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Inside the Flip: A Look at Teacher Motivations and Activities in Flipped Classrooms

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INSIDE THE FLIP: A LOOK AT TEACHER MOTIVATIONS AND ACTIVITIES IN FLIPPED CLASSROOMS

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170 Pages

In the educational setting of the 21st Century and with requirements imposed on schools through state and federal mandates such as the Every Student Succeeds Act, teachers are looking for ways bring additional student engagement activities and collaboration into their classrooms. These requirements along with increased educational technologies in schools have many teachers exploring the flipped classroom model of instruction. In a flipped classroom, educators flip direct classroom instruction and traditional homework or practice. Students might watch a lecture video covering a concept at home and then apply the concept to problems in class with the aid of the teacher or engage in collaborative application with their classmates. There is almost two decades of teachers implementing this model and research on the flipped classroom model. However, little of that research exists at grade levels 6-12, the grade range in which the majority of teachers using flipped classroom teach. Additionally, much of the research conducted at those levels involves either student perceptions of the model or the impact course grades. This study looked inside the flipped classrooms of seven middle and high school teachers from a variety of subject areas including mathematics, science, Spanish, and social studies. Data for the study were collected through interviews, lesson plans and materials, as well as through a classroom observation of each teacher in order to gain a fuller picture of the types of educational activities taking place inside of flipped classrooms. Furthermore, this study sought

to look at the teachers' motivations for using the model and to see if teachers were using

activities to engage students in their classrooms.

KEYWORDS: Flipped Learning Model, Flipped Classroom, Flipped, Middle School Education,

Secondary Education, Classroom Flip

INSIDE THE FLIP: A LOOK AT TEACHER MOTIVATIONS AND ACTIVITIES IN

FLIPPED CLASSROOMS

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FLIPPED CLASSROOMS

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In one of my first doctoral classes, we learned that only half of those starting a doctorate degree actually finish the process. My classmates and I were stunned by this fact and as I finish, I have a clearer understanding of how that can happen. Doctoral students come in as confident, self-reliant problem solvers who are not used to asking for help, only to realize that we need to learn to do so. This would not be possible without my tremendous committee of Dr. Rena Shifflet, Dr. Ryan Brown, Dr. Lydia Kyei-Blankson, and Dr. Robyn Seglem. I am truly honored to have had such a guiding, knowledgeable, and understanding chair in Dr. Shifflet. Thank you for believing in me and encouraging me, even when I doubted myself and for guiding me through this educational experience that profoundly changed me as an educator.

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CHAPTER I: INTRODUCTION TO THE STUDY

In the current educational era of accountability, with its reliance on high stakes testing and its often scripted curricula, K-12 teachers and higher education instructors are searching for ways to incorporate technology in order to provide more classroom time for the instructional methods such as discussions, projects, and student inquiry. For K-12 teachers, these activities can address the higher level thinking skills that are designed to be a key part of Common Core State Standards (CCSS) instruction (Hopson, Simms, & Knezek (2001); Huba & Freed, 2000; O'Down & Aguilar-Roca, 2009). The need to increase such classroom activities, by using the flipped classroom to reduce classroom lecture time, has made the model an option worthy of consideration. The flipped or inverted classroom is one in which the traditional roles of homework (knowledge application) and lecture (knowledge acquisition) have been reversed or flipped (Lage, Platt, & Treglia, 2000). Recently the Flipped Learning Network (2014) formally defined flipped learning as:

> A pedagogical approach in which direct instruction moves from the group
> learning space to the individual learning space, and the resulting group space is
> transformed into a dynamic, interactive learning environment where the educator
> guides students as they apply concepts and engage creatively in the subject
> matter. (para. 5)

The flipped or inverted classroom model has become a grassroots movement in education and this model has been adopted by many educators in the United States and worldwide, and the Flipped Learning Network (FLN) listed over 27,000 members (FLN, 2014). Recently the FLN transformed into the Flipped Learning Global Initiative (FLGI), which as of this writing lists over 29,000 members (FLGI, 2016). The flipped model claims to provide an instructional tool

with positive outcomes that teachers can employ to help them incorporate higher-level activities while still covering important basic content. One of the flipped classroom model's stated advantages is the process of moving lecture out of classroom time. This is supported by Foertsch, Moses, Stikwerda, and Litzkow (2002) who suggest classroom lectures are a waste of face-to-face time and state, "Most students would have done just as well to read the professor's lecture notes or view a videotape of the lecture on their own time" (p. 267). At the same time, content coverage is certainly a concern in a time period of high-stakes testing and increasing use of value-added measures (VAM) in teacher evaluations that are linked to those high-stakes tests (Guarino, Reckase, & Wooldridge, 2015).

Goodwin and Miller (2013) note that the change of increased engagement in classroom activities brought about by moving lectures out of the classroom could be an improvement on traditional homework, as homework seems to be an unproductive way to foster learning. Trogden, (2014) feels that active learning such as asking peers or teachers for assistance, problem solving, and discussion strategies, work best as class activities rather than as homework. This reversing of traditional knowledge application, typically done as homework, and the conventional knowledge acquisition method of lecture—which is usually a low level, one-way flow of knowledge—allows for the increased availability of the teacher to answer questions, to guide, and to reteach as needed. An additional benefit of the instructional videos is that students can watch, pause, and re-watch the lectures to catch information that they might have missed in an in-class lecture. This can be especially beneficial to special education students and teachers who gain the unlimited ability to watch and re-watch lectures.

Moving lectures out of the classroom can allow instructors to increase the level of classroom activities (Clark, 2015; Foertsch et al., 2002; Hutchings, & Quinney, 2015; Jensen,

Kummer, & Godoy, 2015; Prashar, 2015) and many view this as a primary reason for adopting the flipped classroom model. In other words, you can have additional classroom time to add more activities yet still cover required content by using recorded direct instruction lecture videos (Herreid, Schiller, Herreid, & Wright, 2014; Trogden, 2014). An additional reason instructors give for flipping their classrooms is the ability to differentiate instruction (Bergman & Sams, 2012b; Clark, 2015; Finkel, 2012; Hamdan, McKnight, McKnight, & Arfstrom, 2013b; Jensen et al., 2015). These are just some of the ways the flipped classroom model claims to both help provide classroom time for higher classroom engagement, and to move instruction away from a model of the simple transmission of knowledge (Gaddy, Harmon, Barlow, Milligan, & Huang, 2014; Shanahan, 2013). The hope is to move classrooms towards a cooperative, collaborative style of teaching that helps to scaffold student's knowledge by building upon their prior knowledge.

However, some have noted disadvantages to the flipped classroom model with Herreid and Schiller (2013) noting increased preparation time, student opposition, and concerns about content coverage among others. In regards to increased preparation time, Pragman (2014) notes that for instructors to record their own videos requires a lot of time for planning, recording, and editing. Others (Gross, Marinari, Hoffman, DeSimone, & Burke, 2015) note this increase in preparation time as well. In addition to the increased preparation time, Mason, Shuman and Cook (2013) report that the online learning aspect might frustrate some students and, based on upper level college student feedback, they suggest that the technique may not be appropriate to lower lever undergraduate classes. Strayer (2012) found that his students did not like the new method and felt uncomfortable with having to adjust to the new learning environment that required adjustments like self-responsibility for their learning.

Other researchers take issue with the flipped model itself. Herreid et al. (2014) also note that when it comes to the flipped classroom model, "there is little new about this approach. Ever since the invention of the printing press, countless teachers have implored their charges to read the chapter in the book ahead of time, often to no avail" (pp 75-76). Baggaley (2015) also insists that flipped learning is nothing new but simply a form of blended learning. Additional issues with the flipped classroom model reported by Herreid et al. (2014) are that students first need to understand how to learn from lecture videos. Their other concerns include a perceived lack of good quality videos, as well as a lack of case studies to support the model's claims. While the first problem is one that all teachers must confront, the need for more studies is one of the aims of this research.

Conceptual Framework

The conceptual framework of the study situates in the theory of constructivism. Sang-Hong, Nam-Hun, and Kil-Hong (2014) theorize that it should not be the role of teachers to convey knowledge, rather that they should enable students to gain knowledge. They feel that teachers should, "present practical tasks to students and give appropriate guidance, questions and answers to facilitate mutual interaction between learners and provoke more thoughts" (p. 70). However, it is important to note that constructivism is not a theory of pedagogy; rather it is a theory about knowing (Bransford, Derry, Berliner, Hammerness & Beckett, 2005). This is an important distinction because educators who take a constructivist approach to knowing, do not eschew lectures as constructivism yet still allow for direct instruction, because they understand that not all learning has to come from discovery (Bransford et al., 2005). Constructivism fits well with the flipped classroom model with Jacot, Noren, and Berge, (2014) stating that, "Constructivist indicators of active learning such as authentic, inquiry-based, exploratory,

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experiential, and collaborative learning are common features of the flipped classroom" (p. 24).

The flipped classroom model also allows students use classroom time to engage with their fellow students, permitting for an interaction between learners, material, and their social group or peers (Xanthoudaki, 2007). These are all areas that the flipped classroom model says it addresses by supporting instructional and flexibility, as well as allowing for flexible timelines, independent study, and collaborative group work (FLN, 2014).

After determining a student's prior knowledge, the next step is to present the new material in a way that is above the student's current level of knowledge and understanding, but not at a level so high it causes frustration and confusion. Vygotsky (1978) refers this area between what a student can do independently and what they can do with the adult assistance as the zone of proximal development (ZPD), and he believes that what a child can do with help is more suggestive of the level of their mental development than what they can accomplish on their own. Two ways of using scaffolding in order to adjust to a child's current knowledge level are: (1) by organizing educational tasks and settings so that demands are of a suitable challenge level, and (2) by adjusting the quantity of adult assistance given a child's skill level and requirements (Berk and Winsler, 1995). These tasks can be arranged in ways to provide scaffolding, including through the sequence of the tasks, by the choices given to students, or the amount of adult support given to aid the student. These supports or scaffolds, then aid the student by making, "connections to what the learner already knows in other familiar, everyday contexts" (Zeuli, 1986, p. 1). Vygotsky also sees peer interaction where less proficient children advance with the help of students who are proficient as an effective way to develop skills and strategies (McLeod, 2010). Again, one of the flipped classroom model's stated advantages is that it allows for the classroom time and collaborative group work this style of learning requires (FLN, 2014).

The author's educational beliefs are also shaped by educational philosophies such as Progressivism, with its focus on active and interesting learning where the teacher is a guide for problem solving, and Reconstructionism that calls for improving and reforming society and which acts as a way to direct projects (Ornstein, Pajak, Ornstein, 2011). Each of these theories and philosophies call for a deep understanding of material and its concepts by students, much like the stated goals of the Common Core State Standards (CCSS). These beliefs are much different from the concepts of Perennialism and Essentialism that rely on mastery of facts and essential skills (Ornstein et al., 2011) seen as a reflection of the type of teaching done using a traditional lecture model.

Purpose of the Study

With most flipped studies conducted in the higher education arena, there is a need to look more closely at the motivation 6-12 teachers have for using the flipped model. Many flipped classroom teachers note Sams and Bergmann's books or articles as inspiration or note anecdotal reports including Finkel's (2012) article in *District Administration*, Tucker's (2012) article in *Education Next*, and Goodwin and Miller's (2013) article in *Educational Leadership*. The often-cited reason for employing the flipping of classroom is to allow for more student-centered and hands-on learning activities once lectures have been removed (Baker, 2000; Mazur, 2009; Overmyer, 2015; Strayer, 2012). In addition to attempting to better understand what motivates teachers to flip their classes, there is a need to see what kinds of instructional activities actually utilized in the 6-12 classroom time formerly occupied by lectures. As noted, most flipped studies were completed in the higher education setting and those include reports of what activities were used in the class time that was freed up by the use of recorded lectures (Baker, 2000; Demetry, 2010; Frederickson, Reed, and Clifford 2005; Gennod, Burge, & Helmich, 2008;

Lage et al., 2000; Overmyer, 2015; and Schullery, Reck, & Schullery, 2011). Another often cited study by Jeremy Strayer (2012), also took place in a higher education setting and involved the use of a guided software program produced by a textbook publisher. That study required students to use time outside of class to go to a campus computer lab to access the publisher provided content and activities rather than instructor created content (Strayer, 2012). This study focused specifically on 6-12 classrooms, purposely looking at middle school and high school classrooms where the highest percentage of flipped classroom teachers' work. It also looked at how teachers in these grade levels use class time by conducting initial and follow up interviews of practitioners of the flipped classroom model, analyzing their lesson plans and activities, conducting classroom lesson observations, as well as studying the classroom materials related to those class activities.

Although Bergmann and Sams (2012b) state, "there is no single way to flip your classroom—there is no such thing as the flipped classroom" (p. 10), there has come to be an informal definition of flipped classrooms. This is a class in which video lessons or screencasts are available for students to access when it is convenient to watch them outside of classroom time (Hamdan, McKnight, McKnight, & Arfstrom, 2013a). As noted earlier, the Flipped Learning Network (FLN) (2013), an organization set up to attempt to set standards for flipped learning as well as to provide guidance and resources, has set up a formal definition of a flipped classroom. This definition is a class structure where the lecture moved from the classroom to individual learning time, and with class time used for interaction and application.

Many users of the flipped learning model are K-12 classroom teachers with a recent survey conducted by Flipped Learning Network (2014) reported that, 80% taught in grades 6-12, 27% in higher education, and 15% in grades K-5 note that since participants could select several

grade levels the resulting total was greater than 100% (Sophia & FLN, 2014). Despite evidence that most users of the flipped classroom model are K-12 educators, very little of the research seems to be conducted on those classrooms. Most studies done on flipped classroom have occurred in the higher education setting (e.g., Baker, 2000; Demetry, 2010; Frederickson et al., (2005); Gannod et al., 2008; Lage et. al., 2000; Schuller, et al., 2011, Strayer, 2012). This is despite the fact that the flipped model seems to be have been popularized in K-12 due to the efforts of Aaron Sams and Jonathon Bergmann (2012b) and the ideas they started using in their science classrooms. Even Baggaley (2015), a critic of the flipped classroom model who views the flipped classroom model as nothing new, notes that followers of flipped learning are chiefly K–12 teachers.

It was believed that the motivations for using the classroom model given by participants would be similar to those listed in popular education literature (Bergmann & Sams 2012a; 2012b) as well as those given in flipped classroom research articles (Baker, 2000; Mazur, 2009; Overmyer, 2015; Strayer, 2012). With a listing of more than 29,000 educators as members of the Flipped Learning Global Initiative (FLGI, 2016) an understanding of those educators' reasons and their motivations for using a flipped classroom model needed more analysis. This study gathered a variety of materials to compare reasons teachers give for flipping their classes to their lesson plans and activities, so that comparisons could be made between reason teachers gave for employing the flipped classroom model and what actually took place in their classrooms. Finally, those activities were compared to the motivational reasons given to compel teachers to flip their classrooms, in non-peer reviewed literature such as education magazines and popular education books on the topic, as well as in education conferences, and workshops.

Research Questions

The main questions this study seeks to address are:

1. What are the motivations—including reasons, purposes, and goals—that instructors have for employing the flipped classroom model in their 6-12 classrooms?

2. How is classroom time currently structured in 6-12 flipped classrooms?

Definition of Terms

Flipped learning: "a pedagogical approach in direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment" (FLN, 2014, para 5).

Flipped classroom model: A course environment that uses the flipped learning model.

Significance of the Study

Regarding activities used in grades 6-12 flipped classrooms during classroom time freed up from traditional direct instruction, it has been an assumption that while many of types of activities and the cognitive levels used may already be known. This might include but not limited to discussions, analysis, application, and production. However, is the amount of those activities occurring with greater frequency than in those classrooms before the implementation of the flipped classroom model? This study not only conducted interviews and collected lesson materials, it also went into a variety of classes to observe the model in practice. It is believed that the motivation for the movement of direct instruction or lecture, generally seen as a lower order activity that is at the remembering or understanding stages of Bloom's revised taxonomy, to outside the classroom, is to provide classroom time for more activities. Has the number of these classroom activities increased, and will they require higher levels of engagement and be more hands on? Do the activities require students to understand, apply, analyze, evaluate, and

create as opposed to activities that simply ask them to remember (Krathwohl, 2002)? One would also expect to find that these activities are more student-centered as well. Furthermore, there was a hope to find additional, creative classroom activities either not previously identified or not as well known. Going into the classrooms allowed me to observe a variety of ways in which teachers have adapted their teaching using the flipped classroom model and see the types of activities in which their students engaged.

Summary

Regarding activities used in grades 6-12 flipped classrooms during classroom time freed up from traditional direct instruction, it has been an assumption that while many of types of activities and the cognitive levels used may already be known. This might include but not limited to discussions, analysis, application, and production. However, is the amount of those activities occurring with greater frequency than in those classrooms before the implementation of the flipped classroom model? This study not only conducted interviews and collected lesson materials, it also went into a variety of classes to observe the model in practice. It is believed that the motivation for the movement of direct instruction or lecture, generally seen as a lower order activity that is at the remembering or understanding stages of Bloom's revised taxonomy, to outside the classroom, is to provide classroom time for more activities. Has the number of these classroom activities increased, and will they require higher levels of engagement and be more hands on? Do the activities require students to understand, apply, analyze, evaluate, and create as opposed to activities that simply ask them to remember (Krathwohl, 2002)? One would also expect to find that these activities are more student-centered as well. Furthermore, there was a hope to find additional, creative classroom activities either not previously identified or not as well known. Going into the classrooms allowed me to observe a variety of ways in which

teachers have adapted their teaching using the flipped classroom model and see the types of

activities in which their students engaged.

CHAPTER II: REVIEW OF LITERATURE ON THE FLIPPED CLASSROOM MODEL

Background and Defining the Flipped Classroom Model

Pioneers of the inverted or recorded lecture format, Lage et al., (2000), defined the inverted or flipped classroom as one in which "events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa" (p. 32). While sometimes used interchangeable, flipped learning advocates argue the flipped classroom model and blended learning are not exactly the same. The Every Student Succeeds Act (ESSA) of 2015 defines blended learning as:

> a formal education program that leverages both technology-based and face-to-face
>
> instructional approaches…that include an element of online or digital learning,
>
> combined with supervised learning time, and student-led learning, in which the
>
> elements are connected to provide an integrated learning experience; and…in
>
> which students are provided some control over time, path, or pace. (p. 450-451)

The term flipped classroom was popularize by Bergmann and Sams (2012b) who state that, "Flipping the classroom is more about a mindset: redirecting attention away from the teacher and putting attention on the learner and the learning" (p. 12). In 2014, the Flipped Learning Network formally defined flipped learning as:

> a pedagogical approach in which direct instruction moves from the group learning
>
> space to the individual learning space, and the resulting group space is
>
> transformed into a dynamic, interactive learning environment where the educator
>
> guides students as they apply concepts and engage creatively in the subject
>
> matter. (para. 5)

The flipped classroom model can involve the use of technology in ways ranging from mostly traditional classroom work with the addition of computer lab time, to the occasional use of classroom sets of computers, or even mostly online coursework with only occasional face-to-face meetings. The model is not simply recording lecture videos and doing homework in class. The goal of the flipped classroom is about providing classroom time to students for meaningful activities in order to improve learning. Baker (2000) states that the big advantage is that, "the professor is freed from the 'tyranny of the lecture'…[w]ith the essential class content available online, the professor is now free to use class time for other activities" (p. 13). Furthermore, the process of doing that in a flipped environment is flexible and can vary among teachers that choose to implement the model into their classroom. As Bergmann and Sams (2012b) note, "Every teacher who has chosen to flip does so differently" (p. 12).

