increase as grades went from D’s to A’s. He attributes that increase directly to flipping his classes. In describing a specific student, Teacher A stated:

> The one kid that came up at the end, he went from failing to…He’s making 100’s now. He not just bumping up to a better grade, he’s off the charts better. The thing for him was, traditionally, they have this one shot to get the information. One shot, that’s it. That 50 minutes. If you didn’t pay attention, you’re not gonna get it another time. Cause when? So, he wasn’t getting it, he was failing because he was gonna sit back there and get on his phone. Now he and the other kids are learning when they’re ready to learn.

Science Teacher B reported that he thought the students that seem to benefit the most were the ones that he called the “middle kids”. He described the middle kid as a student who traditionally has made low C’s. Those students are now making B’s and he thinks it is because of flipping his classes. This teacher indicated that students were asking better questions and were more engaged in class.

Even though the teachers taking part in this study did not report seeing overall increases in grades, there are other reports from across the country that claim the opposite. SOPHIA, an online social educational platform with over 25,000 free academic videos, recently conducted a nationwide survey. In the 2012 survey, 67% of teachers responding reported seeing an improvement in students’ grades and in the 2014 survey, 71% reported an increase in averages (SOPHIA, 2014). The Flipped Learning Network also recently conducted a survey. In this survey, of the 453 educators responding, 67% of them reported improved student test scores (LaFee, 2013). Neither survey, however, reported on the length of time the teachers had been flipping their classrooms so it is impossible to know if time and perfection of the practice is a factor.

Three of the four teachers stated that while they had not seen a dramatic increase in student grades, they had seen a tremendous impact on student understanding. Two of the four teachers teach on-level math classes. Both reported that students were more engaged in class, asked better questions, and spent more time working to solve problems with their groups instead of just relying on the teacher to help them. Teacher B teaches both on-level and Honors Biology classes. He indicated that student understanding is significantly higher on both levels. The fourth teacher, Teacher D, talked about the kind of students that take an AP class: "These students are typically more motivated. They come to class with a certain knowledge level as well as work ethic." Because of the type of students that typically take AP classes, she noted that she did not really see a big increase in understanding.

Student-centered classroom. Classroom observations revealed the teachers motivating student learning through collaborative activities. In a student-centered learning environment, students are actively engaged in their learning and every observation supported this idea.

In the math classrooms, students worked together to solve problems. Every observation supported the student-centered environment as students were observed helping each other as they worked through the material. The classroom learners were observed asking each other questions and working together to figure out solutions. As the teacher moved through the room, checking with various groups, I observed questions being asked and answered. I heard students say, "Oh, I get it" on numerous occasions.

On one occasion I observed a graphing game with the individual student white boards.   Math Teacher C's classes had been studying graphing rational functions and he wanted to assess student understanding. The teacher put a problem on the board and the students quickly began to graph the function on the white boards. As students held up their boards, waiting for the teacher's feedback, the environment quickly became competitive and students were laughing and enjoying the game. This activity was a fun, quick way in which the teacher could assess student understanding of the material.

In another classroom, I observed a snowball fight. Math Teacher A wanted to know if his students understood the material from the previous night's video, so he wrote problems on pieces of paper and wadded them up. When students came into the room, the teacher explained the snowball fight and threw the wadded-up pieces of paper. Each group was to get one of the snowballs, work the problem on the board, throw the snowball, pick up another one and work that problem. This exercise was a fun and friendly way for the teacher to assess student learning.

Research question #3: How do teachers perceive their roles and their students' roles in the flipped classroom?

The third research question was about teacher perceptions. How do teachers view their roles and their students' roles in the flipped classroom? Three of the four teachers stated that using this model had not changed their ideas about teaching. One teacher said that his ideas about teaching had not changed, just the delivery method. Teachers C and D both agreed, with Teacher C commenting that the model is a different means to the same end; that the goal had not changed. But Teacher B had a different idea.

Student-centered classroom. Science Teacher B said this model had completely changed his ideas about teaching. Before transforming his classroom to the flipped model, he was a lecturer and "very proud" of himself. He commented that he often did not have time to let the students do a lab or an activity because class was all about *his* instruction and *his* leading the class. Since employing the flipped model though, he has totally changed his classroom from a teacher-centered environment to a student-centered environment. As a result, that shift has done “wonders for the kids.” He goes on to state:

> My first years of teaching I was just the all-knowing expert that you’re honored to be in my presence and you’ll sit back and listen to everything that’s amazing that I have to say. It was very much lectured-based instruction. Within 5 days of the week, 3 days were about me instructing and leading the class. And only a couple of times I was actually able to let the kids do a lab or work on something, but it was only after they heard my expertise. I’ve slowly been pulling away from that, but this model has really gotten me to the point where I am completely comfortable not being the focus of attention—not being the center of attention. That’s a huge change. It’s moving from a teacher-centered to a student-centered environment.

Math Teacher C also acknowledged his changing role when he stated that he has more time to “spend one-on-one or one-on-group with the kids”. He told me the greatest strength of this model was that he now has time to “work with small groups of kids instead of standing at the front of the room telling them what they needed to know”.

These teachers’ roles have metamorphosed from being a director of learning to an activator of learning. This is supported by the survey results. The question about the teacher’s role changing had both a mode and a median of four with little variability. The result of this philosophical and pedagogical change in teaching means that teachers’ perceive that student roles have also changed. The survey results show the teachers were even stronger in their opinions about student roles. The question dealing with teachers’ perceptions of students’ changing roles had a mode of five.

The typical dependent learner, who sits in many secondary and post-secondary classrooms, is learning to be more independent in the flipped classroom. Students sitting in these teachers’ classrooms were actively engaged in learning. They discovered it was not possible to sit back and wait for the teacher to tell them how to solve the problem;

that they had to take some responsibility for their own learning. These teachers challenged their students to take more control of their learning and to help each other to solve problems.

Research question #4: What are the factors that contribute to effective/ineffective implementation?

Classroom observations revealed in-class activities effective in keeping students engaged in the learning process. Students were seen collaborating with each other and with the teacher. Without a lecture devouring 20-30 minutes of class time, teachers were able to work with more students in a one-on-one capacity.

Participant interviews supported these observations as all the teachers felt the flipped classroom was an effective model. Math Teacher A reported:

> I believe the flipped classroom model was extremely effective in my class. Not knowing exactly what I was doing probably held my kids back in gaining the maximum benefits from it, however, even with some shortcomings, my students improved. I am looking forward to continuing with the flipped model in the future.

Science Teacher B stated, “Absolutely effective. I’m not going away from this.” Math Teacher C agreed stating, “I think it’s effective, yes. I like it a lot better than the way we were doing things last year.” And Science Teacher D reported, “I think this is an excellent way for students to gain a better understanding of the material.”

Student-centered classroom. Three of the teachers indicated that this model had not changed their ideas about teaching—just their delivery methods. Science Teacher B said flipping his classroom had completely changed his ideas about teaching. He discussed the shift from a teacher-centered room to a student-centered environment and that students were no longer able to hide and do nothing. By changing his ideas and procedures in the classroom environment, he felt like it had "done wonders for the kids."

The interviews revealed that all four teachers were very pleased with the flipped classroom model and all four intended to continue with it in subsequent years. All four reported that the greatest strength of the model was being able to work with students, individually and in groups. By removing the time spent in front of the classroom talking, they were able to engage and activate learning in more meaningful ways, and take advantage of the community of learners in the classroom. All the teachers related that student-to-student interactions improved. They also all told me that student-to-teacher interactions had improved significantly.

One of the classes I observed in Science Teacher D's class was in the unit on Solid and Hazardous Wastes. The topic for the day was Sustainability. The teacher had given background information in the homework and the day's activity was entitled *Comparing Trash Over the Last Century*. Students had to examine a family's trash content and amount at given time intervals of 1850, 1920, and 1990. The students were given the percentages for the amounts and types of trash and had to make conjectures based on the data. Discussions in the groups resulted from questions such as, "How did lifestyles differ? What is different about the means of disposal now as compared to prior years? Even though the same family generates less trash, what two factors make municipal waste a greater problem now than in prior times?" The last task for the students was to come up with 10 different ways to make their high school more sustainable.

Students directed the discussions during this class. My observations noted students actively engaged in this activity, resulting in a very positive, effective learning environment.

Supporting Data

Classroom observations of time on task

The number of students on task was recorded in ten-minute intervals. Those numbers were converted to a decimal and averaged for each class period. Means were found for each teacher. Over the course of this study, students were found to be on task 93% of the time. Observations revealed that when students were not on task, they were having conversations with other students or checking their phones for messages, both of which are somewhat typical for high school students. Classroom observations showed that this off-task behavior occurred in short intervals as is indicated by the high percentage of time-on-task. The other time students were found to be off task was when they finished their work before the end of class and had nothing to do. It was observed that students in the science classrooms did not finish early as the activities took the entire period. In the math classrooms, however, a few students completed the problem sets before the end of class and were left with nothing to do. This observation was made in every class in Math Teacher A's classroom and two out of eight times in Math Teacher C's classroom. During the interviews, the math teachers made it clear that they were keenly aware of this problem and hoped to be able to provide richer classroom activities, as opposed to only problem sets, in subsequent years.