A stated goal of the implementation of a flipped classroom model is to move away from using class time for teacher-centered lectures with students passively learning. Instead, class time should involve using active and collaborative learning tasks where students will learn through application and assessment (Hutchings & Quinney, 2015). Exactly how this is done is based on instructor choice and can vary based upon subject area, available technology, and available digital learning resources, including content and supporting materials. Generally however, as McCallum, Schultz, Sellke, and Spartz (2015) note, "in-class learning is shifted from traditional lecture delivery to class activities such as concept checks, discussions, debates and activities involving application, analysis, problem-solving, experiments and/or evaluation" (p. 43). This structure allows teachers and classmates to offer support while students use class time to work with course ideas and concepts (McCallum, et. al, 2015).

Each teacher can individualize the flipped classroom model based upon their teaching style, classroom environment, availability of support and resources, and their comfort level with various technologies. Some instructors may record all their lectures; some may use only lectures of others; and others may use a mix of the two. Most of those recordings are done in the form of a screencast, "a digital movie in which the setting is partly or wholly a computer screen, and in which audio narration describes the on-screen action" (Udell, 2005, n. p.). Sugar, Brown, and Lutebach (2010) state that, "In a screencast, the instructor records all of the necessary mouse clicks and corresponding screen activity to complete a designated task. The captured video can be accompanied with audio to create a multimedia presentation" (p. 2).   Some instructors include just the screen with a voice over while others use their computer's webcam to insert a video of them into the recording as a picture-in-picture. While some classes completely flip, with every content lecture moved outside of the classroom, others may contain only a limited number of flipped units, or only a few lessons to create a blended learning setting. In fact, Bergmann and Sams (2012b) state that there are, "similarities between a flipped classroom and other blended educational models, reverse instruction, inverted classroom, and 24/7 classroom. All of these models have similar features and could possibly be interchangeable in certain contexts" (p. 7).

There can be enormous differences in application and interpretation of the flipped or inverted classroom model. When Lage et al. (2000) inverted their college level economics course in 1996 using VHS tapes that students had to watch at in the library or have duplicate copies made. On the other end of the spectrum, Clintondale High School's Principal Greg Green considers a flipped classroom as one in which no more than twenty percent of the classroom time is devoted to the teacher directly providing information to the class, or lecturing. The other

eighty percent of the time is used for projects, discussions, and other higher level thinking activities (G. Green, personal communication, December 1, 2012). Some teachers may believe that the flipped classroom is all about creating videos, but Green notes that when it comes to the flipped learning model, videos are not everything. He feels that technology is not always the answer; rather it is about aligning school resources to student needs, which the flipped learning model provides for (Roscorla, 2011). For Green, the idea for using the flipped classroom came from talking to student needs and realizing that the flipped classroom was "about the amount of support and how much activity you do with the kids in class" (NationSwell, 2014, 1:35).

K-12 Based Flipped Research

While seen as a popular trend in education due to the efforts and experiences of Jonathon Bergmann and Aaron Sams, relatively little scholarly research has been conducted and published on using the flipped learning model at the K-12 level. Since 80% of the teachers who report using the flipped model teach in middle and high school classrooms (Sophia & FLN, 2014), this is an important consideration. Outside of the books and articles published by Bergmann and Sams or about their work, relatively few studies have researched the flipped classroom model in 6-12 classrooms. Clark (2015) looked at student engagement and performance in a secondary mathematics classroom and found that "during the flipped classroom, the students witnessed an increase in their classroom participation and communication, thus promoting a student-centered classroom environment conducive to learning and success" (p. 103). Clark's study involved 42 high school students between 13 and 15 years of age in regular education sections of a high school Algebra I class. This was a mixed methodology study with the quantitative portion looking at student scores, while the qualitative portion used the Student Perception of Instruction Questionnaire (SPIQ) to compare and identified five areas that students thought were improved

in the flipped classrooms: active engagement and learning; class time and structure; quality of instruction; collaboration; and communication (Clark, 2015).

Other 6-12 flipped classroom studies looked at areas including student engagement, improved assessment scores as well as self-directed learning and student collaboration. A pilot flipped classroom study conducted in a government classroom tried to increase the engagement of 23 at risk students and discovered that, "students increased their online engagement and homework rates from 75% to 100% and found that students' successes increased by 11% in the flipped class" (Flumerfelt & Green, 2013 p. 364). Another 6-12 based study looked at 61 advanced placement high school chemistry students and compared traditional classes to classes using the flipped classroom model. The study found that students in the flipped sections scored higher on classroom assessments than those students taught in traditional classes (Schultz, Duffield, Rasmussen, & Wageman, 2014). Sang-Hong et al. (2014) looked at the effects of the flipped classroom model in a sixth grade classroom in South Korea and compared differences between flipped and traditional classrooms in collaboration and self-directed learning. The study looked at 112 sixth grade students and in terms of collaboration found significant differences between two types of flipped learning styles and traditional classes and in terms of self-directed learning, found a difference between one of the flipped learning methods and conventional methods (Sang-Hong et al., 2014). More recently, Schmidt and Ralph (2016) conducted a small study of 58 teachers and found that only three used the flipped classroom model. The study listed reason teachers gave for not implementing the model and presented ways to address those issues.

Several other articles on 6-12 flipped classrooms are essentially shorter reports on case studies that employed the flipped classroom model and few are in peer-reviewed journals. While

many mentioned the in-class activities they used, none offered a detailed analysis of the educational activities and materials used in 6-12 classrooms that employ the flipped classroom model. An article in *Education Digest* notes that math students in flipped classrooms outscored those in traditional classrooms (Fulton, 2013). *Flipping the Script in K12* is a brief summary of the model and its advantages (Finkel, 2012). A short report by Goodwin and Miller (2013) briefly describes the research taking place and the evidence coming in on flipped classrooms. Additional reports include one by Pearson (2012) that is an interview article on a Canadian flipped classroom biology teacher, and Alverez (2012) which is a condensed report on the flipped classroom model's use at Clintondale High School that found significant improvements at the school after the entire school adopted the flipped classroom model.

While all of the studies look at advantages of the flipped classroom model, most measurement still involved scores, student perceptions of the flipped classroom model, or both. No studies were found that focused solely on classroom activities in classrooms using the flipped model. Finally, a survey conducted by Herreid et al. (2014)—that was intended for general biology faculty at the college level—found that 46% of their over 1,300 respondents were, "high school teachers of Advanced Placement (AP) biology courses" (p. 77). While the study does mention activities used in class time freed up by moving lecture out of classroom time—using case studies—it does not distinguish between the high school A.P. classes and university courses. The next section that looks at flipped classroom research that has been conducted at the university level including undergraduate and graduate level courses.

Post-Secondary Flipped Research

Most of the research on the flipped classroom model studies post-secondary level education and has often focused on student satisfaction with the use of the flipped classroom

technique (Blair, Maharaj, and Primus, 2016; Butt, 2014; Foldnes, 2016; Galway, Corbett, Takaro, Tairyan, & Frank, 2014; Gaughan 2014; Jensen et al., 2015; Prashar, 2015; Strayer, 2012; Trogden, 2014). Undergraduate university level studies, in which students have either a favorable or a neutral opinion, took place in numerous fields such as business education (Butt, 2014; Findlay-Thompson & Mombourquette, 2014; Pragman, 2014; Prashar, 2015). Additional areas include history (Gaughan, 2014); public health (Galway et al., 2014); computer education (Chen, Wang, Kinshuk, & Chen, 2014); information literacy (Wilcox Brooks, 2014); mathematics (Talbert, 2014); science (Jensen et al., 2015; Trogden, 2014); engineering (Mason et al., 2013); and at the graduate level (Moraros, Islam, Yu, Banow, & Schindelka, 2015). O'Flaherty and Phillips (2015) conducted a review on the use of the flipped classroom model in higher education and results of review, "suggest instructors need to redesign their curriculum so that the pre-class activities are integrated better into their F2F classes with active learning pedagogies so students understand the model and are motivated to prepare for class" (p. 93).

Other post-secondary studies tend to measure course grade outcomes as a measure of the flipped classroom model's effectiveness. Some examples include Mazur (2009), who looked at science courses; Prashar's (2015) study in operations management courses looked at both grades and student perceptions; and Love et al. (2014) who looked at achievement in three different course between flipped and traditional sections. It is worth noting however that they made the recorded lectures available to students in the non-flipped course sections as well. Betihavas, Bridgman, Kornhaber, Cross, (2016) looked at the effects of using the flipped classroom model in nursing school programs in Australia, reviewed nine studies and found that most looked at academic outcome and student satisfaction.

Recently published studies on the flipped classroom still tend to be in higher education settings. Some studies in the United States include Rotellar and Cain (2016), who looked at pharmaceutical education, while Blair et al. (2016) researched information technology. Increasingly, new studies on the flipped classroom model seem to be coming from overseas. Examples include Alsowat (2016) in Saudi Arabia; Betihavas et al. (2017) in Australia; Chen Hsieh, Wu, and Marek (2017) in Taiwan; Jeong (2017) in the West Indies; and Foldnes (2016) in Norway. A study by Thai, De Wever, and Valcke, (2017) from Ghent University in Belgium looked at the satisfaction of college students in flipped classes in Vietnam. A South African study looked at how to find the best blend of techniques for applying the Community of Inquiry model in flipped undergraduate courses (le Roux & Nagel, 2018).

Some studies, including an often-cited article by Strayer (2012), took place in classrooms in which content delivery may not fit the personalized definition of a flipped classroom. Often named as an example of students not liking the flipped classroom model, the study required students to complete publisher created, computer-based modules in a campus computer lab, a requirement that limits the flexibility of information delivery that is at the heart of the flipped classroom model (Strayer, 2012). Hutchings and Quinney (2015) conducted a study still conducted lectures in class. Moran and Milsom (2015) used narrated PowerPoint presentations outside of class. They still required a great deal of application level work to be conducted outside of class time that work was often used to create, "minilectures to address any content areas for which a large percentage of students expressed or demonstrated confusion or that the instructor wanted to highlight during class" (Moran & Milsom, 2015, pp 36-7). An article by Baggaley (2015) has criticized the narrative of the history of the flipped classroom model, as

given by Bergman and Sams, claiming that flipped learning is nothing new, rather simply a form of blended learning and as such should not be claimed as a new model.

Benefits of the Flipped Classroom Model

A *Phi Delta Kappan* article Kathleen Fulton (2012a) lists several advantages of the flipped classroom including improved insight into students; curriculum customization with 24 hour access; improved student achievement, interest, and engagement; facilitated 21st Century learning; and facilitated use of learning theories that support the approach. (An upcoming section on the flipped learning model and active learning looks at some of these learning theories.) Herreid and Schiller (2013) expanded upon Fulton's list, identifying additional advantages including: videos help those in extracurricular activities; more active student involvement; it "promotes thinking inside and outside of the classroom;" and time for, "authentic research," (p. 62). The first points demonstrate that flipped is about providing more in-class time for individualizing education by taking the focus off of the teacher and placing it on the learner and learning (Bergmann & Sams, 2012b). Other points address how additional classroom time can also allow teachers to get to know their students better and to consider their students' everyday life experiences allowing them to, "examine seriously the issue of student experience as a central component in developing a theory of school" (Gonázlez, Moll & Amanti, 2005, p. 41).

Considering video lectures as a method to deliver content, can lead to individualization in instruction is an appeal of the flipped classroom model. The recorded lectures involve the use 21st Century educational technology and recordings and can benefit those in extracurricular activities who might miss classes for events. The ability to watch, re-watch, pause, and rewind video lectures can provide the opportunity for students to catch information that they might have

missed in an in-class lecture, but not have bothered to ask about in class for fear of negative peer reactions. The videos also provide an added benefit in that not only students can watch them, but adults as well. Parents can watch the videos along with their children, a practice that can, "lead to interesting discussion between students and parents about the content" (Bergman & Sams, 2012b, p. 43). Additionally, these videos can serve as an aid to special education teachers and students with individual education plans (IEPs) by providing a way for the student to go back and review a lecture, either alone or with the assistance of a special education instructor or aide. This application of pre-recorded screencast lectures, delivered as videos outside the classroom, can then allow for increased availability of the teacher to the students during class in order to answer questions, to act as a guide, and to reteach as needed. Joanne and Lateef (2014) state, "In a flipped classroom model, teachers are no longer distant figures at the front of class. Rather, they are expected to work alongside students, guiding them individually" (p. 21).

In the current U.S. educational environment there are movements to design and implement classrooms settings that involve the use of more activities as called for by Common Core State Standards (CCSS) and the Every Student Succeeds Act of 2015 (ESSA). While they may relatively new, both CCSS and ESSA are mostly emphasizing what past researchers such as Piaget, Dewey, and Vygotsky have promoted about learning. They all point out that education needs to be about more than learning facts for a test; rather it should be about knowledge, the ability to use those facts. In regards to student-centered and application activities, Bransford, Darling-Hammond, and LePage (2005) state that, "Learning how ideas connect to one another and applying them to real-world problems enhances the probability that they will be remembered and usable later" (p. 23). In CCSS, an example in mathematics is the move away from simply teaching procedures, to the requirement that student learning should include, "conceptual

understanding along with application" (Gaddy, et al., 2014, p. 110). Even with this emphasis, teachers still feel pressure to cover a lot of content in order to expose students to the material covered in high stakes standardized testing. One way for teachers to address this, to be able to cover both the needed content dissemination and to provide practical application in the classroom, is through the implementation of the flipped classroom model.

Other reasons that have been given for considering the flipped learning model for inclusion in classrooms include student-centered learning, flexibility of content delivery, the ability to get to know students better to individualize instruction, and importantly, the possibility of having increased classroom time for higher level educational activities. The flexibility of content delivery is reported by Schultz, et al. (2014) who note the positive features of lecture videos, "included the ability to pause, rewind, and review video lectures; learn at one's own pace; work in class with the teacher present; the ability to stay caught up when absent; the ability to ask questions outside of class; and a better focus with videos" (p. 1338). Prashar (2015) states that, "students in the flipped classroom experienced more hands-on activities as compared to their counterparts. This implied that flipped classroom offered more space to students to try out things themselves and thus, make necessary connections with the course content" (p. 133). Moran and Milsom (2015) note that the flipped classroom model can assist students in developing, "skills in teamwork, higher order thinking, and problem solving. Because students have already reviewed the readings and lectures before class, this skill development can occur through increased opportunities for students to participate in group discussion, project-based learning, and research" (p. 34). Because of these and other reasons the popularity of the flipped classroom has continued to grow (Berrett, 2012). In discussing the rationale for the flipped model one should look at its background, reasons for adopting the flipped classroom—including

the advantages it provides and the educational learning theories it can help facilitate—as well as the challenges, which the next section covers.

Challenges of Implementing a Flipped Learning Model

Bennett, et al. (2012) note that when looking at flipped classroom model it is important to remember that it, "is not a, 'silver bullet' but rather a tool that can have profound impact on issues including student motivation, achievement, and engagement" (p. 1). As with any pedagogical shift there are downsides including technology skills (of both teacher and students), resources, time requirements, changes to both teaching and learning styles, and a need for support both technological and administrative. Adopting a flipped classroom may likely involve not just a pedagogical shift, but also an initial increase of time for preparation, for the transforming of instruction, and to acquire the both the resources and technology skills needed to make the change.

Additional areas of concern for the integration of educational technology involve teacher attitudes towards technology integration and the use of technology in the classroom due to time and support constraints. Often one problem is the lack of funding provided by schools in their technology budgets for educational technology training. Regarding technology integration, Shifflet and Weilbacher (2015) identified seven barriers to the implementation of educational technology: student technology knowledge, time, resources, standardized testing, attitudes of other teachers, a conflict between belief in the value of technology and actual practice, and support. Often, "professional educators are not aware of the instructional support through the integration of technology into the learning environment, and are reticent towards integrating technology into their classrooms" (Fletcher, 2006, p. 209). This ties to another barrier to technology often brought up by professional educators; time to implement technology (Brock,

2009; Desimone, 2009; and Wright, 2010). The importance of these issues has resulted in the inclusion of requirements to address both of these issues in the Every Student Succeeds Act of 2015 (ESSA) which regarding educational technology, calls for "ongoing professional development for teachers," (ESSA, p. 487). A discussion of three areas of these barriers to the implementation of the flipped classroom model, time requirements, technology skills and resources, and student concerns follows.

Time Requirements

One aspect of the time requirements concern in implementing a flipped classroom is the need for additional planning time in order to incorporate the educational technology often used to implement the model, as teachers must adapt and develop ways to tailor a technology to the teacher's specific classroom and other teaching requirements (Wright, 2010). This can be both a new and time-consuming process but it is important, as the use of that technology should improve the curriculum and instruction. This is often a problematic issue because content specificity in educational technology training is needed to overcome the idea that simply using technology can remedy most concerns. Research has shown that a single technology solution or application will not meet all teachers' needs (Wright, 2010). As for content specificity, Mishra and Koehler (2009) believe that in order for teachers to effectively implement technology, "the training must be specific to their classroom needs" (p. 16). Far too often teachers get new educational technology and receive only limited training. They often get little to no additional time to determine how to integrate that technology into their classrooms.

The result is that teachers often domesticate the technology, that is, they figure out how to do what they were already doing using that technology rather than transforming their teaching based upon the new potentials it provides (Rowan & Bigum, 2012). Others promote the idea of

collective participation groups in which teachers work together to build an interactive learning group sometimes referred to as a personal learning community or network (Desimone, 2011). Again, for this to happen teachers need to have enough time to make the preferred curricular changes (Ertmer & Ottenbreit-Leftwich, 2010).

In terms of flipped classroom implementation, a major time challenge that exists for instructors is that if they wish to "record their own videos, they must realize that a great deal of time to plan and create the recordings is required" (Pragman 2014, p. 11). However, not all flipped classroom instructors make their own videos with Herreid, et al. (2014) noting that only 20% of the flipped professors at their university made their own videos. However, if instructors do chose to make their own videos, Talbert (2014) points out that the expense and time, "of creating materials for class is largely a one-time startup expense, since videos and activities can be reused and updated over time" (p. 372). Gross, et al. (2015) posit:

> We found that flipped courses did not require sophisticated technological
>
> expertise in order to implement. Additionally, the authors observed high student
>
> engagement levels and strong course satisfaction without any negative impact on
>
> academic performance. While teacher preparation time levels were increased,
>
> these courses were still highly regarded by the teachers. (p. 37)

Mason, et al. (2013) point out that despite the time required to make the videos there is another advantage to making videos, the students watched each video an average of "2.41 times" (p. 433). This would seem to make the time and effort to produce lecture videos worthwhile, as they can allow the students to go back and review.

Of course some might argue that even if adequate training and preparation time are given, it is important to also remember that with technology, things can still go wrong. Patience and

planning can help teachers avoid problems, as well as help them deal with those problems that do arise. Storms or technology failures can cause the Internet to go down or push bandwidth use to near capacity and causes delays. Situations like this might mean that if in class activities or assessments are online, hard copies of those tests and assignments must be available, or pushing those off until the next day, or having an alternative activity available.

Technology Skills and Resources

It is more than having the needed educational technology training—and the time to practice and plan for it—that enables teachers to have the skills to implement a flipped classroom. It involves technology at school and at home as well as a potential pedagogical change. While the latest of technology and 1:1 classroom environments are helpful, the flipped learning model is not just about technology. As Greg Green noted, technology does not have to be at the center of the flipped classroom model rather as Roscorla (2011) notes, students are. LeFee (2013) reports that Bergmann and Sams started flipping their classrooms with inexpensive software and, "two lousy computers" (p. 20). That said, they started flipping around 2006— Lage, Platt, and Treglia were working on the idea in the mid-1990s—and communication and educational technologies have made great strides since then. Still, many students, especially those who qualify for free or reduced lunch, and those transient students that move frequently, often do not have Internet access at home. Despite recent improvements in the digital divide between students with technology at home in recent years, Dolan (2016) notes that use of technology at home and in schools is still not equitable.

In order to address this divide and allow students without the required technology at home watch the videos assigned as homework, instructors may have to provide electronic file copies of lecture videos to students, as unlike PDF files, paper versions of videos would become

copies of slides without additional explanation. Importantly, ESSA calls for "providing students

in rural, remote and underserved areas with the resources to take advantage of high quality

digital learning experiences, digital resources, and access to online resources taught by effective

educators" (ESSA, p. 488). Some schools are working to provide low cost Internet options, but

in the meantime, modifications may need to be made for academic reasons to ensure pre-class

activities are accomplished prior to coming to class or to adjust for students who have never been

taught in a flipped environment. These issues result in even more added time for the instructor

initially, as with any new course preparation, but Gross, et al. (2015) believe it is worth it, noting

that, "While teacher preparation time levels were increased, these courses were still highly

regarded by the teachers. Likewise, flipped classes were strongly approved of by students,

where high levels of student engagement were the central component to overall course success"

(p. 37).

When it comes to the actual videos to use for lectures there are generally two choices:

using existing online videos or teacher created videos, both of which have benefits and

drawbacks. In 2013 Herreid and Schiller reported that teachers feel that finding good quality

videos can be difficult and time consuming. Fulton (2012a) states that:

> Even though many teaching videos are available online via open sources like
>
> YouTube or Khan Academy, when teachers make their own videos, they can
>
> ensure the perfect fit of content, rigor, and personal connections. Students like
>
> having the voice behind the lesson belong to someone with whom they have a
>
> personal relationship. (p. 22)

While that might be true, Herreid and Schiller (2013) observed that, "the quality of the teacher-

created videos is often marginal, however, and creating them requires a significant amount of

time" (p. 63). Creating videos is demanding with time needed to plan, to record, to edit, to upload, and share the videos (Herreid & Schiller, 2013). Even with time and ways to adapt to technology, Schmidt and Ralph (2016) conclude that combined, these factors make setting up a flipped classroom a lot of work.

Students

Finally, the students themselves might be an additional challenge to the implementation of the flipped classroom model as it is often a change from the traditional learning styles they have previously been exposed to. While sometimes derisively referred to as digital natives who are adaptable and ready to change, today's students do not always like changes in the way things are done, especially the routines of school. For many of them being online is more about the entertainment and social aspects of their lives than it is about education (Tapscott, 2009). As a result, implementing the flipped classroom model can require teaching students digital learning literacy, teaching students to appreciate the online aspects of education today. Strayer (2012) notes that, "students were forced to adjust personal learning strategies they had relied on for years to fit this new classroom structure, and it appeared this adjustment was something students had difficulty doing in a short period of time" (p. 10). Additional problems may exist for teachers that want to develop next level flipped mastery classes, which take Benjamin Bloom's mastery learning ideas and, "takes the principles of mastery learning and marries them with modern technology to make a sustainable, reproducible, and manageable environment for learning" (Bergmann & Sams, 2012b, p. 53). A mastery-based system uses self-paced modules for students to work through that may require the creation of completion deadlines throughout the school calendar to keep students on track. As Deb Wolf an instructional coach in South Dakota observed, while under challenged students can fly ahead, for others, self-paced can

become no pace (Ash, 2012).

Teacher Motivation

When studying the flipped classroom model there is also a need to understand the motivations teachers have for going into teaching, why they make the educational choices that they do and particularly, and why they choose to implement the flipped classroom model in their classrooms. One theory in the area for motivation for career choice is the expectancy-value theory that looks at ability, belief, and prospects of being successful and the worth that one places on the responsibilities involved in that career (Eccles et al., 1983). Both sides of this, potential success and the worth of teaching, are important in the motivation to choose a career like education. Another theory used to measure why teachers go into teacher is Self-Determination Theory (SDT). Deci and Ryan (2000) believe that people enter teaching because they see the importance of students learning new skills and believe that they can fill the need to help students in acquiring those skills. Once in teaching these beliefs impact teacher behavior and choices. Richardson and Watt (2014) believe that these needs and goals must continue to be met after choosing a teaching career or it can lead to burnout and possibly leaving teaching. In order to succeed as a teacher Butler (2014) lists two important areas of influence that can affect teacher motivation, students and organizations. If students do not seem to respond and engage in planned activities, teacher motivation can decrease and organizational influences such as restrictive administrations and leadership styles can have the same effect (Butler, 2014).

Supportive administration and appreciative students can help teachers stay in the profession but in order to grow as educators, teachers need both space and time. Space is when teacher stress is reduced so that teachers can consider the future and time is choosing to remain in the profession; both can improved by having supportive policy makers, administration, and

through an approach that allows teachers to take risks in making changes in how they teach (Husman, Duggan, & Fishman, 2014). This is an important consideration in today's era of accountability and high-stakes testing with Butler (2014) noting the importance of support for teachers' aspirations to engage students in the learning process versus, "a narrow focus on raising scores by any means" (p. 32).

Finally, what motivates teachers to incorporate educational technology in general, and the flipped classroom model in particular, into their classrooms? Holland and Piper (2014) found that the areas of pedagogical knowledge (PK) and technological pedagogical knowledge (TPK) had a high correlation and that TPK had a significant correlation with three motivational variables, intrinsic (strong self-determination), extrinsic (moderate self-determination), and amotivation (a lack of self-determination). This suggests that teachers have a variety of reasons for implementing or not implementing education technology change within their classrooms. As noted earlier in the benefits of the flipped classroom model section, teachers who use the method have managed to find a way to either overcome or deal with the seven educational technology barriers identified by Shifflet and Weilbacher (2015). Most important among the motivations to implement the flipped classroom model is the desire to gain more class time for active student engagement, expanded thinking in and out of the classroom, and authentic research (Herreid & Schiller, 2013). These types of learning tasks could well be informed by active learning strategies.

Flipped Learning Model and Active Learning Strategies

A stated advantage of the flipped classroom model is that by taking traditional lecture out of the classroom space allowing for more class face-to-face time to be used for learning activities that are more active (Vasquez & Chiang, 2015). Freeman, et al. (2014) supported the

use of active learning, reporting "active learning has a greater impact on student mastery of higher- versus lower-level cognitive skills," (p. 8411). By having students watch recorded lectures outside of class time this can be accomplished and Vasquez and Chiang (2015) go on to report that the "pre-lecture videos increased student comprehension of basic concepts before coming to class," (p. 387). Some of the effective educational strategies that can promote student engagement in learning and that can provide individualization are: mastery learning, project-based or inquiry learning (PBL), and Universal Design for Learning (UDL). Butt (2014) states that the flipped classroom model can help as it:

> Can be used to focus teaching activity on what the student actively does. The approach does this very explicitly, by bringing active student engagement with the material (such as problem-solving, case studies, etc., usually in collaboration with other students) directly into the classroom (p. 34).

The next section overviews some theories of student learning and how those theories can be powerful learning tools in a learning environment that provides active and individualized learning time for students. The section also briefly defines mastery learning, PBL, and UDL while providing examples of how the flipped learning model can help in the implementation of each.

Constructivism and Student Learning

Many learning theories make appeals for the student to be at the center of the educational process, an instructional setting referred to as learner-centered or student-centered instruction. Student-centered and learner-centered are two ways to describe the philosophy of moving the teacher away from being the focal point of instructional process. Instead these make learners the focus of the process in order help teach them how, "to take responsibility for their own learning;"

and using assessment, "to give students feedback so that they can improve" (Blumberg & Pontiggia, 2011, p. 190). The flipped classroom method allows for increased classroom time to engage students in activities that use the information presented outside of class through video lectures, reading, or other activities. While this may engage the students in application of that information, the activities may not necessarily utilize higher order thinking, but active learning has the potential to help students learn the content better.

When activities involve ideas like scaffolding—a learning process that builds upon the prior knowledge of students—they build upon John Dewey's (1938) ideas of active thinking and Jean Piaget's (1947) ideas about the stages of cognitive development. Vygotsky (1978) calls for first learning what the student knows and then building upon it through a zone of proximal development (ZPD). In this zone, students are challenged with work that is above their current level of knowledge, believing that what a child can do with adult assistance is more suggestive of the level of their mental development than what they can accomplish on their own (pp. 85-86). Mastery Learning, based on the work of Benjamin Bloom, is defined by James H. Block as, (1) a "theory that asserts that any teacher can help virtually *all* students to learn excellently," and (2) "an effective set of individualized instructional practice that consistently help *most* students to learn excellently" (Block, 1980, p. 66).

Constructivism is one learning theory behind many student-centered instructional strategies, and typical activities associated with it include problem-based learning, exploration, hands-on learning, discovery learning, and inquiry learning (Bofill, 2013). This theory deals with knowing and the construction of knowledge, not teaching or pedagogy (Bransford, et al., 2005). The philosophy of constructivism describes learning as a process in which individuals "create knowledge from the interaction between their existing knowledge or ideas and the new

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ideas or situations they encounter" (Airasian & Walsh, 1997, p. 33). Marshall, Smart, Lotter, and Sirbu (2011) note that, "Constructivist learning theories favor instructional strategies such as inquiry over didactic instruction, because proponents of constructivism argue that learning can only occur if students are given the time and the means to develop their own understandings" (p. 307).

Constructivism does not eliminate the need for direct instruction, only that the prior knowledge and ideas of students be taken into account when designing instruction if scaffolding of knowledge is to take place (Bransford, et al., 2005). The push towards education that involves more active learning or constructivist types of learning strategies, can make for a difficult transition for teachers under pressure to also cover the wide scope of content that appears on high-stakes standardized tests. In fact, CCSS calls for instructional approaches that are constructivist-like in nature with an emphasis on active and higher order thinking skills (Hopson, et al., 2001; Huba & Freed, 2000; O'Down & Aguilar-Roca, 2009. It is this dilemma that the flipped classroom model can potentially address by taking content lecturing out of the classroom to allow more time for active instructional activities (Bergmann & Sams, 2012a) allowing for active learning opportunities that can be constructivist in nature. Importantly, engaged learning strategies generally require more classroom time for activities, time that can be made possible by removing lecture using the flipped classroom model. Essentially, constructivism involves the active engagement of students in order to construct knowledge in place of forced memorization.

Some of the educational methods that have been shown to be effective for actively engaging students in learning, and can be individualized are: mastery learning, project based or inquiry learning, and Universal Design for Learning (UDL). The next sections briefly outline each of these learning positions and indicate how the flipped learning model can help in the

implementation of each by taking out passive learning out of the classroom and replacing it with active learning time (Love, et al., 2014).

Mastery Learning

Mastery learning, based on the work of Benjamin Bloom and James H. Block, is a process that involves three steps with the first being to define the expectations or setting objectives regarding the material to be learned. The second step involves planning the smaller learning units and the needed sequence of those units in order to reach the stated student learning expectations or objectives. The final step is what Block calls corrective or alternative instructional materials and practices that might include small group work, peer tutoring or alternative materials such as other texts, videos, computer programs, etc. (Block, 1980).

In the flipped classroom model, more classroom instruction time should be spent on active learning tasks and skills rather than on less cognitively demanding tasks—reading, watching lecture videos—which can be done outside of class, allowing for concentrated applications in class with the aid of their peers and instructor. Talbert (2017) notes that class time should not be about students simply listening, rather that they process and embrace ideas. Additionally, Moran and Milsom (2015) state that with the flipped classroom model class time changed with "in-class activities, including JITT [Just In Time Teaching], mini lectures, small group projects or discussions, project-based work, and guest speakers" (p. 36).

Bergmann and Sams (2012b) have switched from their early flipped model—with lecture as homework and homework in class—to a similar mastery learning approach in their flipped classrooms. They now use what they refer to as the Flipped-Mastery model, which they call the evolution of the classroom flip. This flipped-mastery model follows a similar sequence to Anderson and Krathwohl's (2001) revised version of Bloom's taxonomy where direct instruction

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(remembering/knowledge) is moved outside of the classroom, so that class time can be used for students working in small groups or individually at their own pace, followed by a formal assessment of student understanding by the teacher, and then remediation as needed. The Flipped Manifest embraces higher order activities as part of the flipped classroom model (Bennett, et al., 2012):

> Learners have immediate and easy access to any topic when they need it, leaving the teacher with more opportunities to expand on higher order thinking skills and enrichment. Offloading some information transfer allows a classroom to develop that understands the need for teacher accessibility to overlap with cognitive load. That is, when students are assimilating information, creating new ideas, etc. (upper end of Bloom's Taxonomy) the teacher is present to help scaffold them through that process. (p. 1)

The components that Bergmann and Sams use also follow the model outlined by Block (1980) to adopt instructional techniques that help, "students to learn excellently" (p.66), but take advantage of the technological advances that have been made in the intervening timeframe. Among those advances are, "the internet, YouTube, and a host of other websites like the Kahn Academy and Bozeman Science that provide high-quality short videos which cover key concepts in STEM education (Herreid, et al., 2014, p. 76). Bergman and Sams (2012b) note that these advances allow for the creation of multiple versions of knowledge level assessment for a given unit of study. If students do not score at a proficient level, they must review the material and then successfully complete the assessment before verbally demonstrating their understanding to the instructor. Only then, are students allowed to complete a hands-on mastery learning activity; in Bergmann and Sams' classrooms, that usually involves a science experiment (Bergmann &

Sams, 2012b). The goal should be to allow advanced students to move on after mastery of a concept, to give additional time to those who need it, but not to eliminate overall learning accountability.

Project-Based Learning and Universal Design for Learning

Both project-based learning and Universal Design for Learning (UDL) are what Sams and Bergmann (2013) refer to as, "natural fits" for the flipped learning model (p. 18). As Sang-Hong, et al. (2014) note in, "flipped learning, student collaboration increases during activities such as group-specific quiz, discussion, debate and project tasks" (p. 77). The designs of Project-Based Learning (PBL) and Inquiry Learning help to teach students through engagement in authentic or real-world type problems. Project-based learning is an approach to teaching in which students learn by engaging in authentic or real-world type problems. Project-based learning (PBL) can help teachers who want to motivate their students, who want to get students to think about what they are doing rather than simply completing it, and who want to get students to understand material rather than just memorizing facts to pass a test. Blumenfeld, et al. (1991) state that the benefits of PBL happen when students are, "cognitively engaged with subject matter over an extended period of time" (p. 375) and that developments in educational technology may help to provide all of these features.

Another teaching method that can be implemented through the use of the flipped classroom model is Universal Design for Learning (UDL). UDL has three principles: providing students with multiple means of representation or acquiring information and knowledge; providing multiple means of expression; and offering alternative ways for students to demonstrate knowledge, and providing multiple means of engagement (Morra & Reynolds, 2010). UDL grew out of the ideas of the Individuals with Disabilities Education Act (IDEA) in

2004 which called for "the design of products and environments to be usable by people, to the greatest extent possible, without the need for adaption or specialized design" (Morra & Reynolds, 2010, p. 43). There are three principles guide Universal Design for Learning, the first is to provide students with multiple means of acquiring or representing information and knowledge. The second goal is to provide multiple means of action and expression or offering alternative ways for students to demonstrate understanding and knowledge. The final principle is to provide multiple means of engagement as a way to increase both choice and autonomy for individual students (Morra & Reynolds, 2010). Given the IDEA background of UDL, one might think it sounds like advocating for an Individual Education Program (IEP) for every student and perhaps in a way it is. Among Edyburn's (2010) ten propositions regarding UDL are proposals about diversity, about course design, involves technology, and that measurement or assessment—particularly of enhanced student improvement—is important (pp. 36-40). Much of the same can be said of the flipped learning model which can help by providing more fact-to-face learning time to get to know each student, allowing for flexible learning and tutoring time, and with the UDL model it affords multiple assessment attempts while providing remediation as needed. Jon Bergmann was quoted in his interview with Scott LeFee (2013) as saying, "I think every kid should have an individualized education program. Not the paperwork, but the personalization" (p. 23).

Summary

Clearly, there are far more research studies conducted on courses using the flipped classroom model at the post-secondary level than there are studies conducted at the K-12 levels. There is a need to conduct more detailed research on flipped classrooms at the 6-12 levels, given the number of teachers at those levels claiming to use it. There is also a need to look not just

more closely at flipped classroom 6-12 usage, but specifically at the activities actually taking place in lieu of traditional teaching practices such as direct lecture as well. With the goal of the flipped classroom being the ability to free up classroom time for more constructivist learning strategies, there is little detailed analysis of the educational activities taking place in 6-12 flipped classrooms to see if that is in fact the case. Currently, the flipped studies analyzed lack a detailed look at the activities that have replaced lecture in the classroom beyond brief mentions in case studies (Herreid, et al., 2014).

CHAPTER III: RESEARCH STUDY AND DESIGN

Introduction

There is a need to look at the flipped classroom model to determine whether the instructional motivations teachers have are being met and that the claimed benefits of more active learning (Kim, Kim, Khera, & Getman, 2014), increased student collaboration (Sang-Hong, et al., 2014), and more development in, "skills in teamwork, higher order thinking, and problem solving," (Moran & Milsom, 2015, p. 34) are actually occurring. This study focused on teacher motivations for using the flipped classroom model and examined the activities taking place in grades 6-12 flipped classrooms. Are teachers' motivations and goals for implementing the flipped classroom model actually met by their application of the flipped model? In other words, this study sought to find out what teachers wanted to do in their classrooms using the flipped classroom model and what they were actually doing in the class time freed up by removing lectures from the classroom space.

As previously noted, there are few studies related to the application of the flipped classroom model at the 6-12 level and most of those studies compared a traditionally taught class to one taught using the flipped classroom model. These studies generally measured student perceptions of the model and/or grade improvement (e.g. Clark, 2015; Flumerfelt & Green, 2013; Sang-Hong, et al., 2014; Schultz, et al., 2014; and Xiu, Moore, Thompson, & French 2018). Those studies briefly mention the activities used in the flipped classrooms in each study. However, searches of existing research found none that looked in detail at the instructional activities and practices taking place across a variety of 6-12 classes that employed the flipped classroom model. This qualitative study interviewed 6-12 flipped classroom teachers about their motivations for using the flipped classroom model. Special attention was paid to the desired

motivations and used classroom observations to provide more details about teaching methods

and activities taking place in flipped 6-12 classrooms. The collection of lesson plans and other

materials helped to provide additional data points. Grades 6-12 were chosen for the study to

create a more specific sample pool rather than looking at K-12 generally, given that 80% of the

Flipped Learning Network's members identified themselves as teachers in grades 6-12 (Sophia

& FLN, 2014).

Research Design

A basic qualitative study design was applied in the course of this research. Merriam

(2009) describes the central focus of a basic qualitative approach as one in which, "individuals

construct reality in interaction with their social worlds" (p. 22) and notes that constructivism

underlies this approach. Interpretive research, or constructivism, "assumes that reality is socially

constructed, that is, there is no single, observable reality. Rather, there are multiple realities or

interpretations, of a single event" (Merriam, 2009, p. 8). This approach believes that knowledge

is not something to be found but rather something that is constructed. Constructivist teaching

tends to favor hands-on teaching approaches and might include problem- or project-based

learning and Universal Design for Learning. The basic qualitative study is a common form of

educational investigation that has the overall purpose of gaining a comprehensive sense of the

ways in which individuals understand their experiences. As was the case in this study, this is

usually accomplished by collecting data from various sources such as document analysis,

interviews, and observations (Merriam, 2009). Then an analysis of collected data is categorizing

by searching for repeated patterns in the data. The findings in qualitative research are essentially

the repeating topics backed up by the data in which the topics were discovered. The explanation

given represents the researcher's interpretation of the events under investigation (Merriam, 2009).