When the students in Math Teacher A's class finished early, they would ask for the next video lesson so they could get ahead. This request was observed three times in Math Teacher A's classroom, but only once in Math Teacher C's class. Since this was the first year into this model, neither teacher was far enough ahead in the lesson planning cycle to be able to meet this request.

Teacher surveys

The survey was constructed using Likert items that were separated into four domains: Lesson Planning, Classroom Practices, Student Performance/Engagement, and Reflection. The purpose of the Lesson Planning domain was to help understand what teachers thought about planning a lesson using the flipped model as compared to before they flipped their classrooms. The domain of Classroom Practices had Likert items that related to the learning environment, including items dealing with more student choice in learning. The items in the Student Performance/Engagement realm dealt with teacher perception about student achievement and understanding. The final domain, Reflections, had items that related to the changing role of the teacher and the students, and the personal interactions in the classroom.

The teachers ranked their opinions based on a scale of one to five with one being "Not at All" and five representing "To a Great Extent". Five indicates that a teacher is in complete agreement with the item; therefore, when looking at five as the maximum rank, it was possible to measure the teachers' overall favorability in each domain. If a teacher were to rank every item as a five, the total ranked points would equal 145. Table

1 reflects the sums for each teacher by domain for the first administration of the survey. Table 2 reflects the sums of the second administration.

When examining the sums from the first administration, Science Teacher B had the highest number in responses overall and in every category. Science Teacher B's sums were 90% of the total number indicating he was 90% of the way to being "To a Great Extent" in every category. Math Teacher C's responses yielded the lowest percentage. The percentage of 68%, putting Math Teacher C closer to the middle between "Not at All" and "To a Great Extent".

Table 1. Teacher Survey Sums First Administration

Domain	Teacher A	Teacher B	Teacher C	Teacher D
Lesson Planning (50 maximum)	35	46	37	37
Classroom Practices (30 maximum)	27	29	18	24
Student Performance/Engagement (30 maximum)	20	23	19	22
Reflection (35 maximum)	32	33	25	28
Total Sum (145 maximum)	114	131	99	111
Percentage	79%	90%	68%	77%

The sums in the second administration were very close to the first administration. All the sums were greater than in the first administration, but not by a large amount. Math Teacher A's increases were the greatest as his overall sum rose by four points. All the teachers' percentages stayed within two percentage points of the initial administration of the survey.

Table 2. Teacher Survey Sums Second Administration

Domain	Teacher A	Teacher B	Teacher C	Teacher D
Lesson Planning (50 maximum)	37	46	37	37
Classroom Practices (30 maximum)	28	30	18	24
Student Performance/Engagement (30 maximum)	21	24	20	23
Reflection (35 maximum)	32	34	26	28
Total Sum (145 maximum)	118	134	101	112
Percentage	81%	92%	70%	77%

Table 3 shows the measures of central tendency that were calculated to help complete the data picture. Those measures include mean, mode, range, and IQR. The median is not reported as it usefulness is limited (Creswell, 2008). The items that show the greatest and least variability did not change from the first administration to the second.

In Domain 1, Lesson Planning, the greatest variation was in the item about planning better formative assessments. This item was also the one that showed the most variability in the entire survey. This was followed closely by the teacher's ability to differentiate instruction.

Classroom Practices, which is Domain 2, had two items that showed the greatest variability in responses. Those items were: Learning is more active and Students have more control over their learning.

In Domain 3, Student Performance/Engagement, the greatest variability in responses had to do with students applying knowledge.   And Domain 4, Reflection, did not have any items that showed as much variability as in the first three domains. In this Domain, the response ranks were much closer together.

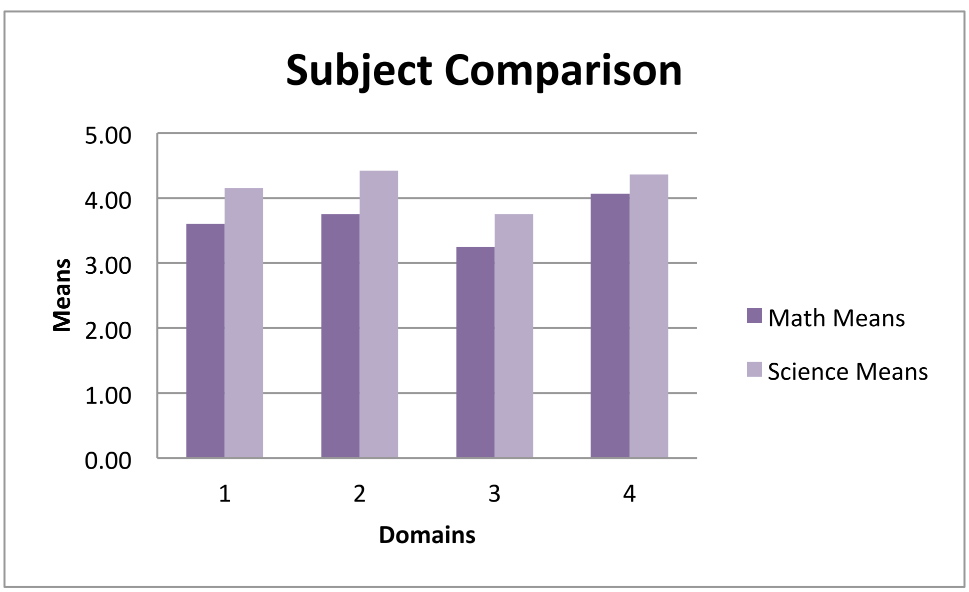
Table 3. Survey Results with Measures of Central Tendency

Lesson Planning	Mean	Mode	Range	IQR	SD
Q1- Improving planning	4.50	4 and 5	1	1.0	0.50
Q2- Changing thinking about learning	4.50	4 and 5	1	1.0	0.50
Q3- Deepen subject understanding	3.25	4	2	1.5	0.83
Q4- More effective learning	4.25	4	1	1.0	0.43
Q5- Plan better formative assessments	3.75	5	3	2.5	1.30
Q6- Plan instruction for individual needs	3.25	3	3	1.5	1.09
Q7- Change my role to facilitator	4.50	4 and 5	1	1.0	0.50
Q8- Differentiate instruction	3.50	No mode	3	2.0	1.12
Q9- Establish expectations of learning	3.75	3	2	1.5	0.83
Q10- Narrow focus to main learning	3.50	4	2	1.0	0.87
Classroom Practices					
Q1- More time to work with individuals	4.50	5	2	1.0	0.87
Q2- More time supporting learning	4.50	4 and 5	1	1.0	0.50
Q3- Learning responsibility shifted	4.25	5	2	1.5	0.83
Q4- Learning is more active	4.00	5	3	2.0	1.22
Q5- Students have more choice	3.00	4	3	2.0	1.22
Q6- Students have some control	4.25	5	2	1.5	0.83
Student Performance/Engagement					
Q1- Students complete more assignments	4.00	4	2	1.0	0.71
Q2- Students more engaged	4.00	4	0	0.0	0.00
Q3- Students engaged in critical thinking	3.25	3	1	0.5	0.43
Q4- Students apply knowledge	2.50	No mode	3	2.0	1.12
Q5- Increase in student understanding	3.75	4	1	0.5	0.43
Q6- Increase in student achievement	3.50	3 and 4	1	1.0	0.50
Reflection					
Q1- Positive interaction between students	4.50	4 and 5	1	1.0	0.50
Q2- Positive interactions teacher/students	4.75	5	1	0.5	0.43
Q3- All students have benefited	3.00	3	2	1.0	0.71
Q4- I can increase student achievement	4.25	5	2	1.5	0.83
Q5- Increase in expectations for learning	4.50	4 and 5	1	1.0	0.50
Q6- My role has changed	4.00	4	2	1.0	0.71
Q7- Students' roles have changed	4.50	5	2	1.0	0.87

When analyzing the data, I noticed that the science teachers consistently ranked a greater degree of satisfaction than did the math teachers. The difference in the means of the math teachers was 0.62 and the difference in the means of the science teachers was 0.65. These differences were very close, but overall I expected to see a higher degree of satisfaction and there was no expectation to find differences along subject lines. Figure 4 shows the results of this analysis.

The differences between the means (with standard deviations in parentheses) for Domains 1 through 4 were 0.55 (0.39), 0.67 (0.47), 0.50 (0.35) and 0.29 (0.21) respectively. The overall difference in the total means was 0.50 with a standard deviation of 0.36.

Figure 6. Subject Comparison



Summary

By the time this research was conducted, the flipped classroom had been utilized for slightly more than a semester in three of the four classrooms (four six-week time periods). In these classrooms, routines were well established. In the fourth classroom, Math Teacher A had only been flipping his classes for about six weeks so his classroom practices were not as established as they were in the other classrooms.

The teachers maximized the structure of the student groups in an effective manner. If the teacher answered a question for a specific student, and another student had the same question, the teacher would often have that student explain to the rest of the group or to the next group. In this respect, it was noted that if the student could explain the concept or problem so that other students understood it, then the original student really understood the material.

The teachers never sat down at their desks or positioned themselves at the front of the room at the document camera. In every class period, the teacher was observed constantly moving from group to group, checking on students, asking clarifying questions, and answering questions if a student, or group of students, got stuck on a problem. Different groups of students had confusion at different places in the problems, but by working with small groups, the teachers were able to meet the needs of individuals or groups working in the same area.