Data were collected through recorded participant interviews, using a predetermined interview protocol (Appendix C), as well as through the compilation of documents including lesson plans, classroom instructional materials, and other pertinent curricular materials. Each participant was also subjected to a classroom observation, along with an accompanying analysis of the kinds of classroom activities used during the observation. Through an analysis of the interviews, lesson plans, classroom observations, and classroom materials, patterns of 6-12 teachers' reasoning and motivations for using the flipped classroom model in their classrooms were sought. The second goal of this research process was to determine the kinds of student activities taking place in those classrooms using the classroom time freed up by moving lecture and other direct instructional activities out of the classroom. This was accomplished through analysis of the lesson plans and classroom observations. The findings represent a triangulated description of the results from the analysis of the interviews, documents, and observations based upon the researcher's conceptual position of constructivism, which influences the structure of the study.

Research Questions

The study has two main questions it seeks to address within the scope of the research:

1. What are the motivations—including reasons, purposes, and goals—that instructors have for employing the flipped classroom model in their 6-12 classrooms?

2. How is the classroom time currently structured in 6-12 flipped classrooms?

Setting and Participants

The use of purposeful sampling helped identify grades 6-12 teacher participants who currently used the flipped classroom model in their classrooms. Purposeful sampling is used when study participants are required to fit a precise criterion in order to reflect the purpose of the study and contribute to an in-depth understanding of the topic or in the expansion of a developing theory (Bogdan & Biklen, 1998). The use of a purposeful sample when the researcher seeks depth of understanding rather than what is generally true (Merriam, 2009). Area middle and high school principals were contacted via email to identify any individual teachers in their buildings who currently employed the flipped classroom model. Before contacting the individual teachers, permission was obtained from their appropriate district administration to secure the authorization to conduct the observations for the study in their buildings and to ensure the research followed the guidelines for those districts.

Once permission was obtained, invitation letters (Appendix A) were sent to those teachers using individual contact information either obtained from the building administrators or from a school's website. Because of the need to conduct live classroom observations, the contact area for subjects was initially kept small but was later expanded to include areas almost three hours away. The use of a flipped educators discussion group on a learning management system (LMS), used by both a subject and the researcher, resulted in the identification of one of the participants for the study.

Setting

The research took place at four Midwestern middle and high schools and the data were collected from December 2016 to July 2017. The schools were of a variety of sizes with locations ranging from rural to urban. Included in the schools were a small rural school district,

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a large district in a medium sized city, a large suburban district, and an urban private parochial school. The Illinois Report Card (2016-2017) provided demographic information for all schools except for the private school.

The rural school district had fewer than 1,000 students in total with approximately 300 students in the middle school (grades 5-8) where one participant taught. The middle school recently went to 1:1 with Chromebooks at the seventh and eighth grade levels and there was concern among teachers for students with no home Internet access at home. While the school had only an 11.5 percent low-income rate, Internet access might have been limited for some of the district's students living in rural areas. As a result, the middle school mathematics teacher used a checklist system that allowed students to watch her short lecture videos in class. Each video was about five minutes long and limited the informational content to a single mathematic concept. Two teachers in the district were known to use the flipped classroom model, one at the middle school and another at the high school however; the middle school math teacher was the only one using the model in the school year in which data were collected. The high school science teacher had taken on all new class preparations for the year and decided to plan the new curriculum the first year and make videos to flip the following year.

The second middle school is located in a medium sized city with approximately 870 students, in a district of 13,750 pupils. The school is a 1:1 building and utilizes Chromebooks for student devices. It is one of four middle schools in the district and provided three total participants for the study, a mathematics teacher, a Spanish teacher, and a social studies teacher. While the district had some relatively affluent areas, it had a low-income rate of over 33 percent. While the teachers in the district hoped all students would watch the lecture videos outside of class, often, accommodations were made. The Spanish teacher reported that almost all of her

students had Internet at home and watched her videos outside of class at home or in school. The math teacher allowed his students without home Internet access to watch videos in class, usually at the beginning or end of the class period, while others watched at school during study hall or free time. The social studies teacher had moved almost all of her videos into the classroom space and made them part of group activities and discussions. All three teachers knew that they each used the flipped model but knew of no other teachers in the school or district that did.

The school in a large suburban district provided two participants from its high school of approximately 2,700 students out of a district of almost 8,500 students. While its 15.1 percent low-income rate was higher than the smaller rural district, the teachers reported that all of their students had Internet access at home and the students had Chromebooks issued to them as part of the school's 1:1 program. One of the teachers taught mathematics and the other taught biology. Both participants expected their students to watch videos at home and to take some type of notes on the videos. Sometimes these notes were ones that the students took themselves but both teachers also recommended the Cornell note taking system to their students. One provided guided note taking sheets for some of her units. The two participating teachers from this school were not the only ones using the flipped classroom model in their classes. The mathematics and science departments each had several teachers using the method. While not all classes in those departments flipped, certain courses were taught almost entirely using the flipped classroom model. In fact, the classes that were observed had sections taught by other teachers all using the flipped classroom model. The various teachers collaborated on the curriculum including making lecture videos on different topics, which were used by all of the teachers in those courses.

The private parochial high school had an enrollment of approximately 1,200 students and has an annual tuition around $15,000 (Great Schools, 2017). As a private school, no information

appeared on the Illinois report card and the administration declined to comment on the

percentage of low-income students that the school had. The school's website did include a

tuition assistance page that stated it had awarded "$2.0 million in need-based assistance"

(Tuition & Financial Assistance, para. 1). The school used 1:1 iPads purchased by families of

the students and all of the students had Internet access at home. The only teacher in the school

known to be using the flipped classroom model was the Algebra teacher. Table 1 summarizes

the participants' school setting, type of device used, and the level of student home Internet

access.

Table 1

Study Settings (all names are pseudonyms)

Participant	Setting	1:1 Devices	Home Internet
Helen	Rural small district	School Chromebooks	Good
Anthony	Urban parochial school	Student purchased iPads	Full
Kevin	Medium city large district	School Chromebooks	Good
Julie	Medium city large district	School Chromebooks	Good
Lisa	Suburban large district	School Chromebooks	Full
Karen	Suburban large district	School Chromebooks	Full
Michelle	Medium city large district	School Chromebooks	Good

Note. Small = under 2,000 total students in district, Medium = 2,000 to 8,000 total students in
district, large = over 8,000 total students in the district. Good access means most students have
home Internet but teachers had concerns and made adjustments for those without. Full access
means participants claimed all students had Internet access at home.

Participants

Participant enrollment was through recruitment letters (Appendix A) sent via email and

this process identified most of the participants. The identification of one participant was through

a flipped learning discussion group on a learning management system and for which

administrative permission to participate in the study was obtained. The selection of participants

was from teachers responding to those invitation letters and followed protocols approved by the institutional review board (IRB). The goal was that selections would be made from a large pool of initial respondents to the enrollment letter who represented a variety of grade levels, disciplines, and teaching experience. From this pool, I would then seek to identify seven to ten participants who would become part of the study. Preference would be given to potential candidates with two or more years of experience using the flipped classroom model in their classes and to help represent a variety of subjects and grade levels. Table 2 provides a summary of the participant data including grade levels, subject areas, and experience.

Table 2

Study Participants (all names are pseudonyms)

Participant	Gender	Grade	Subject Observed	Teaching Years	Flipped Years
Helen	Female	7th	Algebra	21	5
Anthony	Male	9th	Algebra	8	4
Kevin	Male	7th	Algebra	22	4
Julie	Female	8th	Spanish	15	2
Lisa	Female	Mix 1	Alg./Trig.	22	4
Karen	Female	Mix 2	Biology	33	3
Michelle	Female	6th	Soc. Studies	24	6

Note. Mix 1 = 9th, 10th, and 11th grades. Mix 2 = 9th and 10th grades.

The participants chosen for the study represented the total number of seven teachers that responded to the recruitment letter and all of them agreed to participate in the research study. All of the teachers responding met the basic criterion of being experienced flipped classroom model users that used the flipped model for at least two years.   Additionally, all were currently using in this model their instruction throughout the entire school year in which their interview and classroom observation took place.   As it turned out the participants taught a variety of subjects including mathematics at three grade levels, social studies, science, and Spanish.

Once participants were identified, the interview protocol questions (Appendix B) and a letter of consent (Appendix C) were emailed to them. Any necessary school district procedures required to obtain permission to conduct teacher interviews were followed after IRB approval for the study had been obtained. When setting up the initial interviews, all teachers provided either signed and electronically delivered or signed and personally collected copies of the letter of consent.

The participants included seven middle and high school teachers with years of teaching experience ranging from eight years to over thirty years. Four of the seven participants were middle school teachers—seventh and 8th grade—while the other three participants were high school teachers. Middle and high school teachers were sought and selected to avoid replicating studies focusing on either post-secondary courses or studies in which the researcher(s) generally compared flipped and standard versions of a course. The goal of this research was to look inside 6-12 classrooms that used the flipped classroom model and to examine the activities that were taking place in the classroom time freed up by moving direct instruction (lecture) out of the classroom. All participants taught in classrooms with 1:1 technology, either Chromebooks or iPads.

Helen taught both seventh and eighth grade mathematics in the smaller, rural district and had used the flipped model for over five years. Some students in her observed seventh grade course completed an entire year of Algebra I while others only completed half of a year of material, sometimes referred to as Algebra A. Participant two, Anthony, was also mathematics teacher with eight years of teaching experience in different states and who taught flipped classes at a private, suburban parochial high school. He had been using the flipped classroom model for four years.

Participants three, four, and five all taught at the same middle school in a medium-sized Midwestern city. Kevin taught seventh grade mathematics using the flipped classroom model for four years and has over twenty years of teaching experience. The fourth participant, Julia, taught eight grade Spanish for fifteen years and was in her second year of using the flipped model fulltime having had employed it for various units in past years. The other participant from this middle school, Michelle the sixth grade social studies teacher, had taught for over twenty years and used the flipped model in her history classes for the past six years.

The final two participants both taught at a large suburban high school. Karen taught science for over thirty years and was in the third year of using the flipped classroom model full-time in her honors biology classes of mostly freshman with a few sophomores. Like Julia, she had flipped some units for classes in years prior. Finally, Lisa taught for over twenty years, the last four using the flipped classroom model, and taught mathematics including AP classes. The class observed was an advanced algebra and trigonometry section with a mix of freshmen, sophomores, and juniors.

Ethical Considerations

Institutional Review Board (IRB) approval for use of live subjects in interviews was sought and obtained before participants were selected and the interviews began. Participation in the study was voluntary and participants were informed that they could discontinue participation at any time. Participants were also informed that the data they provided would not be used in any way for an evaluation of their performance as a teacher or shared with administrators. Participants received no incentives for their participation. Most interviews were conducted online using video chat software with only the audio captured via screencast software. Two interviews were conducted face-to-face with the audio recorded using the same software. The

interviews lasted between thirty-five minutes to just under one hour in length. In all written

documentation no individual participants have been identified and neither the name of the school

nor the district has been provided. The study exposed participants to minimal risks, which are no

more than what they are subject to in their everyday lives. There was a small possible risk

involved if any participant dissatisfaction with school or district was revealed to administrators,

but only two administrators were spoken to during the collection process and in both cases only

about the general nature of the study or the school. Additionally, all IRB protocols for the safe

collection and storage of interview data and materials were followed during the analysis stage of

research.

Data Collection Protocol

Borgan and Biklen (1998) define qualitative data as including, "materials the people

doing the study actively record, such as interview transcripts and participant observations field

notes. Data also include what others have created and the researcher finds, such as diaries,

photographs, official documents, and newspaper articles" (p. 106). In the study, I conducted

interviews and observations of the class lessons of seven teachers in grades 6-12 classrooms that

used the flipped classroom model. Additionally, I looked at their flipped classroom activities,

lesson plans, and other relevant curricular materials. After the study participants were identified

and selected, the instructors were interviewed. Prior to the interviews taking place, all

participants returned a signed copy of the letter of consent (Appendix B). The initial interviews

were conducted using a semi-structured questionnaire (Appendix C) to gather more detailed

information regarding the motivations that instructors have for using the flipped classroom

model and to understand the general structure of their flipped classes.

The interview protocol (Appendix C) consisted of thirteen questions designed to help draw out full interviewee perspectives relating to the two research questions regarding motivation and class time usage in the flipped classrooms studied in the course of this research. For consistency and authenticity, every participant was asked all of the questions on the questionnaire. Additional follow up questions were used when necessary to help improve the clarity and richness of the answers. The first two questions are background questions to gather more information about the participants. Questions three through five deal with the first research question regarding the motivations for using the flipped classroom model in their teaching. Additionally, question eleven ties to research question one and the motivation for using the flipped classroom model and is somewhat of a consistency check. Questions six, seven, and eight align with both research questions one and two and concern the practical aspects of implementing a flipped classroom. Questions nine and ten address research question two concerning the types of activities used as part of the flipped classroom model and the benefits of those activities. Question twelve is a way to generally compare the instructor's classroom activities both before and after the implementation of the flipped classroom model. Finally, question thirteen is included as a "catch all" question to allow participants to elaborate on topics they felt might have been missed.

The interviews were recorded in their entirety using audio recording for in-person interview and by using screen capture software to record audio only for interviews conducted via videoconference. The initial interviews ranged from thirty-five minutes to just over fifty-five minutes to complete depending upon the amount of detail the participant provided and the number of follow-up questions. The initial interviews were later transcribed in their entirety by the researcher. The transcripts were then member checked by forwarding transcripts to the

interviewees to ensure correctness and to allow them to make clarifications if needed. Feedback on these was then sought both during the class observations and in the follow up interviews, which were also transcribed. Follow up interviews were also member checked by the interviewees via email.

Next, classroom observations were conducted for each participant, which provided for an in-depth look at the instructional activities being used. The classroom observation helped provide tangible examples of the types of activities taking place in classrooms that practice the flipped classroom model. Beyond the activities the students were completing, I was able to observe the teachers interacting with students in small groups, as individuals, in addition to addressing the full class. No recording was done during these observations and only field notes were taken. The classroom observations were of each participant teaching a flipped lesson at the time of his/her choosing in order to witness in action the types of activities taking place in their flipped classrooms. The students in all of the classes were familiar with the flipped learning model, as the instructors had used it in their current classroom over a period of at least one grading quarter to over one semester in duration for the school year in which the study was conducted. During the classroom observations at times, I sometimes interacted with the students while they were working in groups or using computers, to ask questions connected to their work in order to gain an insight into the activity and their understanding of it.

In addition to the instructor interviews and observations of a flipped lesson, artifacts including lesson plan outlines and classroom materials, such as worksheets and discussion prompts were collected from the instructors. The plans and lesson documents collected during the classroom observations formed another data set. In qualitative research these types of materials might be both personal documents, such as teacher produced lesson plans, and official

documents that are internal and include items such as curriculum maps and district or third-party produced plans (Bogdan & Biklen, 1998). These artifacts provided a smaller data set as many documents were unable to be collected due to district or school protocols. An example of a collected item was the function checklist (Appendix E) used to provide the unit structure for Helen's seventh grade mathematics class in the rural school district. I also collected some worksheets and concept quizzes on functions printed for students to use. The worksheets provided students with individual and group application practice and the concept quizzes assessed mastery of a single mathematical concept like domain and range. Her other classroom materials were distributed via Google Classroom to her students. She attempted to give me access to the class and materials but the district's privacy settings blocked access to them.

The teachers in the middle school from the medium sized school district—Kevin, Julie, and Michelle—were able to show me online materials, but again could not give me access to those items as they were constrained by similar district setting. However, I did collect a few items from materials printed for students in class. From Kevin, the mathematics teacher, I collected a printed version of the "Scientific Notation" slide (Appendix F) used at the beginning of class when he conducted a short review using his interactive white board. Other materials collected from him included copies of the textbook pages for the scientific notation problems students completed in class. These problems included application, ordering, and contextual word problems. From the social studies teacher, Michelle, I collected a worksheet that contained four short primary document passages relating to the Mexican-American War (Appendix G). Her unit ThingLink, used to guide the classes' individual, small group, and whole group activities, was not accessible. There were no artifacts to gather in Julie's Spanish class. Field notes taken

during the class, which described the activities taking place in the classroom, were all that came from that observation.

During the observation of Anthony, the Algebra teacher at the parochial high school, I was able to collect a "Systems of Equations" sheet containing blank graphs on which the students solved problems given to them on a task card, which was online and could not be collected. A second item collected that day was a guided note-taking sheet (Appendix H) that the students partially filled out at home while watching the lecture video for the lesson. Students completed the remainder of that worksheet in class in both whole class and small groups. Due to our use of a mutual learning management system, Anthony was able to add me to his courses in order to see the general organization of his online materials. That access was removed shortly after the observation took place.

At the large suburban high school, I collected a copy of a handout called "Protein Synthesis: Transcription" (Appendix I) from Karen's advanced biology class. The students were just starting a new unit that day after going over a unit test they had taken the previous week. The packet contained a multiday activity that comprised the main hands-on learning activity they would be completing in that unit. This activity involved cutting up paper DNA strips to demonstrate the steps of transcription and translation. From Lisa's advanced algebra class I collected a "Warm-Up Ch. 4 Graphing" worksheet as well as a "Fraction Practice" handout (Appendix J). One side of the first worksheet served as a warm up with answers shared as a whole group. Students working in small groups completed the second side during class. Students then shared solutions to the warm up problems on the board, which I copied down into the field notes. The second handout was a "Fraction Practice" (Appendix K) worksheet used as a

review for an upcoming test. Some of the students were scheduled to be gone the either the day of the test review and/or the actual test day, so several were taking the test early.

While I saw many other materials during the classroom observations, many items, including most of the lecture videos were not viewed or collected. Lack of access to the videos was not an issue as the study focused on what happens inside the classroom. However, a lack of greater access to more of these class activity materials limited their use as a data set. Generally, this occurred in schools where the materials were shared with students via Google Classroom, which limits access to students and staff with district issued Google accounts.

Finally, follow up interviews were conducted after an initial coding of the data from the first interviews and observations. These interviews sought clarifications from the participants in order to make any necessary corrections to both the interview transcripts and to the materials and activities collected. The follow up interviews also sought feedback on the categories created during the initial analysis and the organization of interview statements and lesson materials collected.

The recordings, transcriptions, lesson materials, and field notes allowed the interviewer to recall participant responses as well the context. All IRB protocols for the safe collection and storage of interview data and materials were followed for all interviews with transcripts stored on a password protected computer, and those files placed in a password protected folder that used a separate password. A locked filing cabinet housed physical copies of materials to keep those safe.

Trustworthiness and Authenticity

In qualitative research the belief is that reality is not fixed, rather that it is always changing and in a constant state of flux (Merriam, 2009). A result of this belief in the multiple

constructions of reality is that the capture of reality is not possible, meaning that internal validity in qualitative research looks at how closely a study's findings match the reality of the phenomenon (Merriam, 2009). This also alters the concept of validity with Maxwell (2005) noting that unlike in quantitative research, validity is an objective rather than an outcome and that it should not be assumed. "Validity is also relative: It has to be assessed in relationship to the purposes and circumstances of the research" (Maxwell, 2005, p. 105). Reliability and consistency then are concepts that are also different in qualitative research as, "reliability is problematic in the social sciences simply because human behavior is never static, nor is what many experience necessarily more reliable than what one person experiences" (Merriam, 2009, p. 221). Bogdan and Biklen (1998) state that in qualitative research, reliability is an acceptable spot between the recorded data and what actually occurred in situation as opposed to a precise uniformity between similarly observed situations (p. 36). Essentially, as Merriam (2009) says, what is important is not that something can be found again, but rather that results are coherent with the collected data.

Merriam (2009) suggests that in order to ensure consistency; strategies should be employed such as, "triangulation, peer examination, investigator's position, and the audit trail" (p. 222). To ensure trustworthy results, I triangulated the findings from the interviews, classroom observations, and lesson materials. The term triangulation comes from navigation and surveying, but in social science research refers to the fact that multiple sources of data are better than a single source, and that several sources of data can lead to a richer appreciation of the observed events (Bogdan and Biklen, 1998). The interview protocol (Appendix C) and the data analysis were validated by participant review of the protocol questions and through the analysis process. Peer checking of transcripts was conducted by individual participants in the study

group who were asked to conduct member checks of the analysis of their responses and provide

feedback and discussion to ensure validity, as well as to provide insight as to whether or not my

initial explanations were accurate (Maxwell, 2005). This allowed participants to suggest

adjustments to my interpretations of their perspectives (Merriam, 2009). These member checks

were completed prior to the classroom observations. Field notes were collected during the

classroom observations including notes on discussions with the teachers both before and after

class when time allowed. As noted, lesson materials used during the class observations were

also collected when possible to provide an additional data set.

While the investigator's position will be discussed below in a separate section below, an

audit trail was used to increase consistency to help validate the analysis of the investigation by

following a path similar to that of the study's investigator (Merriam, 2009). This audit trail

detailed the data collection process; explaining the development of categories, as well as the

decisions made during this phase of the study. The audit trail was in the form of a research

journal that included memos about questions, problems, and reflections during the data gathering

process as well as notations made during the analysis and interpretation of that data.

Researcher Positionality and Reflexivity

The researcher has 20 years of teaching experience and currently teaches high school

courses including world history, a dual-credit communications course, and a media course (video

production). I have had seven years of experience of both teaching with the flipped classroom

model as well as researching flipped classrooms that will aid in my understanding of

participants' responses. Additionally, I have written a chapter on flipped classrooms for a peer

reviewed reference text on blended classrooms and I have presented sessions on the flipped

classroom model at multiple regional and national education conferences as well as a regional

flipped conference. The motivation for using the flipped classroom model in my history classes was to move lecture out of the classroom in order to allow more classroom time for the analysis of text, content discussions, collaborative projects, and to provide students in-class time to interact with text and questions over it. This allows students the opportunity to get assistance from both their classmates and I as they complete work they would have normally completed as homework on their own. This also allows for just in time teaching (JIT) to address any questions and misunderstandings that might have led students to leave assignments incomplete if they were completing them on their own. The interview sessions and write up may reveal personal beliefs of the interviewer regarding the flipped classroom model and the importance of active learning.

To address the bias from my personal beliefs, I took detailed field notes that included reflections on my subjectivity (Bogdan & Biklen, 1998) as a user of the flipped classroom model. The data were thoroughly looked at to see if things were seen or heard repeatedly to make sure that the findings were saturated (Merriam, 2009). Alternative explanations were also sought in the data and a lack of other explanations helped "increase confidence in the original, principal explanation" (Patton 2002, p. 553). The comments made by members of my committee provided a peer review of my findings that both provided a check on my analysis and that resulted in conducting additional reviews of the data. The considerable time spent reviewing the different sets of data helped in overcoming my opinion or prejudices and ensuring that data helped provide a detailed interpretation of the complex events studied (Bogdan & Biklen, 1998).

Data Analysis

As noted, the interviews were audio recorded in their entirety and the interviewer made transcriptions of the interviews. The transcripts were provided to the participants to be member checked to ensure correctness and to allow them to make clarifications as needed. The

recordings, transcriptions, and field notes were then compiled in a journal to provide an audit trail that allowed the interviewer to recall participant responses and context as well as to improve validity. During the interview process, field notes recorded in that journal began the development of a data audit. The use of this journal helped to guide the coding of the data during the analysis phase. The categories of activities from each classroom observation were then combined to create a collection of activity types seen during the lessons.

Open coding, using line-by-line analysis of individual interviews, was done to identify themes and then responses from all the participants was compared to both look for similarities and differences in participants' motivations for employing the flipped classroom model that were identified and noted during the interviews. Open coding refers to the fact that at the start of the process I will be open to any possible categories that might present themselves (Merriam, 2009). During this process, the transcripts will be gone through line-by-line with notations made in the margins in an effort to begin to construct categories. Classroom observation notes and lesson materials were also compared using open coding to identify themes as well as lesson and activity categories.

Next axial coding, or analytical coding was used on the open coded interview transcripts and observation materials in order to refine the created categories based on further reflection and interpretation of the meanings of those categories (Merriam, 2009). Then the two lists were, "merged into one master list of concepts derived from both sets of data" (Merriam, 2009, p. 180). These merged categories were further analyzed to look for categories that could be renamed and to search for related categories that might become subcategories of either an existing category or a newly created category that would subsume those related categories.

Finally, analytical induction was conducted to compare the categories of activities created from the lesson plans and activity materials. Analytical induction involves deductively formulating a hypothesis about phenomenon, in this case, the types of activities taking place in classrooms using the flipped classroom model. It was anticipated that there would be some clear connections to constructivist and active teaching methods including scaffolding, mastery learning, project-based learning (PBL), and Universal Design for Learning (UDL) among others. During this process I also looked for both similarities and differences between participants' stated motivations for employing the flipped classroom model and the types of activities that took place in classroom time freed up by moving lectures and other direct instruction out of the classroom space.

Theoretical Framework

The materials and interviews collected were analyzed from the framework of the constructivist theory in education. Marshall, et al. (2011) note that, "Constructivist learning theories favor instructional strategies such as inquiry over didactic instruction, because proponents of constructivism argue that learning can only occur if students are given the time and the means to develop their own understandings" (p. 307). Constructivist ideas build upon John Dewey's (1938) ideas of active thinking and Jean Piaget's (1947) ideas about the stages of cognitive development. Related to this is Vygotsky's (1978) call to first learn what the student knows and then to build upon it through a zone of proximal development (ZPD). Using ZPD, teachers challenge students with work that is above their current level of knowledge, believing that what a child can do with adult assistance is more suggestive of the level of their mental development than what they can accomplish on their own.

Additionally, active learning is related to mastery learning, based on the work of Benjamin Bloom and defined by James H. Block as, (1) a "theory that asserts that any teacher can help virtually *all* students to learn excellently," and (2) "an effective set of individualized instructional practice that consistently help *most* students to learn excellently" (Block, 1980, p. 66). As noted earlier, it is important to remember that educators who take a constructivist approach to knowing do not eschew lectures with Bransford, et al. (2005) noting that direct instruction need not be avoided. Additionally, Jacot, Noren, and Berge, (2014) note that constructivist theory is one that fits well with the flipped classroom model.

This study sought to better understand what instructors are doing with the 'freed up' classroom time and not just to look at the overall classroom structure of flipped classrooms. The analysis of lesson plans and activity materials categorized activities by type and then classified them using applicable learning theories or active learning teaching methods. These categorizations and classifications were reviewed during follow up teacher interviews to ensure that the interviewer accurately drew conclusions. These were then compared to the motivational categories created from the interviews to look for a correlation between reasons given for employing the flipped classroom model and the kinds of activities taking place in those classrooms.

Summary

This chapter outlined the basic qualitative nature of the study's research design and listed the guiding research questions that looked at the motivation for using flipped classrooms and the activities that were taking place those classrooms. The identified participants were 6-12 teachers who used the flipped classroom model in their teaching in order to better understand the impact of the model in the types of classrooms in which it is most often used. It addressed ethical

considerations by following IRB protocols and explained the data collection through recorded interviews, class observations, and classroom materials. Trustworthiness was addressed through open coding with participant checks and the data analysis included coding and comparison to active learning strategies. Finally, the researcher's positionality and reflexivity were explained as analyzing through the lens of constructivist learning theory.

CHAPTER IV: RESEARCH RESULTS

Introduction

This qualitative research study used multiple data points to analyze teachers' motivations for using the flipped classroom and to look at the structure of their in class time. Data points included an initial interview using the interview protocol (Appendix C), a lesson observation to look at student levels of active learning, and observation notes. Data collected also included lesson plans and materials, when available, and a final interview conducted using the follow up interview protocol (Appendix D) in order to answer the two research questions. Open coding was done on all data sets to identify categories as well as lesson and activity themes. Next axial or analytical coding was used on the open coded interview transcripts and observation materials in order to refine and merge the created categories and themes based on further reflection and interpretation of the meanings of them (Merriam, 2009). These merged categories and themes were further analyzed to look for ways in which they could be renamed and to search for related categories and themes that might either become subcategories of either an existing category or a newly created category that would subsume those related categories and or themes.

Finally, an analytical induction was conducted to compare the categories of activities that were created from the lesson plans and activity materials. Analytical induction involves deductively formulating a hypothesis about phenomenon, in this case, the types of activities taking place in classrooms using the flipped classroom model based upon classroom observations, lesson materials, and lesson plans. This analytical induction of all of the data sets created the connected analysis categories and themes and is summarized in Table 5. Results are presented as they relate to the two research questions and further organized under the two questions by the themes that developed during the coding and analysis process. Having taught

using the flipped classroom model for seven years influences the investigator's position, as well as having written a chapter in a peer reviewed reference text on blended learning. Additionally, I have presented multiple sessions and workshops on the flipped classroom model at both regional and national conferences. As noted, my teaching philosophy has its basis in constructivist learning theory that involves student engagement in activities and discussions in class.

Research Questions

1. What are the motivations—including reasons, purposes, and goals—that instructors have for employing the flipped classroom model in their 6-12 classrooms?

2. How is the classroom time currently structured in 6-12 flipped classrooms?

First Research Question Themes

This section will look at the themes that developed from questions three, four, five, and six (Appendix C) on initial interview protocol that relate to RQ1. Included as well are responses from question eight, which dealt with the challenges of using the flipped classroom model, along with relevant responses from questions eleven and twelve that dealt with activities and the frequency of those using the flipped model. Additionally, some responses from the final 'additional comments' question were also included. Categories and several themes emerged from the analysis of the initial interview questions that related to the first research question including: what first drew them to the flipped classroom model, their motivation and goals for using it in their classes, the perceived benefits from their use of the model, and the challenges they have faced using the flipped classroom model.

The design of the individual interview protocol questions was to probe for specific qualities (first attraction, motivation for implementation, benefits, etc.) and in their eagerness to share, almost all of the participants provided some detailed information during responses to a

question that were in effect answers to questions later in the questionnaire. As the interviews progressed, many responded to a later question with a reply that was essentially a response of, 'as I said' followed by a shorter recap. For example, Kevin's response to question three, about what first drew him to the flipped model, was that he wanted to have more time in class to work with students and to "be there to answer their questions and to be there to have kids more collaboratively work together." While that certainly can answer the question, it was also essentially his response to question six, which asks about perceived benefits. As a result, there were responses to some early protocol questions that also answered research questions that occurred later in the protocol. These answers were adapted as needed. Table 3 is an overview of that analysis.

Table 3

Research Question 1 Analysis: Interview Themes

Categories	Themes
First drawn to model (Q3)	**Effective direct instruction** Versatility/absent students Recommendation
Motivation and goals (Q3, Q4, Q5, Q13)	**Increased student engagement** Improved student understanding
Claimed benefits (Q6, Q11, Q12, Q13)	**Increased interaction with/knowledge of students** Increased student content knowledge Increased student collaboration Future student course opportunities
Challenges of flipped (Q8, Q13)	**Motivating students** Technology access Time requirements Support Issues

First Drawn to the Flipped Model

Interview question three did not provide clear subtopics regarding what first drew participants to the flipped classroom model and those reasons varied for almost every individual.

One area where some related responses regarded the idea of moving lectures out of the classroom. Anthony and Karen both mentioned that the flipped model seemed a more effective way to deliver direct instruction, which Anthony called "boring … the least favorite classroom activity." Similarly, Kevin was attracted to the idea of having more time in class to not be "so lecture driven … that they can get some of that background, basic knowledge at home and that we can do more of the applications and stuff, here in class." Others had varied reasons for adopting the technique. Julia was concerned about students who missed class not getting the same information from other students' notes—a concern Bergman and Sams had when they first started. They originally made lectures specifically for absent students or those gone for school extracurricular activities (2012b).

The versatility of this model attracted Helen, as it provided her a way to organize her courses involving teaching two grade levels into one class. Lisa was attracted by the excitement of a former teaching colleague who had adopted the model and talked Lisa's school into sending several staff members to a flipped learning conference (FLIPCON). Martha faced a different situation; selected to pilot the school's 1:1 initiative, she knew that she would soon have devices for all her students, but she did not know how she would effectively implement those devices into her teaching. She first learned about the flipped classroom model while serving as a member of a district team observing another 1:1 school to get implementation ideas. She chose this model as a way to effectively organize her class time and integrate the new technology.

Motivation and Goals for Adoption

This section combines participant responses on their motivation, their goals, and purposes for their adoption of the flipped classroom model into their classrooms. It uses a combination of participant responses from interview protocol question four, asking about motivations for

implementing, and question five, which asks about their goals and purposes for wanting to implement the flipped classroom model. Since the concepts of motivation, goals and purposes for wanting to implement a concept are so closely related, it was clear that there was overlap from participant responses to the two questions. From the analysis of this combination, two themes emerged: 1) less in-class direct instruction (lecture) allows for engagement of students through more class activities and 2) increased student application and understanding of material.

Increased student engagement

The clearest theme to come out of the analysis of questions four and five was a desire on the part of the participants to provide increased engagement for the students with the material, with each other, and with the teacher. Anthony liked the idea of the delivery of information through videos as homework, because he saw it allowed a more effective use of class and homework time. "I like the idea that delivery of information could happen in a more efficient manner and we could use that classroom time to … get more in depth with them or spend more time one-on-one helping." He went on to state, "I wanted to allow more time for one-on-one interaction with students on a daily basis to be able to help them." Karen echoed this, noting that giving notes in class and having the application of that information as homework, was not:

> Really useful … plus, if they had questions, they had to come back the next day
> and ask them. Whereas, they could go home and listen to our voices or watch us
> on a screencast and take notes, and then that left us time in class to actually be
> there to help them do what they needed to do *and* [emphasis in response] to just
> do more engaging things in class.

Karen went on to explain the problems of lecturing in class, like waiting while slower students finished writing notes before the lecture could move on and the resulting problem of other

students getting bored while waiting. Kevin and Michelle also stated that they wanted more engagement with their students, and that information delivery at home and application in class seemed to be a better use of class time, allowing the teacher and the other students to help explain or assist when needed.

Lisa found herself motivated to implement the flipped model, because students lined up outside of her door looking for homework help on the mornings after an in-class lecture day. Her students found themselves unable to complete the work at home, because they needed clarification on information from the lecture. She said they would say, "Oh, when you were explaining it in class, it was crystal clear, and then I got home and had to do it on my own and none of it made sense."   She went on to state that when she was thinking about the flipped model, "I thought well, we're doing it all wrong. We're making them do the hard stuff by themselves at home and for them to come and sit in their seats and be just a receiver." This idea of being able to engage the students was also echoed in Julia's motivation of wanting to provide "more feedback for those that don't usually get the assignment done. And then again, it was offering resources for those students that were missing class."

Improved student understanding

The concept of wanting to engage the students in the application of knowledge in class was another often mentioned response to question five about participants' goals, purposes, and reasons for using the flipped classroom model in their classrooms. Participants felt that it was through engaging activities in class that not only are students using class time to apply material, but student understanding also increased, as well as opportunities for students in the future.

Karen's responses best illustrate how the ability to have more time in class for activities not only provided engagement, but also led to better understanding. As a science teacher she

wanted more classroom time for labs and "to do more data analysis, to do more critical thinking activities … to do more … class discussions, more group work, to make the kids own their own learning." She also felt that direct lecture content delivery was something that the students could do on their own, providing more class time for higher-level skills. She felt that this not only combated cheating, but also changed the classroom dynamic. "When they do a worksheet in class, they have to prove they are doing it … instead of being that talking head at the board, I'm a facilitator and I get around to … every group and have conversations." The ability to work with students one-on-one was Anthony's primary reason for implementing the flipped classroom model, but he also wanted to "allow time for more activities of different sorts." It was the desire to free up class time for those activities that led Anthony to make videos of his lectures. While Julia's original goal for making lecture videos was simply to help students who missed class, she realized that she could use the videos "for students that need additional or re-teaching" and to flip her lessons.

For others, the idea of improving student understanding was the reason to get beyond direct instruction during class time to include more activities. Kevin noted that it allowed him to "get to more higher-level questions and things…and… have a real discussion around those questions." Michelle echoed that sentiment stating, "I wanted to get away from the sit and get. I wanted to get them more involved." Like other participants, she felt that getting students more involved in class would help lead learning beyond the simple recall of information and allow for more understanding and application. She noted that "being in social studies … a lot of times we came up with questions immediately and we needed those answers. We needed to be able to research right away." For Karen, one aspect of helping to increase student understanding and

application was the desire to better implement the Next Generation Science Standards (NGSS), noting that there is:

A specific way that NGSS is supposed to be taught. It is a lot of having kids construct their own learning, a lot of group work, a lot of data analysis. I feel like we have a chance to do more critical thinking in class doing the flipped model.

While giving students more application time in the classroom is one reason for using the flipped classroom model, another reason given was to help provide students with more opportunities to take additional courses in the future.

Claimed Benefits of the Flipped Model

Almost all of the participants seemed to feel that the perceived benefits from their use of the flipped classroom matched their initial motivations, goals, and reasons for implementing the model. The participants' responses to the benefits question, number six, were combined with aspects of their responses to questions eleven and twelve that dealt with the ability to use activities in class and the frequency of the use of the activities. The themes that developed out of the analysis of these responses were 1) increased interaction with and knowledge of students' abilities; 2) increased student content knowledge; 3) increased student collaboration; and 4) preparation of students for future class opportunities. Only Michelle, the social studies teacher, first told she would get devices and had to figure out what to do with them, had a response that fell outside of these two themes. She said, "I had the devices and I knew that kids are so video minded, so I needed to take that step." She observed the flipped model in use at another school and saw it as a fit for the technology she would be getting.

Increased interaction with and knowledge of students

When it comes to the increased interaction with and knowledge of the students that can be gained through the implementation of the flipped classroom model, it is important to remember that the increased class time for activities and interaction is made possible by moving direct instruction or lecture out of the classroom and bringing the traditional homework into class time. An argument for the flipped classroom model is that it can allow for the movement of practice and application from the homework space into the classroom space. As Karen put it, "I think that this is one of the more effective things that we have done as far as having direct instruction to the kids." She noted that while she spends a few minutes reviewing at the beginning of the class, it is about "seeing if they have any questions," and "trying to do a lot more of bridging of lessons from one day to the next." Anthony feels that the one-on-one interaction time provided by the flipped model has had a big impact on his teaching. "There's more opportunity for me to re-explain myself … on a one-on-one or maybe a two-on-one kind of a basis as I'm walking around the room. I just perceive it in terms of I see that there's more understanding."