Students were able to spend class time doing the work of mathematicians and scientists, not just watching the teacher do the work. At no time did any of the instructors teach a lesson. On occasion, when a prevalent misconception was present, the teacher would bring the class together and address the entire class. This lasted an average of three minutes and then students went back to work.

The findings in this study were consistent with what was expected to find, with the exception of differences along subject lines. The quantitative data supported the qualitative data. Overall the data shows teacher satisfaction with the results of their efforts in this first year of flipping their classrooms.

CHAPTER V

DISCUSSION, IMPLICATIONS, AND CONCLUSIONS

This section provides a summary of the research findings, a discussion with interpretations relating the findings to existing literature, possible implications, and the conclusion. The chapter is divided into six sections. The first two sections offer a summary of the purpose, methods, and findings, followed by the limitations of the study. A discussion of the research questions is provided in part three followed by implications and considerations for practice in light of current research. Part five contains recommendations for future practice and suggestions for further research. Part six concludes this record of study.

Summary of the Purpose, Methods, and Findings

This study examined veteran teachers' practices when flipping their classrooms for the first time. The purpose was to understand what actually happened in the classroom and what teachers did to prepare for classroom learning experiences.

A qualitative case study approach was used for this study. This method was chosen because I was attempting to understand teacher practices in their natural classroom setting (Denzin & Lincoln, 2005) when attempting a paradigm shift. Qualitative case study research is useful when there is a clearly identifiable case with boundaries (Creswell, 2007; Stake, 2005) and the need exists to make sense of an issue.

Since teachers across the country are experimenting with this model, it is an issue that needs to be explored.

Before the study began, all available information on the flipped model was explored in order to become familiar with the model. After gathering initial information, the research began by conducting participant observations. Observations were carried out in order to gain a greater understanding of the educational paradigms in place in the classrooms, the learning activities, and the interactions and dynamics in the classrooms that were being flipped.

After three weeks of classroom observations, teacher surveys were sent out. The surveys were sent out via email and returned in the same manner. Three more weeks of observations ensued and the surveys were sent out again, after the observations were completed. The delivery and retrieval method for the surveys was the same for the second administration.

Data were also gathered through participant interviews conducted at the conclusion of the observations. By interviewing the teachers, I was able to gain a more thorough understanding of the teachers' perceptions since those thoughts and ideas were not readily observable. All the interviews were conducted in the individual teacher's classroom on his/her conference period at a time of the teacher's choosing.

After the data had been gathered, the analysis began. As part of the analysis process, observational field notes were studied and coded for examination of broad themes. Transcripts of the digitally recorded interviews were subsequently analyzed and coded. Excerpts from the transcripts were sorted by codes and frequencies tabulated according to the responses. The survey data were analyzed by calculating measures of central tendency to explore patterns in the data. Broad themes were proposed and data re-analyzed and triangulated to confirm the preliminary analysis. All the data were then subsequently re-examined and triangulated and the number of themes was reduced.

The findings of this study revealed broad themes related to teacher practices and perceptions in the flipped classroom. As discussed earlier, different sources of data revealed different patterns, but the triangulation process allowed me to focus on one major theme. During the discussion of the research questions, the findings will be interpreted according to available literature.

Limitations

There are several limitations to this study that need to be noted. At the time this study was conducted, only four teachers in this district were implementing the flipped classroom model. A convenient sample was used to involve the four teachers who volunteered for this study. This is a limitation for generalizing the results of this study.

Another limitation is based on the economics in the district in which the study took place. The demographics and income vary greatly due to the expanse of the district. One part of the district is very wealthy, while another part has a very low socio-economic status. Only one of the schools in this study has a majority of their students that come from very wealthy families. The other two schools have a much more diverse population with neighborhoods representing less wealth. Overall, however, since this district has a mixture of households that have incomes at both ends of the spectrum, this study may have some benefits to offer other districts that are similar.

This school district is a large suburban district in Texas and may not be representative of many school districts in the United States. This part of Texas attracts many businesses to the area that results in a large tax base. Because of the large tax base, the district can afford to pay salaries above the state averages. A higher income attracts many applicants, resulting in many highly qualified teachers. School districts that do not have the means to attract highly qualified teachers may not experience the same results.

The data collected in this study took place over a six weeks grading period in the spring semester, and may not reflect overall performance. The teachers in this study had about a semester to adjust their classroom practices before participating. Teacher experience and time spent on the flipped classroom model will vary from teacher to teacher, but results may vary from a study conducted over a longer period of time.

Another limitation concerns students. Because the teachers in this study had decided to flip their classrooms, students did not have a choice as to the method of instruction they received. This lack of random classroom assignment may prevent this study from being generalized to a larger population.

Finally, by the inherent nature of a qualitative case study, my experience and bias as a researcher is a potential limitation. In addition, my personal values and experiences could potentially limit my objectivity in my reporting to my potential audience.

Discussion of Research Questions

The research questions will be discussed in this section. The discussion will offer an interpretation of the findings of this record of study within the context of the available literature to support my understanding of teacher's perceptions of the flipped classroom. The research questions were all answered using data from classroom observations and participant interview questions.

Research question #1: How is the flipped classroom structured?

There are two key components of this question. The first element was to help me understand the teacher planning and preparation for the flipped classroom and the second component was to observe what actually happens in the classes that were being flipped. Putting these elements together helped me to gain an understanding of the practices used by experienced teachers when attempting a new pedagogical model. The following is a discussion of the theme and my interpretation of the findings in light of this theme.

When the teachers were interviewed, they related their experiences about preparing for and delivering flipped classroom instruction. All four participants agreed that much more up-front time was needed. Math Teacher A stated, "There's so much more thought that goes into how I present it, but it's not only that, I'm trying to anticipate questions that will be asked". Math Teacher C agreed stating, "The biggest thing was I had to think farther in advance." Both science teachers were also in agreement with Science Teacher D expressing "There's more planning for activities" with this model. Survey results support these ideas showing means of 4.5 on both items: “Improved my ability to plan instruction” and “Improve the way I think about learning.”

The second component of this question dealt with the day-to-day classroom experiences. Classroom observations revealed the teachers did no lecturing in the classroom. Math Teacher C and Science Teacher D asked questions relating to the video, which might constitute as a quick recap, but Math Teacher A and Science Teacher B started class activities right away based on the assumption that students were prepared for class. Any student that was not prepared in those classes quickly caught up.

Students were observed working in collaborative groups and engaged in solving problems. Teachers spent the entire class period working with individuals and with groups, asking questions and probing thinking. The survey questions dealing with classroom practices supported the observations as “I have more time to work with individual students” and “I am able to spend more time supporting student learning” both had means of 4.5 indicating they were in agreement with the items. Science Teacher D stated:

> Pretty much when I lectured in class, many, many of them pulled out their phones, heads down, you know, were not engaged. And I tried questioning, how can I get around conveying this information; they need the basics. You can’t do that all through questioning. They have to see some of these things. You have to write it down for them. I just felt l like straight up lecturing for 20 or 30 minutes during the class period was very ineffective.

Research question #2: How do teachers perceive student learning in the flipped classroom?

Student learning was broken into two components. The first part of the question dealt with student achievement. The teachers reported seeing huge gains with individual students, but felt that overall averages were pretty comparably to averages in previous years. When speaking about grades, Math Teacher C stated, “I feel that it’s probably about the same. I don’t really see that it’s dramatically higher.” The teachers’ opinions, however, did varied slightly in their perceptions of student achievement. The Likert item dealing with “Demonstrating an increase in achievement” had a mean of 3.75, which supports those reported perceptions. All teachers agreed that since this year’s students were a different group of students from last year students, it was hard to make a true assessment of student achievement. As one teacher stated, “more data is needed in order to make more accurate comparisons”. While these teachers did not see a dramatic increase in grades, reports from across the country indicate grades are increasing dramatically in schools where the flipped classroom has been employed (Clintondale High School, 2013; Driscoll, 2012; Pearson & The Flipped Learning Network, 2013; SOPHIA, 2014).

The second part of the research question had to do with student understanding. Classroom observations showed students working together and explaining problems to each other. It was also observed that students were able to answer more “why” questions from the teacher than in a typical classroom. Understanding why something happens usually relates to a greater understanding that just “how” something happens.

Teacher interviews revealed their perceptions of student understanding. Math Teacher A reported, “The best way to put it is…I see a difference in student understanding.” Agreeing with him, Science Teacher B stated, “Understanding is significantly higher. Math Teacher C’s comments were, “I think that they do understand it better." Science Teacher D had a slightly different opinion. As far as an increase in student understanding in an AP class, she stated:

> With this class, it's about the same. I had hoped, but again this is the first year, so anytime you're doing something for the first time, it's very new. These kids are probably a little more motivated than the typical on-level kid so that may make a difference.

Research question #3: How do teachers perceive their roles and their students' roles in the flipped classroom?

Weimer (2002) states, "Current instructional practice often finds us in the spotlight, at the center of the action, but our persistent position there compromises the learning potential of students" (p. 94). In this new paradigm, the role of everyone in the classroom is changed. The teacher does not stand at the front lecturing while students passively receive knowledge. In the flipped classroom, students have to take more ownership of their learning and the teacher becomes more of a guide or facilitator. In Math Teacher A's interview, he stated:

> The delivery of information is the biggest part of it. They are in control of it. They are learning when they want to learn…If I can get them to pay attention in class doesn't mean they're ready to learn it. When they push play, they're ready to learn it.