This ability to assist students as they work through material, beyond remembering and understanding, into levels of activities like application and analysis, not only helps the students better understand the material, it helps the teachers to gain an increased appreciation and awareness of students' level of understanding of the material. Even with Lisa's large sections of high school mathematics, with over 30 students per section, she felt that the flipped classroom model helped her comprehend her students' grasp of the material. "I think I have a better idea of how kids are understanding the material even though my classes are huge." Julia noted that understanding and assisting students in class is possible because "there are so many resources

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available online. It's great for re-teaching and again, it's helping those students that are absent." She believed her foreign language flip works because when you record the lessons, "students watch the lesson and then apply it when they come to the classroom and do all the practice in class."

Helen felt "it's exciting to see the students buy in…they love that they know exactly what's going to happen when they come into class. They have control over their learning environment." Lisa had an interesting observation about her students since her switch to the flipped classroom model. "I noticed that kids smile more in class…they just seem to have more confidence."

Increased student content knowledge

Some of the participants' most commonly identified benefits of the flipped classroom model during the interviews included the increase in student knowledge and student collaboration. That increase in students' knowledge levels is important in order to get to higher level activities and application of knowledge in classes. Michelle noted that among the benefits of the flipped model, she likes the ability to jump into discussions on a topic. "When we talk about it in class, it's not like that's the first time they've heard it. They've got a little background information…it helps with a little background, a little prior knowledge." Helen noted this background knowledge stating that, "a better foundation of algebra…is what I'm seeing now." Karen feels that this increased knowledge base is helpful because it allows students to make connections between concepts. She says she was able to "do a lot more of bridging of lessons from one day to the next…I think there is more learning, actual more constructive learning going on in class than there used to be." Additionally, she felt that the model has changed the dynamic in her classroom. "After doing this several years, I would say the learning being transferred from

teacher-centered to student-centered is huge." While the students in her class were not completely in control of what they were to learn and master, the students were more active in asking a variety of questions, as well as seeking help from the teacher and fellow students. She also feels that the increased use of technology in her classes has led to her students "getting a lot more out of the curriculum."

Increased student collaboration

Another noted factor in that increase in student knowledge—besides the lecture videos as homework—is the increase in student collaboration that takes place in their classes since the application of the flipped classroom model. In his math classes, Kevin liked the ability to increase collaboration stating, "The kids have an opportunity; they have a resource, me and also their peers, to be able to ask questions of and not [having to] go home and be like, I didn't really understand." Anthony felt that the flipped model gives students "so much more in-class time to do work [in groups], and that they have the opportunity to ask me questions." Lisa was also fan of the collaboration time, because when students work with and help each other, they deepen their own understanding as well:

> I think the problem solving, the working as a team…I love to walk around and listen to them explain things to each other, because I think that makes them stronger at math. You think you know it, and then you have to explain it to someone who doesn't understand it and all of a sudden, you're like, 'Oh, now I really get it.'… I think it gives us more time to do the really rich application problems in class.

Lisa also noted in question twelve (able to do activities as frequently before flipping) that "I really, really believe that doing this flipped model and making the videos for them, has to deepen their understanding."

Future student course opportunities

The participants' implementation of the flipped model can be seen as more than just attempts to move lecture but as attempts to move learning up the revised Bloom's Taxonomy (Krathwohl & Anderson, 2010). Some participants focused on the model as a way to provide learning opportunities that will also help their students in the future. Helen taught two levels of algebra in combined classes, where most students completed half of the content and the second part of the curriculum the next year. This is essentially an Algebra A and Algebra B situation in which students complete Algebra I over the course of two years. However, some students completed a full year of Algebra I material in the course of that single year in order to be able to take advanced mathematics courses in high school. She wanted "to ensure that advanced opportunity for the students without doubling up on classes." Spanish teacher Julia wanted to add student buy-in to the learning process and to make it more intuitive, noting that she felt "I'm instilling some responsibility, some self-discipline in students." Lisa thought of what she was doing was along those same lines. "I think it prepares them for college…. I'm providing you with the resources, you have to figure out how to use them…the learning is on them and that if you're not successful you only have yourself to blame."

Challenges of the Flipped Model

As detailed in the literature review, there are challenges to implementing and using the flipped classroom model. The interview protocol asked participants about the challenges they had experienced since they began using the flipped classroom model in their teaching. The

analysis of their responses revealed four topics that were deemed to be challenges for the participants: 1) motivation of students to do the homework and watch the videos, 2) technology and Internet access issues, 3) time requirements, specifically for making the videos, and 4) a perceived lack of administrative support in using the model.

Motivating students

The most often mentioned challenge of the flipped classroom by the participants was the issue of getting the students to watch the videos at home as homework. Four of the seven participants mentioned this as an issue, and all of those taught middle school students (7th and 8th grade). Three of those teachers taught in the same building which could make it an issue of the student population, a school culture issue, or both. Helen notes that for her "the biggest challenge is keeping the students motivated … you have those students who want to do well and want to succeed and they buy in quickly. Then you have those who … wait until two nights before."

Of the three teachers in the same middle school, Julia feels that "you are still going to have some students that aren't going to do the homework…and I find that probably that on a good day 60% - 65% of the students are going to get the work done." Michelle was more direct concerning the issue of homework completion saying, "They don't do homework no matter if it's flipped or not flipped. That's what's disappointing, because you've gone to all that work trying to make it interesting, to make it fun, video … games and they just don't do it." Other teachers in that building see this perceived lack of student effort. Kevin noted, "There would always be two or three kids in the class that couldn't watch them," so as a result, he had abandoned the process in past years before the school went 1:1. With the school's 1:1 implementation, students

who do not or cannot watch videos at home have improved opportunities to watch the videos at school.

Technology access

Although we are almost two decades into the 21st Century, access to technology, specifically the home Internet access divide, is an issue that teachers must still deal with and one that affects teachers that use the flipped classroom model. "The other thing is that I still tend to have a small percentage, I'd say one maybe two in a class, that have problems accessing the Internet at home," mentioned Julia. Kevin, a colleague in the building who stated that technology was a problem, especially early on, echoed this. "The first couple of years I would try it, and people couldn't watch them; not everyone could watch the videos at home … some people don't have Internet access at home, so then they can't watch them." He went on to say that he currently only uses the model in his higher-level classes, because in his other classes, there are "too many people that don't have Internet, or what not [technology], at home." This problem of all students not being able to access the videos at home was also a factor for their other colleague, Michelle. She complained that students just would not watch the videos at home and has since moved most of her lecture videos into the classroom space.

Time requirements

Another commonly mentioned issue with implementing educational technology in general, as well as in implementing the flipped classroom model, is the amount of time required to set up the changes. This was especially true of the up front time requirement to record the lecture videos needed to flip the lesson. Lisa found that "the biggest challenge is finding time to make the videos. When I first started making them, I would redo one video six times before it was perfect." Her building colleague Karen also noted that recording videos requires a lot of

time. "Initially, recording the screencasts was very time consuming, you know, I was coming home every night and recording a new screencast for the next day."

Both also noted that the time requirement is mostly a major requirement at the beginning of the implementation process of the flipped model. Karen stated, "I have to admit that I don't re-record my screencasts. I find that sometimes when I go back to listen to them, there are some comments that I throw in" and how those comments can be a problematic. One example of is when the video says "remember, we did this in class yesterday, and the next year it's like, we [the students] didn't do that in class yesterday this year." Karen had a similar opinion but noted, "Once I have them done, I have to admit that I don't tend to go back and redo them unless I know that it was totally, totally outdated and needs to be redone." Both did note that with practice, the process of creating the videos has become easier, as Lisa stated, "now, I can sit down, spend maybe ten minutes putting together the outline, then five minutes to record it. So the time is better."

Support issues

The final challenge, brought up by two different participants, was the issue of support regarding their decision to implement the flipped classroom model. In both cases, the participants noted that their department chairs did not like their use of the flipped classroom. Anthony noted that "there's a little bit of a lack of support ... from my department chair," and Lisa stated that her department chair thought the flipped model was "silly." In both cases, the participants stated that this did not worry them too much since they had support for its use from other administrative sources. In Anthony's case he stated his "principal's totally on board with it and the other administrators are totally on board with it" as well.   Lisa became less concerned when Mark, the district STEM coordinator, asked her department chair if he could visit some

high school math classes. Lisa agreed to let Mark observe her classes, but when her department chair spoke to Mark, the department chair pointed out that since Lisa used the flipped model, her math classes might not be a good place to start. However, afterwards, Mark told Lisa [in her words] "he was so excited about what he saw, the collaboration, the moving around, the interaction and the learning." Later, Mark told Lisa's department chair that her flipped classroom, "was a good place to be."

This first analysis section looked at interview responses related to the first research question revealed many themes including what drew the participants to the flipped classroom model, their motivations and goals for implementing the model, the benefits, and challenges of their use of the flipped classroom model. The next section of the chapter will look at the collected interview data that relates to the second research question, how time is currently used in the participants' flipped classrooms.

Second Research Question Themes

This section looks at the themes that developed from the initial interview questions (Appendix C) that relate to RQ2 as noted in Table 3. This focuses on questions seven, nine, ten, and twelve, but also includes relevant information from question six which talks about the perceived benefits. Included as well is question eight—in this case regarding how challenges influence what is happening in the classroom—as well as relevant responses from questions eleven (frequency of activities) and thirteen, the final catch all question. Out of the analysis of the participants' responses to these questions four main categories developed: 1) Outside of class work, 2) decision making for in-class activities, 3) types of in-class activities, and 4) activity time including its use and a perceived increase in class activity time. Additionally, each category

included two to three themes regarding teachers' responses to the protocol questions. Table 4 represents an organizational overview of this analysis.

Table 4

Research Question 2 Analysis: Interview Themes

Categories	Themes
Outside of class assignments	Video lecture activities Non-video lecture activities
Making decisions	Standards (NGSS, Standards based grading) Collaborative activities Teaching Experience
Types of in-class activities	Group/collaboration Facilitation and feedback Whole class discussions/reviews
In-class activity time	Mini lectures Perceived increase in activities

Outside of Class Assignments

When people think of the flipped classroom model, they generally think of students having to watch lecture videos outside of the classroom for homework; while that can be true, it is not always the case. All of the participants had videos that students had to watch for homework, but the frequency varied greatly, ranging from daily videos by some teachers, to once or twice a week for others. Some of the participants, Helen, Anthony, Kevin, and Michelle, allowed time and opportunities for students to watch videos in class as well, either in the form of stations students rotated through, or if they finished other classroom activities before the end of class. This is something now called the in-class version of the flipped classroom (Gonzalez, 2014). This will be looked at more in detail in the analysis of the theme of in-class assignments. For this theme of outside of class assignments, two main narratives emerged. As might be

expected, the most commonly mentioned outside of class activity was video lecture activities, while the second most often mentioned was non-video lecture activities.

Video lecture activities

All of the participants used video lectures, usually in the form of screencasts, as homework or outside of the classroom activities. Anthony, Kevin, Karen, and Lisa all used video almost exclusively for homework. For Anthony's math classes, "homework that is due on that day is to watch the video and take notes." He provided note sheets for them, "guided note sheets that basically just have the problems already written out and a list of definitions they can fill in." While most participants used Google Classroom as a central hub for student work and assignments, Anthony's school used the learning management system Schoology where, "they can find those guided note sheets and write down everything I write down on the screen." Kevin's math classes worked in a similar manner with homework usually "some type of background knowledge video that I make using the SMART Board, and then they watch that." He kept his videos between ten and twenty minutes and like Anthony, used a note template. "They take notes on it and stuff for that basic background knowledge."

Similarly, homework for Karen was also lecture videos, except that students might also be finishing an activity that they had started in class. She and her fellow biology teachers tried to keep their screencasts under ten minutes but stated "most of them are between thirteen and fifteen minutes." She noted an advantage of recorded lecture videos was that students can, "stop it, start it, stop it, start it, and watch parts again." She had no requirements for her advanced placement (AP) students to take notes after the first semester although almost all continued to do so even after she stopped doing note checks. She stated that they know that we will "go over what they learned in the screencasts at the beginning of class the next day," and for her AP class

they would be required to apply what they learned from the video. This included her answering questions about practice problems and with peer assistance during in-class work.

Lisa also assigned her students videos. "I tell them every night they are expected to watch a four to eight minute video, and the majority of the time, that's it." She also noted that the total length of the videos combined could be much shorter than the time it would take to deliver the information in an in-class lecture. She felt this to be true because she limits each video's length by keeping to one concept per video and that because students can pause the videos, she did not have to stop and wait as students wrote things down as she would when lecturing in class.

Helen, Julia, and Michelle also used lecture videos as homework, but they included other activities as well. Julia stated that for her "outside classrooms usually will entail filling in some guided notes. There's a video of me teaching, maybe a grammar lesson, or I might be introducing vocabulary, and the students are filling in their notes." Helen originally used this same system but later changed. "Originally when I started, I did the video the night before, come in, answer questions. You post questions to me and I'll answer them. We work, I'm with you to work," but later she moved to a checklist system. This system allowed students without Internet access, either none or temporarily, to be able to watch videos in class, while students who wanted to get ahead would watch at home. When Michelle started, she also did, "a lot of videos, games…recorded information," but like Helen and Julia, changed to meet the technology needs of her students. Those changes and non-video lecture homework will be discussed in the following section on non-lecture out of class activities.

Non-video lecture activities

In addition to her lecture videos, Julia also used other activities for homework, which might include, "completing listing activities or video activities in which they are presented the vocabulary, or applying the vocabulary and grammar concepts from the chapter, and then they are answering some questions." While Lisa mostly used video lectures as homework, she said that, "every once in a while we have a problem set. But I would say that because now we have fifty minutes in class everyday, to work on problems, we get it all done in class." Her other non-lecture homework involved projects, "the last one was I asked them to make a video for me. So I gave them a challenging problem, they worked with a partner, they created a video and they handed in the video to me." In addition to his lecture over basic math concepts, Kevin sometimes gives his students, "two problems to try at the end of the video and I say bring that to class and that's how we start class."

Some have changed how they use the flipped classroom model to a system in which there is little to no homework. Helen began her use of the flipped classroom with the traditional lecture at home and homework in class model but because of Internet access issues and because of students who did not always complete homework, she moved to a checklist system. The checklists are given, "at the beginning of every unit, and it has anywhere from twelve to twenty items on it, with due dates of when I expect them." Students completed the checklist inside or outside of class and she says, "as long as they stick with my due dates they'll be able to take the assessment on assessment day." She liked the flexibility of this system and states, "they can work ahead, and if they work ahead and they need a day in class to work on poetry because they got behind in language arts, I give them that flexibility." Instead of traditional homework, she noted that students are "able to work outside of the classroom at their leisure." For similar

reasons, Michelle changed her use of the flipped model to one in which students have little to no homework. She stated, "This is where flipped classroom is difficult. [Internet access and students not completing] We use a lot of videos, games…recorded information. Sometimes [it was] like looking at a cartoon, but most times it's playing games and videos." She has since integrated a lot of what was formerly homework into group activities with her ThingLink boards. After looking at how participants changed their outside of class work in order to provide more time for activities, application, and collaboration in class, the next theme looked at how users of the flipped classroom model make decisions about what to do during class time.

Making Decisions

The second category looked at how teachers make decisions about their curriculum. All teachers face decisions about what to do in the classroom, but teachers who use the flipped classroom model generally have one classroom activity that is less frequently on their list of options, direct instruction or lecture. The themes that developed out of the interview analysis for research question two were three considerations that influenced the participants in planning their in-class activities: standards, the desire for collaborative activities, and their body of experience as classroom teachers.

Standards

For some of the participants, standards guided decisions about what to include in their courses and lessons. For her math classes, Helen stated that she had "moved to standards-based grading, so about every two or three concepts, per se, they have a concept quiz." Passing the concept quiz was a way for the students to demonstrate mastery of the concept or standard she was evaluating. Another participant who mentioned the influence of standards was Karen based her biology courses on NGSS and their call for more data analysis. For her, it was important to

use the flipped classroom model to move lectures outside of class time to be able to "spend more time having kids do more data analysis, being able to recognize significance, statistical significance, that kind of stuff."

Collaborative activities

For most of the participants, the main goal of using the flipped classroom model was to be able to have more classroom time for activities and collaboration rather than lecture. Karen stated that the main goal for her and the other biology teacher was to have the students "do more collaborative activities, being able to insert more labs into our curriculum. We [the biology teachers] try to do those things instead of having direct instruction any more." Using video lectures as homework also allowed Kevin to do more activities in class. "I feel that once they have that background knowledge, that there can be more group and collaborative type activities." He noted that the collaboration they do could help develop deeper mathematical understanding for the students:

> The first thing that they do, just maybe talking about a couple of the problems that I gave them, gets them not only just seeing if everyone has the same answer, but maybe how different people in their group might have approached it differently. So, then that initially will lead us into a discussion of, 'well how come some people did it like this and home some people did it like this?' And we can talk about … the more efficient strategies. Whether it's just completely whichever way you like works for you, or whether it was something special about the problem that maybe lent it to a certain problem-solving strategy. So, it lets us have those discussions a lot more.

Julia also thought in terms of collaborative activities that needed a facilitator to guide the students during the activity. "I try to think about what activities do they need me … to be around for? What do I need to facilitate, if they need a facilitator? Those are the kinds of activities I want them to do in class."

Teaching experience

All of the participants in this study were veteran teachers having taught for several years. The participant with the least experience had been teaching for eight years. One participant had fifteen years experience, while four of them had over twenty years of experience. One participant actually had over thirty years of classroom teaching experience. Because of this it should not be surprising to find that one of the areas that developed about how teachers made decisions regarding classroom activities was based upon their experience. Michelle, with twenty-four years of teaching, said she goes with her experience or "what works well and I survey the kids too and ask them what works. But we just try different programs, you know, going on experience with what has worked in the past, what doesn't." Lisa had taught for twenty-two years and used both experience and surveys of her students. "I do ask for feedback. I use Google forms a lot, so I'll just send something out." She also relies on informal feedback from students at the beginning of class. "Sometimes when I walk in, the kids say, 'we watched that video Mrs. L, we still don't get it,' so I'll have to do a re-teaching." Even Anthony with eight years of teaching used his experience and tried to find activities that "fit in with a certain lesson that we're doing or a certain concept…something that is suitable." Next, the analysis will look at the types of activities that the participants were using in their classrooms with the implementation of the flipped classroom model into their teaching.

Types of In-Class Activities

This theme is an important one, as it is perhaps one of the main reasons research says that teachers implement the flipped classroom model into their classrooms. In this theme, three major areas of activity types developed, mainly through the analysis of question ten. As with other analysis, relevant participant statements from other questions were added if they fit better here. This analysis was to complete a fuller understanding of all the types of activities the participants used in their classrooms based on their interviews. The three themes that developed during the examination of this category were, 1) collaborative group activities, 2) activities that allowed for facilitation or feedback, and 3) review and discussion activities.

Group and collaborative activities

Looking for activities where their students would have opportunities to work collaboratively together was the most mentioned adjective in participant responses regarding the types of activities they used in their classrooms using the flipped classroom model. For Kevin's middle school math class most of the activities that they do are practice and application, the types of problems that would have traditionally been homework. He sees the application of the current topic in class as an advantage, because "they can collaborate with their group mates…ask questions as they go … even if they're not asking me questions, just the discussions I think they have with each other is something that they wouldn't have had at home." In-class activities in Julia's Spanish classes generally means "we're spending most of the time with speaking activities, activities in which students collaborate with each other." As will be seen in the next theme, her students also work on writing in class to be able to get assistance from her and from their classmates.