Science Teacher D noted that by not being a classroom lecturer, it "frees up the teacher in the classroom" to work with students on a more personal basis.

Survey results on the items "My role as a teacher has changed" and "My students' roles as learners have changed" reveal means of 4 and 4.5 respectively. This supports the expected results that teachers perceive this model has changed the roles of all the participants.

Research question #4: What are the factors that contribute to effective/ineffective implementation?

Since there is no one single model for the flipped classroom, the answer to this question cannot be all-inclusive. Merriam-Webster.com defines effective as "producing a result that is wanted". Teachers everywhere are realizing that as our demographics and learners change, our tried-and-true teaching methods are no longer as effective as they once were. Recognizing the need to make adjustments to reach our changing learners is driving teachers to make pedagogical changes. These changes are being made because many of the results that are wanted are not the results being realized.

Communication with all stakeholders is a vital component of this pedagogical shift. Depending on district policies, such as instructional procedures and technology requirements and/or restraints, central office personnel may need to be informed. Campus administrators also need to be informed. Administrator support is important when stepping out of the normal routine. Administrators do not want to be caught unaware, so it is important to keep them informed. Parents and students also need to be informed. Not understanding classroom policies and procedures may result in misunderstanding, especially when trying something new. One of the main points brought up in the Allen Independent School District's presentations was the importance of communication with all stakeholders (Casto, 2012).

Teachers should always have clearly established classroom policies and procedures. In the flipped classroom, routines and procedures are important in order maximize learning. Since more time is available, teachers who have procedures in place are less likely to end up with students engaging in off-task behaviors by finishing early and having nothing to do.

Since the flipped classroom utilizes technology, several technology areas must be explored. The platform that will host the videos is one that must be considered. Teachers must think about where the videos will be accessible. If the videos will be hosted on a district website, district policies will need to be examined. If the videos are hosted on an outside platform such as YouTube, teachers will need to know if videos can be accessed at school. If the videos are recorded using an app on a tablet, teachers will need to explore whether the app is device agnostic.

Another area of consideration is the hardware and software that will be used to create the videos. The teacher will need to know whether the videos can be made at school with school equipment, or must be made at home on a personal computer. The software used to make the videos will also need to be researched. Teachers will need to know if free, readily available recording software is sufficient or explore the cost of purchasing a more sophisticated software program.

One of the major considerations with the flipped model is equity of access to technology. All teachers must address this issue and work to resolve it. In the case of Math Teacher A, access was not an issue. He stated, “I have had no issues as all.” He reported that all his students had Internet access at home. With Science Teacher B, about 25% of his students did not have reliable Internet access. All of his students had access to a computer, either at home, in the school library, or other places in the community, so he elected to make DVD’s for the students. Whenever a new video was posted, he would hand the DVD's out to students. This teacher reported that he "probably makes about 30 DVD's for each video lecture." Math Teacher C only had a handful of students without access. Out of the three classes he was flipping, he said there were five or six students with issues of Internet access. He did not grade the video notes for these students and reported that these students just "survived" in spite of the technology issues. He did not hand out recordings of his lectures since these students told him they sometimes went to friends' houses to watch the video. Science Teacher D, like Math Teacher A, had no issues with accessibility.

When teachers re-teach material presented on the video, the students rapidly learn that they do not have to do the homework because the teacher will just go over the material again. The teachers in this study quickly realized this and only did a brief recap in the event of a very difficult topic or if they noticed that a large majority of the students had not watched the video. When this happened, it was often the day after a student activity (football game, etc.). However, the teachers took these activities into consideration when assigning homework and, as a result, this was rare.

"Lack of access is, of course, not the same as choosing not to do the homework", lamented Math Teacher C. Students not completing homework is nothing new, but in the flipped classroom that means that students missing out on some instruction. Each teacher approached this problem differently. Math Teacher A had the expectation that students would get their phones out in class and watch the video as they were working through the problems. I observed this several times. The teacher did not have to say anything to the students; they started watching the video as soon as class started.

Science Teacher B simply set up the expectation that the students would watch the video. He did not recap the video at the beginning of the class and used student group peer pressure to help students to want to be prepared for class. He told me that a student would occasionally come in before school started to watch the video if there had been an issue. Math Teacher C stated that in order to address this issue, he did a brief recap of the video lesson at the beginning of class so students that did not do the homework could get a sense of the lesson. His comments were confirmed by classroom observations in which I observed him giving an overview of the video. Each recap lasted less than 10 minutes. If Teacher D saw that a large number of students did not watch the video, she would quickly go through the material; otherwise, she let the groups' peer pressure take care of any individual students who were behind.

Only two of the teachers reported showing students how to watch the videos and take notes. One of the teachers tried to do so, but the website where the videos were posted was blocked by the district, so he simply gave a verbal description. All of the teachers stated that was something they needed to work on and would handle it differently in the next school year because they thought it was important to model the process of watching the video and taking good notes.

Both teachers at High School C developed their own video notes and the students were graded on the notes. The notes directed the students to look for important topics and concepts. The teachers at High Schools A and B used the district-provided study guides and explorations to go along with the videos.

The math teachers used the district-provided worksheets as their classroom problem sets. It was a true reversal of lecture and homework. The science teachers were able to use experiments and problem sets to further students' exploration and understanding.

In the first year of flipping the classroom, all the teachers were spending a large amount of time creating videos. When asked about any weakness of the model, Math Teacher A told me, "Honestly, this is a stupid weakness. It's time. It's time consuming in the beginning, but this shouldn't even be called a weakness". All four teachers, and especially the math teachers, commented on their intent to refine the process in the second year of flipping to include more engaging and dynamic activities. They all reported that their first year had been devoted to the mechanics of flipping and subsequent years would yield richer and more creative classroom activities.

Posting videos, documents, and quizzes on a consistent basis proved to be very important. Students thrive on reliable structures and if a teacher fell behind in posting, students were quick to point out the problem. Math Teacher A had consistently posted videos on Sundays by 6:00 p.m. and twice, when he had not met that deadline, he reported that student emails started Sunday night and complaints ran into his classes the next day. Science Teacher C confirmed this in his interview, noting that consistency in posting was crucial—especially for the students that needed set routines. In many instances, students would want to get ahead and ask for the videos early. These teachers found it difficult to get ahead and all reported looking forward to their second year when videos only needed to be edited and not created from scratch. Allowing students to progress at their own pace was a desire commented on by all four teachers. This technique is known as "Mastery Learning" in the flipped classroom (Bergmann & Sams, 2012) and is a natural second step in the progression of the flipped classroom.

Based on classroom observations and discussions with the teachers, some of the essential classroom factors that contribute to successfully implementing the flipped classroom model are:

- Addressing all technology issues including various devices and equity of access;
- The use of video notes and/or study guides;
- Not re-teaching the material that was presented on the video; and
- Well-designed learning activities that maximize and extend learning in a student-centered environment.

Implications

This section provides implications and recommendations based on the knowledge I gained from this record of study. First, recommendations in light of theory will be discussed. Second, recommendations in light of active learning will be explored. Third, recommendations in light of student-centered classrooms will be examined and education and training will be suggested. Finally, recommendations for future research will be considered. This knowledge has the potential to be used by other researchers as a guide for future research and practice.

Considerations in light of theory

The findings in this study speak to the theories of learning discussed earlier. Constructivism is considered the foundation for theories on student-centered instructional strategies. Constructivism modifies the teacher's role to one of supporting students' construction of knowledge, rather than reproducing a series of facts. Thirteen Ed Online (2004) lists six benefits to a constructivist classroom:

- Children learn more when they are actively involved;
- Education that concentrates on thinking and understanding is more effective;
- Constructivist knowledge is transferable;
- Constructivism gives students ownership of what they learn;
- Constructivism stimulates an engages students though authentic learning activities; and
- Constructivism promotes social, collaborative, and communication skills.

Classroom observations support these benefits as has been previously discussed. The teachers in this study provided problem-solving and inquiry-based learning activities resulting in students testing their ideas in a collaborative learning environment.

In a constructivist classroom, knowledge is seen as dynamic and students are involved in experiential learning (Dewey, 1938). In the constructivist, flipped learning classroom, learning is interactive (Thirteen Ed Online, 2004) and builds on the foundational knowledge students receive prior to participating in classroom learning activities. I believe the findings of this study show that flipped classroom students have more opportunity to explore concepts, build understanding, and experience learning in ways that students in traditional classrooms do not.

Considerations in light of active learning

Active learning is an essential part of the flipped classroom model. In active learning, students are actively engaged in the learning process. The constructivist paradigm transforms the student from a passive receiver of information to an active participant in the learning process. During the course of this study, students were observed being actively engaged in learning activities. In the participant interviews, Science Teacher B reported “they know when they come to my class they can’t just sit back, be quite, don’t make noise and everything’s fine. They can’t do that in my class. They’re going to be involved. They’re going to be more active.”

Background knowledge is empowering and since active learning has shown to increase student achievement and engagement (Michael, 2006; Prince 2004), it is possible that students also experience a more self-efficacious stance in the classroom. Math Teacher A’s interview supports this ideas when he stated, “What was shocking too was they walk through the door and go ‘Can we start?’ They just want to get to it because they’ve already got the information.”

Since more class time is devoted to building knowledge through active participation, students have more time to process information and gain a deeper understanding. I believe the findings in this study show students to be more involved in learning activities that required their full participation than might be seen in a traditional classroom.

Considerations in light of a student-centered learning environment

Student-centered learning theories form the basis for the flipped classroom (Brame, 2014). In a student-centered learning environment, student learning is the focus. Student-centered environments are active, friendly, and collaborative. In these environments, students experience learning.

In the constructivist classroom that is flipped, there is a heavy emphasis on collaboration. Collaboration is a major contributor to learning because students not only learn about learning from themselves, but also from their peers (Thirteen Ed Online, 2004). In a collaborative classroom, students can work through learning processes together and help peers with strategies and methods for solving problems. It is my belief that the findings in this study show that these classrooms were student-centered as opposed to teacher-centered.

Considerations for teaching and learning

The flipped classroom has inverted tried-and-true pedagogical practices. A changing role for instructors is a large part of this model. Teachers must give up their front-of-the-class position and move into a more collaborative environment. This variation promotes changes in the classroom dynamics and the type of learning that can be accomplished. Newcomers and skeptics should be aware that this model does not constitute pedagogical reform; it simply leverages old ideas in new ways (Bergmann & Sams, 2012). In the flipped classroom, teachers' roles have changed to one of a facilitator and activator, but their roles as orchestrators of learning have not changed. In this regard, teachers' roles are as important as they ever were.

Student roles have also changed. Students have been transformed from passive learners to active learners who are taking part in their own education. This model puts more of the responsibility for learning on the shoulders of the student and some students may be reluctant to take on this new role. Through repeated rehearsals, students have learned to play the game of school and many have honed their skills to a level of mastery. Because of the ability to constantly practice these skills, taking more responsibility for their own learning will engender resistance with some students. Working together in a collaborative environment may help foster acceptance on the part of the student.

Recommendations

Teachers wanting to flip their classrooms must give careful consideration to the practice and not just jump in without fully understanding the commitment they are making. There are many decisions that have to be made, the first of which is understanding the considerable time commitment in the first year. Teachers will have to decide if they are going to make their own videos, share this responsibility with a colleague, or use videos that have been made by a virtual teacher found on the Internet.

Another consideration is about what goes into making the videos. This model challenges teachers to reflect on their practices and rethink how they reach students. If a video is only 15 minutes long, teachers must decide the best use of that teaching time. Decisions must be made about what concepts to cover and in what depth and which problems to work and why. Planning for video lectures is different than planning face-to-face instruction so time will need to be devoted to thinking about student misconceptions and anticipating questions.

The type of software and hardware needed to make videos will need to be explored. Those decisions may be predicated on the type of video that is going to be made. The teacher will need to decide whether or not he/she is going to appear in the video or if the video will consist of drawing on a screen while teaching. The type of software may also depend on whether or not the teacher wants to bring in any outside resources, such as movie clips, applets, Google docs, etc.

Another consideration is equitable access to technology. When videos are made and posted, teachers must be diligent about making sure that all students have access to the learning. Instructors will need to determine which students may not have access and determine the appropriate steps to take.

The learning environment is a very important piece to consider. Instructors flipping their classrooms for the first time will need to plan daily activities that support and extend the learning gained from the recorded lecture. Careful thought will need to be given the types of activities used and the amount of time required to complete them. With the lecture taken out of the classroom, teachers may struggle with the pacing of activities.

Since there is no right way to flip a classroom, decisions will have to be made about how to structure the lessons. Will every lesson be flipped? Will the videos always be used to introduce a new topic followed by explorations and practice in class the next day, or will class time be used to introduce a topic through exploration and the video be watched that night to further explain the concepts? These are only some of the considerations that must be considered.

In the case of the teachers in this study, all elected to deliver content as a video assigned as homework the night before working with the problem sets or activities in class. By structuring classes in this way, students are required to have first contact with the material and use that newly acquired knowledge to apply to different situations in class.

Teachers will also have to realize that the flipped classroom is collaborative in nature. Those who are comfortable with not being the director of learning will have an easier adjustment than those who are more traditional in their teaching practices. In a collaborative environment, students will work in groups and the classroom will be full of discussions. The noise level may not be conducive to some teaching styles.

Another consideration is one of classroom autonomy. Traditional teaching has been more private in nature. At the beginning of class, teachers close their doors and conduct class in the manner they deem best. Administrators, parents, and other teachers do not really know what happens in any given classroom on any given day. By flipping the classroom, teachers are releasing that privacy and putting themselves and their lessons out there for the world to see. In the interview with the Science teacher B, he stated:

> When I go into my classroom and close my door and I teach, if I don't give 100% when I teach, the kids may know that I'm having an off-day, but probably not a lot of people are gonna know unless I don't give 100% every day. This forces you to give 110% every time you give that instruction because there's sort of this conscientiousness on my part that if I'm gonna throw this out there,

> anybody can see it. Any parent can see it. Any administrator can see it. Any district personnel can see it.

This type of public exposure may make some teachers uncomfortable and should be given thought before embarking on this pedagogical shift.

Since no two flipped classrooms are the same, it is not feasible to make general recommendations for implementing this model. However, based on these considerations, the following list provides the issues that must be considered by those teachers interested in flipping their classrooms:

- Decide what will be flipped (a lesson, a unit, a class or classes);
- Decide what hardware and software will be used and how to address any potential lack of access;
- Decide what content will be delivered in the videos;
- Decide how to keep students accountable for watching the videos;
- Decide how to communicate with students, parents, and administrators; and
- Decide how to reorganize students' classroom experiences since extra time is available.

Current research

Little additional research has been published since the time this study was conducted. Fulton (2014) states that there are no large-scale studies on this teaching method to date. The research page on The Flipped Learning Network (flippedlearning.org) details existing research, but none is more current than what has been described in this paper.

Numerous classroom experiences with the flipped classroom can be found on the Internet with a simple Google search. The Flipped Learning Network (flippedclassroom.org) is one of many websites that provides a forum where teachers can post videos and detail experiences with flipping their classrooms. These experiences are anecdotal, however, and not based on any large-scale trials.

Further Research

When teachers realize the teaching methods that have been successful for so long are no longer effective, they will realize the need for change. The efficacy of the flipped classroom warrants further study as it holds promise of allowing the teacher to differentiate to meet the needs of individual learners. Teachers new to flipping are dealing with many obstacles associated a change of pedagogical practices, some of which are time, technology, and challenges to personal teaching philosophies. However, teachers new to this practice will not be settled enough in the model to be able to truly differentiate to meet individual learning styles. Action research could provide new understanding as teachers extend their knowledge from the first year flipping to subsequent years, so it would be advantageous to study this model in practice for a longer period of time. Teacher practices in subsequent years as they learn to fine-tune their practices are worth examining. Moving into the mastery model as described by Bergmann and Sams (2012) holds great promise for true differentiation.

Since the outcome showed differences between math and science, it would be worthwhile to study the flipped classroom model in different subjects and across grade lines to note the differences in teacher practices. A quantitative study measuring student progress would also be of benefit.

Future studies are warranted as this pedagogical model is showing great promise across the country. Articles, reports, blogs and media coverage all cite improvement in student understanding and achievement, successful differentiation to meet the needs of different learners, and overall satisfaction with the model. Topics such as mobile device usage in the classroom, one-to-one technology implementation, individualized instruction, etc., are all subjects that would benefit from further research.

Conclusion

In conclusion, this study provides preliminary information for teachers interested in flipping their classrooms. It also provides administrators with background information that can help them support teachers venturing into an unknown pedagogical arena.

A veteran teacher has established practices and procedures for operating his/her classroom on a day-to-day basis. When trying something that is contrary to those routine practices, changes have to be made on multiple fronts. The purpose of this study was to look at those newly constructed practices and to examine them in terms of what actually happened in the classroom and what the teacher did to orchestrate change. Looking at the flipped classroom from the teacher’s perspective will help teachers who would like to try this method understand the commitment and what actually happens in the first year of implementation.

The intent of this study was to understand the struggles and successes when implementing a model that is completely foreign to the pedagogical practices that had been employed for years. Other teachers may benefit from these teachers' experiences helping to make a smoother transition to a new pedagogical model.

The teachers in this study all reported they were satisfied with their first year's attempts. If we define success to be increased student achievement and understanding (as viewed by the teacher), teacher satisfaction with the model, and the intent to continue flipping classes in subsequent years, then the teachers felt they were successful. Even though student achievement did not increase as much as everyone had hoped, all the teachers ended the year being very satisfied with the results and intend to continue flipping their classes next year.

Teacher interviews showed that teachers saw students engaged in problem solving and working to figure out problems on their own. In this respect, the teachers were fostering an environment conducive to independent learning, something that may not happen on a regular basis in some high school classes. These teacher views were supported by classroom observations.

Based on decisions that must be made when flipping a classroom for the first time, the teachers in this study successfully shifted their classroom constructs to accommodate a different approach to learning.

The flipped classroom model hold promise as teachers make a shift in priorities from a teacher-centered classroom to a student-centered classroom. This shift helps foster an environment that is changing from a setting in which material is simply covered to an environment that is working toward mastery.