Anthony's mathematics classes were similar to other classes concerning class activities he noted that the flipped classroom model helped him add more activities to his class, "I probably could have fit in a few, but no way I could have fit in as many as I fit in now." Anthony liked to use online Tarsia puzzles in his class, where students can use technology to take "a collection of triangles, and squares, and different shapes that like match up...like matching linear equations to a point on a line or those kinds of things." He also liked Dan Meyer's three act math problems that present the groups with a problem without telling them the solution. The second act gives them the information they need to solve it, without telling them how to solve. In the third act the goal is that "by that time they're more engaged cause they want to figure out how to solve the problem." In one group example, students did:

> An activity with unit rates to see if LEGO uses gender bias and charges more for
> girl-marketed LEGOS instead of the boy marketed Star Wars LEGOS. It was kind
> of an interesting lesson. They got into it, you know, they're all really writing it
> down. And in case you're wondering, in their small sample, they do charge more
> for the girl ones.

As noted in the making decisions theme, Karen was guided by the NGSS standards, so she was "able to spend more time having kids do more data analysis, being able to recognize significance—statistical significance—that kind of stuff … more collaborative activities." Lisa liked to have her students work in pairs and groups using the Desmos graphing calculator application on their Chromebook to do discovery activities as well as using programs such as Kahoot and Socrative. However, for her, one of the best things the students did collaboratively was decidedly low tech:

Everyday they walk in, they grab a whiteboard marker and they go to their desk,

and they do all of the work on the desks. So, they are writing on their desks as if

they were whiteboards. And they can write as big as they want and they can look

at each other's work and the whiteboard gives them the opportunity to erase their

mistakes. And I tell you, they act like it's Christmas that they get to write on their

whiteboards.

Michelle and Helen did things differently in their middle school social studies and math

classes, partially to address the problem of students either not watching the homework videos or

for those who do not have Internet access at home. Helen used a unit checklist system that

allowed students to watch videos in class. She said that sometimes they watch a video together

in class "because I want to discuss that." As part of her checklist "there's a lot of group activities

that they do, the concept quizzes, sometimes it's a video, sometimes it's an activity, sometimes

it's something online," noting that they generally complete at least one or two activities each

day. Michelle's classes included both collaborative group and whole class activities. She

created ThingLink boards with different kinds of activities that they work through together. She

told of one example they had just completed:

We just did a president one and they watch an introduction on a president, so like

say, Jefferson. They are looking for three things on this video: when he was in

office, who the vice president was, and what party he belonged to. So they watch

that and we talk about it in class and make connections to other people and the

president before him.

Facilitation and feedback

A second theme commonly mentioned was the idea of having in-class activities that allowed or required the teacher to be present and act as a facilitator for the activity, making the teacher available for feedback and assistance. Helen noted that she likes her activity-driven classroom time "because I've become more of a facilitator and see them making those discoveries on their own." Kevin felt that his students could ask him questions, and that he puts "the answer keys out so that they can be checking themselves as they go, in case I'm working with another group somewhere." For him, being able to facilitate is the biggest advantage of the flipped classroom model. "I mean, it really does help me helping students that don't get it, that need extra help or need 1:1 time, and that really is probably the biggest key to using it the way that I do." As noted in the making decisions theme, Julia tried to get her students Spanish writing tasks completed in class. "That way I'm able to guide them and offer them feedback." Adding that she asked herself "what do I need to facilitate if they need a facilitator? Those are the kinds of activities I want them to do in class." Karen stated that having students watch screencasts and take notes at home "left us time in class to actually be there to help them do what they needed to do and to just do more engaging things in class…more constructivist learning." Facilitation for Lisa might mean adjusting activities over a period. The class began with an agenda on the board and started with her answering any student questions over the video from the night before. However, she noted that classes might vary depending "upon about how they're feeling about the material, where we are in the chapter, do we have a test tomorrow, a quiz tomorrow, are we starting something new?"

Discussion reviews

The final theme that developed under types of activities taking place in the participants'

flipped classrooms was that of whole class discussion review. While the discussion reviews

might look like lecture with the teacher up front and all the students listening, they differ in that

these are discussions of material or concepts previously covered in the video lectures. During

the classroom observations, the teachers questioned the students over materials in the video

lectures and students had to explain or defend any answers they gave during the review

discussions. In other cases, students applied information from a video lecture. Helen noted that

her school's schedule varied with shorter period days and days with hour-long class periods. She

said that on the longer days, "I start every one of those a mini-lesson. For some it's a preview of

a video that's coming, others it's a review…I do a lot of mini-lessons." For Julia, the reviews in

class were part of the process of setting up activities for the students to use for the practice and

reinforcement of material covered in the homework lectures. Julia clarified that if "I feel like I

need to explain, then those are the ones [activities] I want to do in class." According to Michelle

she also included a lot of her shorter lecture videos in class using ThingLink boards through the

use of embedded YouTube videos, annotated EdPuzzle videos, images, songs, and even graphic

novels, in order to make time for class activities and to create discussion topics. She also

explained that she models analysis of documents such as, "political cartoons that I do with

Sceencastify and talk through…sometimes I put together a slide show for them and I narrate it.

Sometimes we use video clips from the John Adams movie."

In-Class Activity Time

The final category that developed out of the analysis of the interview questions that

corresponded to the second research question dealt with the frequency at which activities took

place in the participants' flipped classrooms, comparing the current frequency of activities to the frequency in their classes before implementation. Almost universally, the participants stated their perception of the frequency of classroom activity use was higher than before their implementation of the flipped classroom model. The two themes that developed during the analysis both centered on the concept of the use of class time. The first theme was the use of much shorter mini lectures to refresh students about the current topic area, as the implementation of the flipped classroom model often replaces the traditional in-class lecture with video lectures watched outside of classroom time. A perceived increase in activity time was the second theme to develop. Since there was no longer a necessity for full lectures, the flipped teachers perceived that there was more class time to include additional activities than before their implementation of the model.

Mini lectures

Kevin noted that before implementing the flipped classroom he had fewer activities in his mathematics class because after reviewing homework and lecture, a student "might have 5-10 minutes where they could get started on something." He said that under the flipped classroom model "we might talk for 10-15 minutes at the beginning of class, kind of summing up some of the things on the video…some extension or some application." That means "the next 25-30 minutes or so, is their time to work together on whatever the homework is." Helen was the same with her mathematics classes "I was traditional. Lesson, guided practice, independent practice, because I only had about 45 minutes, so it was very much structured that way." The result was in-class activities were less frequent except when "I would do a mini-lesson every once in a while…[and] we would do group activities." The use of mini lectures was a way to provide just-in-time teaching and review discussions as needed to check and reinforce student understanding

before starting activities much like Bergmann and Sams did in their science classrooms in Colorado (2012b).

Lisa summed up the lecture and class time problem when asked about the use of activities in her classes saying, "I always like to think that I was that teacher that changed it up and had different activities. But the problem was I had a lecture to deliver." Karen noted that before the biology teachers at her school implemented the flipped classroom, they were giving notes during a couple of the five fifty-minute periods a week. Additionally, "at the beginning of a unit we'd be giving notes three days in a row just to front load them with the information they needed to know to understand the activities we were going to do later." On the other hand, Michelle noted that she had more activities the first year she flipped but had students either not watching or unable to watch the videos. So, while they do more activities than before she flipped, "it's all together [with her ThingLink boards] in class." The other issue she mentioned was that many of her activities done in class are digital, so part of the reason she did less before was "because I didn't have devices and without those, I couldn't do a flipped [classroom]."

Perceived increase in activity time

As noted, the flipped classroom model lessens the use of traditional lectures during the classroom time. In traditional classrooms, lectures can consume the majority of time, leaving little for in-class activities and application. Julia noted that she was still doing similar activities before she flipped but that with the flipped classroom model, she is "saving one, maybe two days of curriculum time," that had been lecture …"by moving the direct instruction outside of the classroom." Lisa stated that before the flipped classroom model, she only did activities infrequently, "The problem was I had a lecture to deliver. Oh, and on top of that I had to go over homework and that sometimes could take up 20-30 minutes if they kids didn't get the

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homework." She went on to talk about the impact of class time on activities. "It seemed to me, before I flipped the classroom, it was driven by going over homework and then getting to the lecture. So not nearly as much as I get to do now." Karen was surprised at the amount of classroom time that was saved using the model. She said that "once we [the biology teachers] flipped, we have more time to add more authentic activities … If we're giving notes a couple times a week and we're not doing that anymore … wouldn't that free up like forty percent more time?" By her analysis, if a typical class was 50 minutes, taking out lectures would mean adding the equivalent of an additional 20 minutes of classroom time each day.

The analysis of the participants' interview protocol responses to research questions revealed several themes. The themes of motivation of the use of, and the benefits of, and the challenges of the flipped classroom model developed out of the analysis of interview questions and responses related to RQ1 about the motivations—reasons, purposes, and goals—for the use of the flipped classroom model. The second research question looked at how participants structured classroom time in their flipped classrooms. The examination of participant responses related to it revealed the following categories: outside of class assignments, making decisions about in class activities, the types of in-class activities used, and the perceived increase of those activities in the classroom before and after the implementation of the flipped classroom model. The next section will present the results of the analysis of the classroom observations and lesson materials. Analyzed as a separate data set to look for themes, this would later be merged with the interview analysis to form a connected analysis of the data sets.

Classroom Observations and Lesson Material Analysis

An examination of the classroom observations and lesson materials data collected from the seven participants is the focus of the third area of this study's results. A combined analysis

of the classroom observations and the lesson materials was conducted, as the connection of the activities observed in the classrooms to the lesson materials provided additional support for those observed activities. The analysis of the combined data resulted in the creation of two categories based on the levels of activities witnessed during the observations of the participants' classrooms and the levels of the activities included in the lesson materials.

The categories developed out of the analysis of the observations and lesson materials were 1) lower engagement activities, that tended to be at the remembering and understanding level of Anderson and Krathwohl's (2001) revision of Bloom's taxonomy, and 2) higher engagement activities that included applying, analyzing, evaluating, and creating.

Lower Engagement Activity Analysis

The stated goal of the flipped classroom flipped classroom model is to move lower-level activities out of the classroom to allow additional class time for higher engagement activities. While the participants' flipped classrooms did remove much of those activities, such as lecture and background readings, the study found that the participants did not completely remove these from the classroom environment for a number of reasons including technology and Internet access issues or circumstances where students had trouble understanding a homework lecture video. Many of the participants began their classes with at least a mini review and often included other full class reviews during class work time that consisted of group and some independent practice of concepts. While this is still lower engagement work, it is generally applying information that is above the remembering and understanding levels. Additional, this allowed for the teacher to be present, as well as other students, for the clarification of understanding if needed. Another activity seen during classroom observations was individual and small group reviews of procedures related to the basic concepts applied by students in the

classroom. This was time when teachers answered student questions, guided them in their work, and checked in on students to gauge understanding even if the students did not directly ask the teacher a question.

Helen's middle school algebra class was a mixed level flipped classroom and included her use of a unit checklist system (see Appendix E). She started her lesson with a two-minute quick review of where they were at in their functions unit with a remembering and understanding check for the entire class in which they defined functions and their use. She then reminded students of where some of them were in the checklist and where they needed to be in order to complete the checklist before the unit assessment. Her functions unit checklist included remembering level activities, such as lecture videos and understanding level activities like a model function worksheet, along with some higher order activities. Students complete the items on the checklist either in or out of class, sometimes called an in-class flip (Gonzalez, 2014). Michelle's social studies classes also included in-class flipped elements with students often watching direct instruction videos in class, either as individuals, as groups, or as a whole class. She also used ThingLink boards with activities ranging from small group to whole class with both types of activities culminating in whole class, teacher-led discussions of the activities. Examples included a Twister Geography exercise at the remembering level and a Manifest Destiny group activity that led to a whole class review and discussion.

Both Anthony's and Kevin's mathematic class started with short concept reviews at the remembering and understanding levels. Anthony began with a short five-minute review over a homework problem and their note sheet (Appendix F) that students talked him through and he guided them to explain the process. Later, he had a similar review session with class members sharing five example problems on the board after they had completed a graphing application

exercise (Appendix G) through paired work. Kevin conducted a short two-minute review of about based on where they were at in their scientific notation unit (Appendix H). Students then worked in groups of four on problems listed on the SMART Board; the first two problems were at the remembering and understanding levels and the third question was a multistep problem at the analyzing and evaluating levels. After students completed these problems as in groups, Kevin worked through the problems on the SMART Board and had students talk him through the steps during which he clarified and explained as needed.

Julia's Spanish class began with a bell ringer activity, ¿Adonde va la gente?, in which students worked with partners and small groups on the near future form in Spanish. This was a lower level activity that led to a quick whole class mini review of the form. Much of the collaborative group work the students completed in class entailed remembering, understanding, and applying, as they had to recall older vocabulary terms, construct meaning from messages in Spanish, and apply the near future form to various activities. Each activity involved either partner or group work and each ended with whole class sharing of examples created during the activity with clarifications given by Julia and corrections given by both her and other students based on the class analyzing the responses.

Observations of both Lisa and Karen's classrooms were somewhat atypical of their typical days, as Lisa's class had had a quiz the day before and Karen's class had had a test. Originally, these were not going to be the topics for their observation days, but as is common in teaching, original lesson plans changed due to schedule changes and to meet the needs of students and classes. Lisa's class began with extended time at lower levels as she spent time explaining quiz answers with students' assistance. Afterwards, student volunteers put up two sample problems from the previous night's lecture video. These questions were then gone

through together and Lisa asked the student volunteers to explain their work while she provided clarification and review. The time spent explaining test answers at the beginning of Karen's biology class was also a lower level activity. This was especially true for the essay questions. During this time, students helped explain and provided examples as well. Students and Karen made connections between the essay questions on the test and activities that students had previously completed in class. Followed the test clarifications a nine-minute mini-lecture of recombinant nucleic acid (RNA) took place, based on the previous night's video lecture. This involved a review with multiple questions and student provided answers and explanations used to set up the group RNA sequencing activity. The completion of the activity would be over several periods as part of the daily activities.

Upper Level Activities Analysis

As noted earlier, the stated goal of the flipped classroom flipped classroom model is to move low level lecture out of classroom space in order to allow class time for engaging activities. While the participants' flipped classroom did include some lower level activities, the analysis of the data from the observations and lesson material included a great variety of activities that were more engaging and constructivist in nature. These activities that took place in the participants' classrooms were generally more like the application, analysis, and creating types of activities traditionally associated with constructivist education.

Helen's checklist system (Appendix E) included activities at many levels of Bloom's taxonomy. The higher-level activities were at the applying, analyzing and evaluating levels. The book practice problems and the online work at Mangahigh.com: "Algebra Meltdown: Lines, Equations, and Number Machines," and "Represent Filling Containers Using Graphs" were at the applying level. The In-and-Out Burger Task was at the analyzing level, as were parts of the

Mangahigh.com: "Represent Filling Containers Using Graphs" activity. Finally, the two concept quizzes were at the evaluating level and were part of her standards-based grading system.

The first two problems from Kevin's initial question set were at mixed levels and required remembering, understanding, and applying. The third problem was at the analyze and evaluate levels, requiring the students to compare three student answers, identify each as correct or incorrect, then finally to explain why they were correct or incorrect. Students worked in groups for most of the rest of the class period on fifteen problems from their Prentice Hall Algebra I text. Questions 19, 21, 29, 31, and 33 were application problems; questions 23, 25, 27, 35, 37, and 39 were at the analysis level, while question 41 was an understanding level question. Questions 43, 45a & b, and 47 were again at the application level. Note that problems numbered 35-47 were problems with real world applications. While this can be seen as traditional homework, the important difference is when and where the students are completing the work, i.e. in class with the teacher present to clarify and to act as guides.

Kevin provided guided help in the form of additional individual or small group teaching and re-teaching during this student work time, while students collaborated, explained answers, taught or re-taught processes, and even rationalized their answers to each other. This process also involved evaluation, as students used his provided answer keys to check both their own work and work of others at their table. In a similar manner, Lisa's fraction half sheet problems (Appendix I), where students worked with partners and assistance from her and then shared on board, were at the application level. Her group collaborative white board activities were at three levels including application or procedural problems, analysis level involving graphing and helping others, and the evaluation level as students made judgments and determined the relevance of the results of the problems and graphs.

Anthony's class included individual application of problems 8-28 from the textbook, after which five students put example problems on the board. Again, while these are essentially the things that might make up a traditional homework assignment, the movement of direct lecture out of the classroom created time for students to work on these in class with peer and teacher support. Anthony helped individual students at their desks while students were working, including some who asked questions and others whom he asked probing questions as he walked by. He later noted that most of the students he probed were the weaker students that needed more help. He also assisted the students at the board with the word problem analysis questions as they were putting questions on the board for the entire class to go through. He then had students talk through the examples on the board, getting input from the class, and provided additional input as needed. During the last twenty minutes of his class, students worked at the applying and analyzing levels, working on problems in a partner exercise. Scanning a QR code on a task card with their iPads took the students to the Systems of Equations worksheet problems. Anthony continued to help student pairs in the same manner as he had during the earlier textbook problems.

Julia's class mostly involved groups practicing the near future form in teacher guided activities that required them to determine what people were going to do and then say it in Spanish. All these activities were at the understanding and applying levels but also involved analyzing level work, as the students had to differentiate by selecting, and organize by structuring responses correctly. Pairs of students chose a word from three columns: people, verbs, and activities in the first collaborative activity.   In another activity, groups of four students each, worked on the near future form in Spanish. Student one chose who (¿qué?), student two chose what they were doing (¿qué hace?), student three chose where the person was

going (¿donde?), while student four answered in Spanish. Groups then shared some of their practice examples with the class, while Julia made corrections or asked students to make corrections and provide explanations. The final activity involved students practicing five times with a partner in preparation for the entire class working through more examples at the application with other students analyzing the correctness of the responses. A student with notecards called out which student would then create and tell a possible near future situation. Others helped, corrected, and retaught, as needed resulting in an activity that included elements at the higher levels of applying, analyzing, and evaluating.

Most of Michelle's class involved students working either individually or with people at their table on a variety of activities, then sharing and discussing those as an entire class. She organized the activities as part of a ThingLink board that is teacher-guided. Their analysis of a document on Nineteenth Century transportation involved both analyzing and evaluating in addition to requiring them to remember information and to be able to understand that information through exemplifying, summarizing, and comparing. This tied in with a Twister Geography question also used in the class. While that particular question was at the remembering level, they had to pick a transportation type, explain how it was the best to use in the expansion of America in the era of Manifest Destiny, and then justify their answer. These requirements placed this activity at the analyzing and evaluating levels. Two other activities in the class were also at the analyzing level. These were the analysis of Document 402, "Causes of the Mexican-America War," (Appendix J) that involved four excerpts from primary source documents and the territorial acquisition ThingLink board activity in which the students applied and analyzed aspects of westward expansion in United States history.

Finally, Karen's class also included activities that involved multiple levels including the

RNA activity where the students started in groups, which then explained the differences between, long tail versus short-tail RNA to the whole class. This activity required students to not only remember and understand but to apply and analyze as well. Additionally, the students started a group RNA sequencing activity (Appendix K) that students would complete over several days during class and required both the application and analysis of how parts of enzymes contribute to the whole sequence for both long-tail and short-tail RNA.