As a result of my research, I have worked to make sense of my experience and have attempted to construct meaning from it for myself.   My goal was not to change the classroom dynamics, but simply to make sense of it based on my skills as an educator. Although I realize, with the evolving and variable nature of this paradigm shift, I will never quality as an expert on the flipped classroom, I hope I have made a small contribution to the body of knowledge in this educational arena.

REFERENCES

21st Century Skills (2010). *What is 21st century education?* Retrieved from http://www.21stcenturyschools.com/index.htm

21st Century Skills (2008). *21st century skills, education and competiveness: A resource and policy guide.* Retrieved from www.21stcenturyskills.org

Akinoglu, O. & Tandogan, R. (2006). The effects of problem-based learning in science education on student's academic achievement, attitude and concept learning, *Eurasia Journal of Mathematics, Science & Technology, 3*(1), 71-81. Retrieved from http://files.eric.ed.gov/fulltext/ED495669.pdf

American Psychological Association (2014). *Education and socioeconomic status fact sheet.* Retrieved from http://www.apa.org/pi/ses/resources/publications/factsheet-education.aspx

Ash, K. (2010). Making the move to the virtual world. *Education Week*, *30*(4), S6-S7. Retrieved from EBSCO*host*.

Armario, C. (2012, May 24). Report: More students taking science, math. *Bloomberg Businessweek*. Retrieved from http://www.businessweek.com/ap/2012-05/D9UV48SO1.htm

Baker, J. W. (2000). *The "classroom flip": Using web course management tools to become the guide by the side.* Paper presented at the 11th International Conference on College Teaching and Learning, Jacksonville, FL.

Baker, J. W. (2011). *The origins of "The Classroom Flip"*. Unpublished manuscript, Department of Media & Applied Communications, Cedarville University, Cedarville, OH.

Bergmann, J., Overmyer, J., & Willie, B. (2013, July 9). The flipped class: Myths vs. reality. *The Daily Riff.* Retrieved from http://www.thedailyriff.com/articles/the-flipped-class-conversation-689.php

Bergmann, J. and Sams, A. (2008) Remixing chemistry class. *Learning and Leading with Technology*, *36*(4), 24-27.

Bergmann, J., and Sams, A. (2012). *Flip your classroom*: *Reach every student in every class every day*. Washington, DC: ISTE; and Alexandria, VA: ASCD.

Bishop, J., & Verleger, M. (2013, June). The flipped classroom: A survey of the research. Paper presented at the 120th American Society for Engineering Education, Atlanta, GA. Abstract received from www.asee.org/file_server/papers/attachment/file/0003/.../6219.pdf

Bondelli, K. J. (n.d.). An evaluation of the ineffectiveness of the traditional education system. Retrieved from http://www.scribd.com/doc/38418/An-Evaluation-of-the-Traditional-Education-System-by-Kevin-Bondelli

Bonwell, C. & Eison, J. (1991). Active learning: Creating excitement in the classroom. *AEHE-ERIC Higher Education Report No. 1*. Washington, D.C.: Jossey-Bass.

Brame, C. (2014). *Flipping the Classroom.* Vanderbilt University. Retrieved from http://cft.vanderbilt.edu/teaching-guides/teaching-activities/flipping-the-classroom/

Bransford, J.D., Brown, A.L., & Cocking, R.R., Eds. (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academies Press.

Brown, A. (2012). *A phenomenological study of undergraduate instructors using the inverted or flipped classroom model.* (Doctoral Dissertation, Pepperdine University). Retrieved from http://pepperdine.contentdm.oclc.org/cdm/ref/collection/p15093coll2/id/348

Butrymowicz, S. (2012, June 13). 'Flipped classroom' model's promise eludes poorer school districts. *The Huffington Post.* Retrieved from http://www.huffingtonpost.com/2012/06/13/flipped-classroom-models-_n_1594279.html

Bybee, R.W. (1997, October). The sputnik era: Why is this education reform different from all other reforms? *Reflecting on sputnik: Linking the past, present, and future of educational reform.* Symposium conducted at the Center for Science, Mathematics, and Engineering Education National Research Council, Washington, DC. Retrieved from http://www.nas.edu/sputnik/bybee1.htm

Callet, V. (2010). *Problems solved, problems created: A critical case analysis of a public-private partnership in alternative education for at risk students.* (Doctoral Dissertation). Retrieved from ProQuest Digital Dissertations. (UMI 3403532)

Casto, L. (2012, January). *Flipped classroom.* Symposium conducted at Allen High School, Allen Independent School District.

Cator K. (2013, December 10). *Big idea 2014: Let's close the digital learning gap.* Retrieved from http://www.linkedin.com/today/post/article/20131210124932-2906843-big-idea-2014-let-s-close-the-digital-learning-gap?trk=mp-reader-card

Chapman, D.D. & Stone, S. J. (2010). Measurement of outcomes in virtual environments. *Advances in Developing Human Resources, 12*(6)*,* 665-680.

Churches, A. (2012). 21st century teacher. Educational Origami. Retrieved from http://edorigami.wikispaces.com/21st+Century+Teacher

Clintondale High School (2013). *About Clintondale High School*. Retrieved from http://flippedhighschool.com/

Collins, A. & Halverson, R. (2009). *Rethinking education in the age of technology: The digital revolution and schooling in America.* New York, NY: Teacher's College Press.

Conner, M. (2013). *Introduction to informal learning*. Retrieved from http://marciaconner.com/resources/informal-learning/#wrap

Creswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among the five approaches.* Thousand Oaks, CA: Sage Publications.

Creswell, J. W., (2008). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Upper Saddle River, NJ: Pearson Education, Inc.

Davis, M. (2011, June 15). 'Hybrid' charter schools on the rise. *Education Week*. Retrieved from http://www.edweek.org/dd/articles/2011/06/15/03hybrid.h04.html

Denzin, N., & Lincoln, Y. (2005). *The sage handbook of qualitative research* (3rd ed.). Thousand Oaks, CA: Sage.

Dewey, J. (1938). *Experience & education.* New York, NY: Macmillen.

Driscoll, Tom. (2012). *Flipped Learning and democratic education: The complete report.* Retrieved from https://docs.google.com/file/d/0B0VIwE5hKSWta0RqbmdZSGh0WTQ/edit

Durley, C. (2013, April 14). *Is equity an issue in the flipped classroom?* [Web log post]. Retrieved from http://flipperteach.com/2013/04/14/

Ferriter, B. (2011, April 20). Teaching the iGeneration: It's About Verbs, Not Tools. *Education Week Teacher.* Retrieved from: http://www.edweek.org/tm/articles/2011/04/20/ tln_ferriter_igeneration.html

Fink, L. D. (2003). *Creating significant learning experiences: An integrated approach to designing college courses*. San Francisco, CA: Jossey-Bass.

Fletcher, J., Tobias, S., & Wisher, R. (2007). Learning anytime, anywhere: Advanced distributed learning and the changing face of education. *Educational Researcher, 36,* 96-102.

Foot, H. & Howe, C. (1998). The psychoeducational basis of peer-assisted learning. In K.J. Topping and S.W. Ehly (Eds.) *Peer-Assisted Learning.* (pp. 27–43). Lawrence Erlbaum Associates.

Fulton, K. (2012, April). Inside the flipped classroom. T.H.E. Journal. Retrieved from http://thejournal.com/articles/2012/04/11/the-flipped-classroom.aspx

Fulton, K. (2014). *Time for learning: Top 10 reasons why flipping the classroom can change education.* Thousand Oaks, CA: Corwin.

Gerstein, J. (2012). *The flipped classroom model: A full picture.* User Generated Education. Retrieved from http://usergeneratededucation.wordpress.com/2011/06/13/the-flipped-classroom-model-a-full-picture/

Grabinger, R.S. & Dunlap, J.C. (1995). Rich environments for active learning: A definition. *Association for Learning Technology Journal, 3*(2) (pp. 5–34). Retrieved from http://repository.alt.ac.uk/11/1/CALT_A_00302005_O.pdf

Green, G. (2012, July). *The flipped classroom and school approach: Clintondale High School.* Presented at the annual Building Learning Communities Education Conference, Boston, MA. Retrieved from http://2012.blcconference.com/documents/flipped-classroom-school-approach.pdf

Goodwin, B. & Miller, K. (2013). Evidence on flipped classrooms is still coming in. *Educational Leadership 70*(6). 78-79.

H.B. 2843, 82nd Gen. Assem., Reg. Sess. (Tex. 2011).

H.B. 3088, 82nd Gen. Assem., Reg. Sess. (Tex. 2011).

H.B. 3280, 82nd Gen. Assem., Reg. Sess. (Tex. 2011).

Hamdan, N., McKnight, K., McKnight, P., & Arfstrom, K. (2013). *A review of flipped learning*. Retrieved from http://www.flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/41/LitReview_FlippedLearning.pdf

Harris, M., & Cullen, R. M. (2010). *Leading the learner-centered campus: An administrator's framework for improving student learning outcomes.* San Francisco, CA: Jossey-Bass.

Hart, J. (2008, September). Understanding today's learner. *Learning Solutions Magazine.* Retrieved from http://www.learningsolutionsmag.com/articles/80/understanding-todays-learner

Hazell, E. (2005). 21st Century Teaching: Mapping the connections between ICT literacy skills, technology tools, and the learning goals of core subject areas. *Access Learning.* Retrieved from: http://resa7.k12.wv.us/Technology%20Integration/AL-03-05-21stCenturyTeaching%5B1%5D.pdf

Hew, K., & Cheung, W. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K-12 and higher education settings: A review of the research. *British Journal of Educational Technology*, *41*(1), 33-55. doi:10.1111/j.1467-8535.2008.00900.x

Hiebert, J. C., & Grouws, D. A. (2007). *The effects of classroom mathematics teaching on students' learning*. In F. K. Lester, Jr. (Ed.), Second handbook of research on mathematics teaching and learning (Vol. 1, pp. 371–404). New York, NY: Information Age. Retrieved from http://books.google.com/

books?id=Cww16Egbp4oC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

Jackson, R. (2009). *Never work harder than your students & other principles of great teaching.* Alexandria, VA: ASCD.

Jacobs, H. H. (2010). A new essential curriculum for a new time. In H. H. Jacobs (Ed.), *Curriculum 21: Essential education for a changing world* (pp. 7-17). Alexandria, VA: ASCD.

Jacobs, H. H. (2010). Upgrading content. In H. H. Jacobs (Ed.), *Curriculum 21: Essential education for a changing world* (pp. 30-59). Alexandria, VA: ASCD.

Jarvis, J. (2010, March 6). TEDxNYED presents Jeff Jarvis [Video file]. Retrieved from http://www.youtube.com/watch?v=rTOLkm5hNNU

Jerald, C. D. (2009). *Defining a 21st century education*. Alexandria, VA: Center for Public Education. Retrieved from: http://www.centerforpubliceducation.org/Learn-About/21st-Century/Defining-a-21st-Century-Education-Full-Report-PDF.pdf

Johnson, R., Johnson, R., & Holubec, E. (1992). *Advanced cooperative learning.* Edina, MN: Interaction Book Company.

Kagan, S. (1994). *Cooperative learning*. San Clemente, CA: Kagan Cooperative Learning.

Khan, S. (2011). *Let's use video to reinvent education*. Speech presented at TED2011. Retrieved from http://www.ted.com/talks/salman_khan_let_s_use_video_to_reinvent_education.html

Khan, S. (2012). *The one world school house: Education reimaged.* London, England: Hodder and Stoughton.

Klein, D. (2003). A brief history of american K-12 mathematics education. In, James Royer's (Ed.) *Mathematical Cognition.* Information Age Publishing. Retrieved from http://www.csun.edu/~vcmth00m/AHistory.html

Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development, volume 1*. Englewood Cliffs, NJ: Prentice-Hall Englewood Cliffs, NJ. Retrieved from http://academic.regis.edu/ed205/kolb.pdf

Kominski, R., Jamieson, A., & Martinez, G. (2001). *At-risk conditions of U.S. school-age children* (Working Paper Series No. 52). Washington, D.C: U. S. Bureau of the Census. Retrieved from http://www.census.gov/population/www/documentation/twps0052/twps0052.html

Kramarski, B., & Mevarech, Z.R. (2003). Enhancing mathematical reasoning in the classroom: The effects of cooperative learning and metacognitive training. *American Educational Research Journal, 40,* 281-310.

LaFee, S. (2013). Flipped learning. *School Administrator 3*(70). 19-25.

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *Journal of Economic Education*, 31(1), 30-43. Retrieved from Education Research Complete database.

Lambert, C. (2012, March/April). Twilight of the lecture. *Harvard Magazine.*

Li, Q., & Ma, X. (2010). A meta-analysis of the effects of computer technology on school students' mathematics learning. *Educational Psychology Review, 22*, 215-243. doi: 10.1007/s10648-010-9125-8

Lincoln Y. & Guba E. (1985), *Naturalistic Inquiry*, Beverly Hills, CA: Sage Publications

Martin, N. & Brand, B. (2006). *Federal, State, and Local Roles Supporting Alternative Education*. American Youth Policy Forum. National Center on Education.

Marzano, R. (2013, March). Ask yourself: Are students engaged? *Educational Leadership, 70*(6)*,* 81-82.

Merriam, S. (1998). *Qualitative research and case study applications in education.* San Francisco, CA: Jossey-Bass.

Michael, J. (2006). Where's the evidence that active learning works? *Advances In Physiology Education*, *30,*(1). 59–167. doi:10.1152/advan.00053.2006

Musallam, R. (2010). *The effects of using screencasting as a multimedia pretraining tool to manage the intrinsic cognitive load of chemical equilibrium instruction for advanced high school chemistry students.* (Doctoral Dissertation, The University of San Francisco). Retrieved from http://flipteaching.com/resources/Dissertation_Musallam.pdf

Murray, C. (2010, October 4). Software's pull on hard-to-reach teens: Brilliant educational programs can transform secondary education. *The Washington Times.* Retrieved from http://www.washingtontimes.com

Nagel, D. (2011, January 26). Online learning set for explosive growth as traditional classrooms decline. *Campus Technology.* Retrieved from http://campustechnology.com/Articles/2011/01/26/Online-Learning-Set-for-Explosive-Growth-as-Traditional-Classrooms-Decline.aspx?Page=1

November, A. (2010). Power down or power up?. In H. H. Jacobs (Ed.), *Curriculum 21: Essential education for a changing world* (pp. 186-194). Alexandria, VA: ASCD.

November, A., & Mull, B. (2012). Flipped learning: A response to five common criticisms. Retrieved from http://novemberlearning.com/wp/assets/flipped-learning-a-response-to-five-common-criticisms.pdf

Nystuen, R. (2009). *Understanding today's learners and meeting their needs through differentiation.* Retrieved from http://www.scribd.com/doc/11582470/Understanding-Todays-Learners-and-Meeting-Their-Needs-Through-Differentiation

Overmyer, G. (2010). *The impact of mastery learning and video podcasting on learner performance in secondary mathematics: Pre-vodcasting and the reverse classroom* (Doctoral Preliminary Examination, Colorado State University). Retrieved from http://api.ning.com/ files/T2b4rjlq5Mh7NkeaxkGRDN-TF4-LebCX5fuwynQ7Bx8OrrQjXv7VZjIaveJEztK7WebRo9IjdTYRybHmyqREcHqYlhmRVZcs/VodcastingResearchProposal.pdf

Partnership for 21st Century Skills. (2008). *21st century skills, education and competitiveness.* Retrieved from www.21stcenturyskills.org

Palfrey, J. & Gasser, U. (2008). *Born digital: Understanding the first generation of digital natives*. New York, NY: Basic Books.

Pea, R.D. (1987). Socializing the knowledge transfer problem. *International Journal of Educational Research, 11,* 639-663.

Pearson & The Flipped Learning Network (2013). *Flipped learning model dramatically improves course pass rate for at-risk students.* Retrieved from http://assets.pearsonschool.com/asset_mgr/current/201317/Clintondale_casestudy.pdf

Pearson & The Flipped Learning Network (2013). *Flipped learning model increases student engagement and performance*. Retrieved from http://assets.pearsonschool.com/asset_mgr/current/201320/Byron_standalone_casestudy.pdf

Peterson, P. E. (2010). Saving schools: From Horace Mann to virtual learning. Harvard University Press.

Pellegrino, J., Chudowsky, N., & Glaser, R. (Eds.) (2001). *Knowing what students know: The science and design of educational assessment*. Washington, D.C: National Academy Press.

Pfeil, U., Ang, C., & Zaphiris, P. (2009). Issues and challenges of teaching and learning in 3D virtual worlds: real life case studies. *Educational Media International*, *46*(3), 223-238. doi:10.1080/09523980903135368

Pinar, W. F. (2004). *What is curriculum theory?* New York, NY: Routledge.

Pink, D. (2010). Think tank: Flip-thinking-the new buzz word sweeping the US. The Telegraph. September, 2013. Retrieved from http://www.telegraph.co.uk/finance/businessclub/7996379/Daniel-Pinks-Think-Tank-Flip-thinking-the-new-buzz-word-sweeping-the-US.html

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon, 9*(5). 1-6. Retrieved from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf

Prensky, M. (2001). Digital natives, digital immigrants part 2. On the Horizon, 9(6). 1-9. Retrieved from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part2.pdf

Prensky, M. (2005, September/October). “Engage me or enrage me”: What today’s learners demand. *Educase*, 60-64. Retrieved from http://net.educause.edu/ir/library/pdf/erm0553.pdf

Prensky, M. (2008, March). Turning on the lights. *Educational Leadership, 65*(6), 40-45.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*. 223-231. Retrieved from http://www4.ncsu.edu /unity/lockers/users/f/felder/public/Papers/Prince_AL.pdf

Privateer, P.M. (1999). Academic technology and the future of higher education. *The Journal of Higher Education, 70,* 60-79.

Richland, L.E., Stigler, J. W., & Holyoak, K. J. (2012) Teaching the conceptual structure of mathematics. *Educational Psychologist, 47*(3), 189-203. doi: 10.1080/00461520.2012.667065

Rogers, D.L. (2000). A paradigm shift: Technology integration for higher education in the new millennium. *AACE Journal, 1*(13), 19-33.

Rotherham, A. J. & Willingham, D. (2009). Teaching for the 21st Century. *Educational Leadership, 67,* 16-21.

S.B. 1483, 82nd Gen. Assem., Reg. Sess. (Tex. 2011).

Safdar, K. (2013, July 8). Math, science popular until students realize they're hard. *The Wall Street Journal*. Retrieved from http://blogs.wsj.com/economics/2013/07/08/math-science-popular-until-students-realize-theyre-hard/

Sams, A. and Bennett, B. (2014). The truth about flipped learning. *eSchoolnews.* Bethesda: MD. Retrieved from http://www.eschoolnews.com/2012/05/31/the-truth-about-flipped-learning/?ast=123&astc=11015

Sarason, S.B. (2004). *And what do you mean by learning?* Portsmouth, NH: Heinemann.

Schaffhauser, D. (2009). The Vod couple. *T|H|E Journal*. Retrieved from http://thejournal.com/articles/2009/08/09/vodcasting.aspx

Sefton-Green, J. (2006). Youth, technology, and media cultures. *Review of Research in Education, 30,* 279-306.

Slavin, E. R. (1983). When does cooperative learning increase student achievement? *Psychological Bulletin, 94*, 429-335.

SOPHIA (2014). *Growth in flipped learning*. SOPHIA Learning. Retrieved from http://www.sophia.org/flipped-classroom-survey

Stake, R. (2005). Qualitative case studies. In N. Denzin & Y. Lincoln, (Eds.). *The sage handbook of qualitative research* (3rd ed.). (pp. 443-466). Thousand Oaks, CA: Sage.

Strayer, J. (2007). *The effects of the classroom flip on the learning environment: A comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system.* (Doctoral Dissertation). Retrieved from https://etd.ohiolink.edu/

Texas Association of School Administrators (2008). *Creating a New Vision for Public Education in Texas.* Austin, TX: Public Education Visioning Institute.

Texas Education Agency. (2013). *Highly qualified teachers*. Retrieved from http://www.tea.state.tx.us/index4.aspx?id=4650

Thirteen Ed Online (2004). *Constructivism as a paradigm for teaching and learning.* Educational Broadcasting Corp. Retrieved from http://www.thirteen.org/edonline/concept2class/constructivism/index.html

Topping, K. J., & Ehly, S., Eds. (1998). *Peer-Assisted Learning.* Mahwah, NJ: Lawrence Erlbaum.

Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for a life in our times.* San Francisco, CA: John Wiley & Sons.

U.S. Department of Education. (2004). *National education technology plan.* Retrieved from http://www.nationaledtechplan.org/

Vander Ark, T., (2013). *Making math work: K-8 blended learning.* Dreambox Learning. Retrieved from http://www.dreambox.com/white-papers/making-math-work-k-8-blended-learning

Vasquez, O.A. (2006). Cross-national explorations of sociocultural research on learning. *Review of Research in Education, 30,* 33-64.

Vockley, M., & Lang, J. (2010). *Deepening connections: Teachers increasingly rely on media and technology.* Grunwald Associates, LLC. Retrieved from http://www-tc.pbs.org/about/media/about/cms_page_media/182/PBS-Grunwald-2011e.pdf

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wagner, C., & Ip, R. K. (2009). Action learning with second life: A pilot study. Journal of *Information Systems Education, 20*(2)*,* 249-258.

Warschauer, M., Knobel, M., & Stone, L. (2004). Technology and equity in schooling: Deconstructing the digital divide. *Educational Policy 18*(4). 562-588. doi:10.1177/0895904804266469

Weimer, M. (2002). *Learner-centered teaching: Five key changes to practice.* San Francisco, CA: Jossey-Bass.

Weimer, M. (2013). *Learning-centered teaching: Five key changes to practice.* San Francisco, CA: Jossey-Bass.

Willis, J. (2010). *Learning to love math: Teaching strategies that change student attitudes and get results.* Alexandria, VA: ASCD.

Yin R. (2009). *Case study research design and methods* (4^{th} ed.). Thousand Oaks, CA:

Sage.

Zhao, Y., Lei, J., Yan, B., Lai, C., & Tan, S. (2005). What makes a difference: A practical analysis of research on the effectiveness of distance education. *Teachers College Record, 107*(8), 1836-1884. Retrieved from

APPENDIX A

TEACHER SCRIPT

Hi ______________:

I have a favor to ask. I need to recruit several teachers for my research for completing my doctorate. I am doing my research on teaching practices of teachers who are flipping their classrooms. You are one of the few teachers in Plano who are flipping their classes so I'm reaching out to you.

This is what it would entail:

I will observe one of your classes—approximately once a week. The research will begin sometime in the fifth six weeks and last for six weeks. I will observe in various classes and my observations will last an entire class period. Half-way through the research, I will ask you to fill out a simple survey. At the end of the study, I will ask to sit down with you for an interview. To help me keep track, I will probably want to make an audio recording of our interview.

I am only looking at teacher practices. I'm not collecting any data on students at all. I'm trying to determine what practices lead to the greatest success using this model.

Do you think you might volunteer☺?

Thanks!

Julie

APPENDIX B

CLASSROOM OBSERVATIONAL FIELD NOTES

Observation Date: ______________________ Subject observed: ___Math ___Science
Setting:_____________________________________ Students: ____Number in Class
Time/Class Period:____________________ Ability Level:__On-level __Pre-AP ___AP

Minutes into Class	Teacher Actions	Reflective Notes
5		
10		
15		
20		
25		
30		

35		
40		
45		
50		

APPENDIX C

TEACHER SURVEY

1. Lesson Planning

Flipping the classroom enabled me to:	**Not at All**				**To a Great Extent**
Improve my ability to plan instruction	1	2	3	4	5
Improve the way I think about learning	1	2	3	4	5
Deepen my understanding of my subject	1	2	3	4	5
Increase my effectiveness at promoting student learning	1	2	3	4	5
Plan better formative assessments as a measure of student learning	1	2	3	4	5
Plan instruction/activities to meet individual student needs	1	2	3	4	5
Change my role to a facilitator of learning	1	2	3	4	5
Differentiate and personalize instruction	1	2	3	4	5
Establish clear expectations so students can feel confident they are on the right track	1	2	3	4	5
Narrow my focus on the important learning that needs to happen	1	2	3	4	5

2. Classroom Practices

Please indicate the extent to which you agree or disagree with each of the following statements	**Not at All**				**To a Great Extent**
I have more time to work with individual students	1	2	3	4	5
I am able to spend more time supporting student learning	1	2	3	4	5
The responsibility of learning is shifted more to the student	1	2	3	4	5
Learning is more active and experiential	1	2	3	4	5
Students have more choice in learning tasks	1	2	3	4	5
Students have a sense of control over the pace of the learning process	1	2	3	4	5

3. Student Performance/Engagement

When comparing your flipped class with your classes before you flipped, about how often are students:	Not at All				To a Great Extent
Completing assignments	1	2	3	4	5
Engaged in the learning process	1	2	3	4	5
Engaged in critical thinking/problem solving	1	2	3	4	5
Appling knowledge in real life settings	1	2	3	4	5
Demonstrating an increase in understanding	1	2	3	4	5
Demonstrating an increase in achievement	1	2	3	4	5

4. Reflection

Please indicate the extent to which you agree or disagree with each of the following statements	Not at All				To a Great Extent
There has been an increase in positive interactions between students	1	2	3	4	5
There has been an increase in positive interactions between students and teacher	1	2	3	4	5
All my students have benefited from the flipped classroom structure	1	2	3	4	5
By flipping my classroom, I can significantly affect my students' achievement level	1	2	3	4	5
My expectations for my students' learning have increased	1	2	3	4	5
My role as a teacher has changed	1	2	3	4	5
My students' roles as learners have changed	1	2	3	4	5

APPENDIX D

TEACHER INTERVIEW QUESTIONS

Domain 1: Planning and Preparing

1. How has the flipped classroom model changed the way you prepare for lessons?

2. Do you prepare study guides/lecture notes/etc. for students to use?

3. Do you create your own videos? If you do, what goes into making a video? If not, where to get your videos?

4. On average, how long are the videos?

5. How do you tackle the technology problems of students not having access to the internet?

6. Do you think teacher-made videos are/would be more or less effective than videos currently available via the web?

Domain 2: Classroom Strategies and Behaviors

1. What do you do to establish and communicate the learning goals of the lesson?

2. Approximately what percentage of students (on average) come to class having done their homework (e.g. watch the video/take notes/do the assigned questions)? Is this a greater or lesser amount than when you had a traditional classroom?

3. What do you do when students come unprepared (not having watched the lesson)?

4. Do you begin class with a recap of the lesson that was assigned as video homework?

5. How did you teach students to watch the videos?

Domain 3: Community Reaction

1. How did the students react to this model in the beginning?

2. How are the students reacting to this model now?

3. How do the parents react to this model?

4. Compared to previous years, does there appear to be a difference in student achievement? What about student understanding?

Domain 4: Reflecting on Teaching

1. How many years have you been teaching?

2. Please identify any specific areas of strengths and/or weaknesses using the flipped classroom model.

3. In your opinion, how effective is the flipped classroom model in your classroom?

4. Has using this model changed your ideas about teaching? How?

5. Do you like this model? Will you continue flipping your classroom? Why or why not?

Any general comments you would like to make?