The analysis of lesson materials and the data gathered during the observations of the participants' classes clearly demonstrated that the participants used the flipped classroom model to help them have more class time for students to work on activities. The activities often allowed students to apply the information presented in lecture and the text and to use the information to evaluate and create. While some of the in-class work was considered lower level activities, they were activities that at least engaged the students in the application of material as opposed to listening and taking lecture notes. Additionally, it was also observed that all participating teachers included higher-level activities that engaged the students with analytical problems, discussions in which students had to rationalize, justify or defend their answers, and long-term projects. The final section of this chapter will combine the results of the interview protocol analysis and the examination of the observations and lesson materials.

Connected Analysis: Interviews, Observations, and Lesson Materials

The final analysis was an analytical induction that included all the previous data sets, the participant interviews, the classroom observations, and collected lesson materials. The analysis included both research questions and showed clear connections between the actual lessons and the participants' goals and motivations for implementing the flipped classroom model into their teaching. The planned lessons and activity materials, along with the observed classroom

activities, in many ways paralleled the themes that developed from the interviews. This section's categories of the participants' stated motivations, reasons, purposes, and goals for implementing the flipped classroom model shows these were actually demonstrated in the classroom structure of the observed classes. It also provides examples of connections from the observed in-class activities and the desired changes expressed by the individual participants in the interviews. Table 5 shows an organizational overview of this analysis.

Table 5

Connected Data: Combined Interview, Observation, and Lesson Materials

Categories	Themes	Connected analysis themes
Motivation and Goals	Increase engagement & activities Student application & understanding	Increased engagement through application and collaboration Increased student knowledge of content Increased knowledge of students and opportunities for them
Perceived benefits	Interact with and understand students Better student content knowledge Increased student collaboration Future preparation for students	

Motivation, Goals, and Perceived Benefits

Two categories developed from the interview protocols regarding the participants' desires for implementing the flipped classroom model into their teaching were 1) their motivations and goals for the use of the model and 2) their perceived benefits from using the model. The two themes that developed in the first category of motivation and goals were increased student engagement and application for increased student understanding and opportunities. The four themes that developed in the benefits category were first, increased interaction and knowledge of

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the students, second, increased student content knowledge, third an increase in student collaboration, and finally, an increase in future preparation for students. The observations and lesson plans and materials revealed many activities that demonstrate the teachers' ability make their flipped classroom model goals a reality. During the analytical induction it was observed that many of the activities used in the observed classrooms showed connections to both motivations and benefits so categories and themes were revised to reflect these connections. This section organizes these subtopics into a combined category that has three themes in order to reduce redundancy. The themes in the combined category are 1) increased engagement through application and collaboration, 2) increased student knowledge, 3) an increased knowledge of individual students that allows for increased opportunities for those students. This section looks at examples of activities that exemplify ways that the teachers were able to help make the teachers' motivations into benefits for the students. This begins with examples that show increased engagement through application and collaboration.

Increased engagement through application and collaboration

Kevin had implemented perhaps the most traditional version of the flipped classroom model in that the students generally watched lectures at home and traditional homework, in the form of application and higher-level activities, completed in the classroom. Kevin liked that his students "can collaborate with their group mates and then ask questions as they go and the group work and cooperative work the students had done in class reflected that. Students worked together, corrected each other and generally explained their work to their group mates rather than simply giving each other the answers when someone was stuck on a problem. The checklist model Helen used in her mixed level class (see Appendix E) illustrates the increased opportunities and the variety of activities that she included to support her desire for increased

student engagement and understanding. Many of the activities allowed for student engagement, collaboration, and application, and collaboration include the application problems, worksheets, and the online. She sensed that the collaborative aspects of the checklist were important and believed a result of her checklist system was "the learning being transferred from teacher-centered to student-centered was huge."

Anthony wanted to have more class time for interaction with his Algebra students with more application and improved content knowledge for his students. He wanted to "get more in depth with them or spend more time on one-to-one helping." Students problem solved individually or in pairs and he helped students individually or as they worked with their partners. This ability to work interact more often with students clearly demonstrates how the flipped classroom model had helped him meet his goal. Lisa had similar goals when she implemented the model in her classroom. "It gives us more time to do the really rich application problems in class. They work collaboratively, so I think that … that's a big benefit." A good example of this collaborative work in her class was her 'white board' activities with partners, where students explain problems to each other rather than just giving struggling group members the answers. She noted that she liked "the problem solving, the working as a team" that the students were able to do.

Spanish teacher Julia already included a variety of activities in her class time, and while she initially wanted to provide resources for students who missed class, she soon found that by moving direct instruction out of the classroom she could create more classroom time for activities. Additionally, she found it to be a good way to address the problem of students who were not completing traditional homework, as now they had classroom time to work on the activities with the support of both their peers and teacher. Her near future form activity

demonstrated collaboration and students worked to apply the form, analyze, and evaluate by critiquing and helping their partners and group members.

While Karen's class spent time reviewing quizzes and then reviewing RNA sequencing, her group activity was a hands-on, collaborative activity that hit several levels from remembering, to analyzing, to creating. This fit her classroom goals of "having kids construct their own learning, a lot of group work, [and] a lot of data analysis. I feel like we have a chance to do more critical thinking in class doing the flipped model." Michelle also wanted more participation that was active for her students when she switched to the flipped classroom. She was "hoping they would get more engaged." Her social studies activities allowed her students to work together to apply content knowledge in a geography problem that went on to become an analysis problem, as students picked and justified the best uses of modes of transportation from the Nineteenth Century. The document analysis (Appendix J) allowed students to collaborate while they analyzed the documents.

There were clear connections between participants' motivations and goals for implementing the flipped classroom model and the activities they had their students completing in class. The in-class activities clearly involved knowledge application, analysis, evaluation, and even creation level activities. The ability to move much of the direct instruction activities to outside of the classroom—generally in the form of video lectures—allowed extra class time to provide more of these types of activities.

Increased content knowledge

The flipped classroom model promotes the idea that taking some direct instruction out of the classroom time can lead to more opportunity for classroom application. In Julia's case, while some of the activities observed were at the understanding level, they still provided necessary

practice in a foreign language classroom that took place through listening exercises. Kevin felt that if they get the background knowledge at home then there was more time in class for not only collaborative activities, but also likes it when students get to see how different approaches to a problem can still result in the same answer. This then led to discussions about strategies, which were more efficient and whether or not that matters. Seeing different approaches allowed for a better conceptual understanding of the content rather than just a procedural understanding.

Lisa noted similar findings for increased student understanding in her mathematics courses. The ability for students to get "the lecture at their own pace, being able to stop it, pause it, go back" lead to student notes that she calls "impeccable" and that some students even color code. The advantage of lectures at home was the increased time for application of that content knowledge in class and for students to work collaboratively. She felt that she saw the increased content knowledge as she walked around the class and listened to the students explain answers and concepts to other students. She said students' understanding of knowledge grows in these cases, "you think you know it, and then you have to explain it to someone who doesn't understand it, and all of a sudden, you're like, 'Oh, now I really get it.'

Other examples of teachers' sense that student content knowledge increased using the flipped classroom include Helen's observation that she sees students seeming to have a "better foundation of Algebra" and Anthony noting that from working in with students with the extra class time, he perceives "that there's more understanding." Lisa also felt that the flipped model has "deepened their understanding" of material in her class. While these observations may not be quantifiable, the teachers generally perceived that the flipped model lead to increased content knowledge for students, not just by having lectures they can view and review, but because the extra class time allowed for more guided practice and application in the classroom which put that

background knowledge to work.

Increased knowledge of students and opportunities

The last area of connections between participants' goals and the activities they implemented into their classroom through the use of the flipped classroom model was the desire for increased content knowledge for students, a better knowledge of students—to aid in gauging student content knowledge—and finally, increased opportunities for students now and in the future. As noted above, Anthony's use of individual and paired student problem solving allowed him to help students in a more individualized manner. Later, during sharing of problems with the entire class, he was able to review areas of misconceptions and that he felt he had a clearer understanding of those because of the class time to work more closely with students. The flipped classroom model gave Anthony the availability of addition in class time to work with and better understand his students, time made possible by moving the direct lecture to homework using video lecture homework.

Karen noted that the flipped model allowed her time to work with students individually, to better understand their knowledge of the content, and to know them better as individuals. One of her classes was a course she had not taught before and she felt she had to go through the class at least one year in a traditional manner before she would be able to flip it. The class had thirty-three students in it and she noted, "I was just so frustrated that days would go by and I would ask myself, boy, I haven't even talked to this student. It was impossible to get to everyone." She then took a long weekend to make a bunch of videos and told the class they were trying something new. Now she notes that, "it doesn't feel like I have thirty-three kids, except when I have to grade papers."

Helen's main goal with her mixed mathematics levels classroom was to ensure that the

upper level students had the opportunity to take advanced level math classes in high school, "without having to double up math in high school." She also found that while this example of increased opportunities for her students may have been the driving need for her implementation of the flipped classroom model it also led to increased content knowledge for her students. She noted that her students had a "better foundation of algebra…is what I'm seeing now." Her use of a checklist model allowed her the opportunity for frequent interactions with all of her students and helped her understand their individual understanding levels. Anthony also wanted to have more application and felt that his ability to provide one-on-one interaction with his students would lead to a greater depth of content knowledge for his students as well as provide him with a better understanding of his students. "The fact that the students get so much more in-class time to do work, and that they have the opportunity to ask me questions…I see that there's more understanding."

Michelle liked the flipped classroom model as it allowed for deeper student discussions in class when they worked on her guided activities. "It's not like that's the first time they've heard it, they've got a little background information." Karen also felt that "there is more learning, actual more constructive learning going on in class than there used to be." Her hands-on group activities like the RNA sequencing were good examples. Lisa also felt that she had "a better idea of how the students are understanding the material" and that allowed her to have more time for application in class.

Kevin was another participant who wanted to be able to get to higher order questions and discussions for increased understanding but also noted that "the kids have an opportunity, they have a resource—being me and also their peers—to be able to ask questions." His traditional flip setup gave students time to do traditional homework in class. During the class observation,

he explained this allowed him the opportunity to individually check with students to help them if needed and to get a better sense of individual students' level of understanding. Lisa also felt that assisting students not only helped them, but also helped her to develop a better understanding of the students and their skills. She says, "I love to walk around and listen to them explain things to each other, because I think that makes them stronger at math." This is something that was evident in both her opening exercise and in the 'white board' group activities that her students enjoyed.

Julia felt that the flipped classroom model allowed her to provide additional resources for learning for her students, give them more practice time, and help them be more responsible. She noted that "there are so many resources available online. It's great for re-teaching, and again, it's helping those students that are absent." Her class activities clearly indicated that she likes to have students practicing in class, and she planned it that way through her use of the flipped model:

> I try to think about what activities do they need me for, or do I feel like I need to
>
> be around for? What do I need to facilitate if they need a facilitator? Those are
>
> the kinds of activities I want them to do in class.

Additionally, she feels "that I'm instilling some responsibility, some self-discipline in students," something that will be useful for her eighth graders when they enter high school next year.

Summary

The purpose of this chapter was to present the findings of data collected through research conducted using seven teachers who use the flipped classroom model in grades 6-12 classrooms. The chapter presented an analysis of the data collected in the study including the interview protocols, the classroom observations, and the collected lesson materials. The first analysis

looked at the interview protocols and developed themes based around the study's two research questions.

The first question dealt with motivations and goals for implementing the flipped classroom model and generated themes of first attraction to, motivations for adoption, benefits of, and finally, challenges of the flipped classroom model. Like teachers in many flipped learning studies (Baker, 2000; Mazur, 2009; Strayer, 2012; Overmyer, 2015), the teachers first felt drawn to the model as it seemed to provide a way to better provide direct instruction and allow for versatility in terms of having extra classroom time without lectures. One teacher first became aware through colleagues and another as looking for a way to take advantage of the technology she was getting as a result of a 1:1 computer implementation plan. Their motivations for using the flipped classroom model included being able to provide increased student engagement in the classroom, to improve student understanding of the content, and to allow classroom time for the application of that content with the assistance of the teacher and classmates.

The teachers in the study felt that the benefits of using the flipped classroom model include increased interaction with the students, which leads to an increased knowledge of those students. They provided numerous examples of student collaboration in the classroom and some of the participants mentioned that the model allowed them to help prepare students for learning opportunities in the future. The implementation of the model into their teaching and classrooms was, however, not without some challenges. Most mentioned that it took some time to motivate the students to the new routines of the model, and all of the teachers mentioned that it took significant time to plan for and to implement the flipped model. Some of the teachers mentioned a perceived lack of support from some of their supervisors, but they almost all mentioned that

other administrators do support their decision to use the flipped classroom model.

The second research question examination of the interviews resulted in themes of out of class activities, decision-making about activities, types of in-class activities, and the frequency of those activities. Almost universally, the teachers stated that out of class activities consisted of video lectures, usually in the form of screencast lectures. Generally, these involved watching the screencast, note taking and, in some cases, completing a few practice problems. Out of class learning activities also included the completion of activities started in class that may not have completed. Teachers made instructional decisions for the flipped model based on reasons such as national standards, increasing collaborative activities, and based on their teaching experience.

The analysis of the observational data, including observation field notes and lesson materials, resulted in a comparison of planned activities and observed activities. Many of the activities that the teachers planned and used in the classroom with the flipped classroom model included group, collaborative activities at levels including application and analysis. Teachers mentioned that they like the ability to provide students with feedback as they work and to act as a facilitator when students need assistance. Other activities that the teachers used included content review mini-lectures—generally based on videos watched the night before—to set up activities, or for student clarification. Overall, all of the participants stated that they perceived having more activity and application time in their classrooms since their implementation of the flipped classroom model.

Finally, a connected data analysis looked at goals and activities mentioned in the interviews and those activities that took place both in and outside of the classroom space. This led to the development of three themes, increased engagement through application and collaboration, which mirrored results in other studies (Clark, 2015; Flumerfelt & Green, 2013;

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and Bennett, et al., 2012). The finding of an increase in students' knowledge of content in the study is similar to findings by Hutchings and Quinney (2015), and an increased knowledge of students which can help teachers guide students towards future opportunities is similar to findings in several studies (Hutchings & Quinney, 2015 and McCallum, et al., 2015). The next chapter will be a discussion of how the collected and analyzed data connects to the research that has previously taken place in flipped classrooms and the relevant educational theories.

CHAPTER V: CONCLUSIONS, DISCUSSION, AND SUGGESTIONS FOR FUTURE

RESEARCH

Introduction

In the current arena of education, there are many calls for in the introduction of engaging

activities that involve the application of knowledge in the classroom. Common Core State

Standards (CCSS) calls for these changes as does the Every Student Succeeds Act of 2015

(ESSA). Additionally, there has been a rapid increase in the implementation of educational

technology into all levels of K-12 classroom and beyond. The importance of these issues

resulted in the inclusion of requirements in ESSA to address the technology and blended learning

training needed to bring these into the classroom. ESSA formally defines professional

development as activities that, "are sustained (not stand-alone, 1-day, or short term workshops),

intensive, collaborative, job embedded, data-driven, and classroom focused." Additionally, it

describes educational technology training as also involving "ongoing professional development

for teachers," (ESSA, p. 487). As schools and teachers look for ways to address these mandates,

they have looked to educational technology and many teachers have turned to the flipped

classroom model.

The Flipped Learning Global Initiative (FLGI) alone claims over 29,000 members (FLGI,

2017). One of the claimed advantages of the flipped classroom model is the practice of moving

direct lecture out of the classroom space which can then provide for more time in class to do

application activities (Foertsch, et al., 2002). Hutchings and Quinney (2015) call this "a shift

away from traditional information-transmission, teacher-led lectures where students sit and listen

as passive learners, to offer an active and collaborative learning environment, where students

assimilate knowledge through application and evaluation" (p. 107). This study took a qualitative

look at seven flipped teachers motivations and inside their classrooms to understand their goals and the activities they use.

This research looked specifically at practitioners of the flipped classroom model in grade levels 6-12 classrooms, as 80% of flipped teachers claim to teach at those levels (Sophia & FLN, 2014). This was also chosen as most flipped classroom studies have been conducted in the higher education arena (Baker, 2000; Demetry, 2010; Frederickson, et al., 2005; Gannod, et al., 2008; Lage, et al., 2000; Overmyer, 2015; Schullery, et al., 2011; and Strayer, 2012). The goal of this study was to look for teachers' motivations for using the flipped classroom model as well as what they are actually using for both their in-class and outside of class activities. Most studies, even those conducted at the K-12 level, tend to research whether students liked the model or if class scores went up (Flumerfelt & Green, 2013 and Sang-Hong, et al., 2014) and looked at individual classrooms rather than looking at what was generally taking place in most flipped classrooms.

Analysis of Findings

In order to gain a better understanding of what was happening inside of 6-12 classrooms using the flipped classroom model, this study collected data from seven flipped classroom teachers who taught grades 6-12 in a variety of subject areas. Four of the participants taught mathematics, two in middle school and two at the high school level. The other participants included a Spanish teacher, a Social Studies teacher who taught at a middle school, and a high school science teacher. Two main questions guided this research: first, what are the motivations—including reasons, purposes, and goals—that instructors have for employing the flipped classroom model in their 6-12 classrooms? Secondly, how is the classroom time currently structured in 6-12 flipped classrooms? In order to gain a fuller picture of the structure

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and organization of the participants' flipped classrooms, several points of data were collected. Participants completed an initial interview conducted using an interview protocol (Appendix C), had an observation of their classroom, submitted lesson plans and materials, and finally, participated in a follow up interview. These multiple data points helped to increase the understanding of teachers' motivation for using the flipped classroom model, as well as provided a deep and rich picture of what is happening inside of flipped classrooms at the 6-12 level.

Participant Motivations

The first research question covered participants' motivations for implementing the flipped classroom model into their courses. Many mentioned the adaptability the model brought to their teaching as a reason for implementation, along with its ability to free up class time by removing lectures from class time. They felt this allowed for not only more activities in class (Baker, 2000) but it also allowed for versatility in content delivery through the implementation of the model (Bergmann & Sams, 2012b). They wanted to be able to engage the students more directly in class using a variety of activities including concept checks, discussions, application, and analysis as well as to move away from the passive learning of teacher-led lectures (Hutchings & Quinney, 2015). The engagement of students in class meant two things, engaging students in activities in which they applied basic knowledge, along with being able to engage and interact with the students themselves. The contact with the students was in itself a twofold process. The first part of the process was to be able to help students as they worked through or struggled with the in-class assignments and to be able to provide just-in-time assistance. Secondly, this allowed teacher time to work with students during class time, allowing teachers to get to know the students as individuals.

These motivations for using the flipped classroom model were also seen as potential

benefits for the participants. Their goals of increased interaction with students as well as an increased personal knowledge of those students and their abilities are among the benefits listed by Fulton (2012a). Other benefits the participants hoped to gain included increasing student collaboration time and time for activities that better promoted thinking, collaboration, and research both inside and outside of the classroom space (Herreid & Schiller, 2013). Finally, several participants mentioned that the flipped classroom model might help them better prepare their students for classes in the future or allow them to learn more content in the regular school year, thereby enabling those students to take advanced classes in the future, an option that otherwise would not have been possible. Mention of this specific benefit has not been seen in other studies.

Participant Challenges

While the participants were motivated and looked forward to the potential benefits of the flipped classroom model, they had concerns as well. The biggest concern, one often mentioned in literature, is the time it takes to implement the model and master the technology often used in the accomplishment of that process (Gross, et al., 2015; Pragman, 2014; Wright, 2010). Almost all of the participants noted the challenge of the time it took to record the lectures their students needed to watch as homework in order to be prepared for the in-class activities. Most participants stated they became more proficient at creating the videos over time. They also came to appreciate that the recordings could then be used for multiple years and much like a lecture, did not have to be flawless. As Bergmann and Sams (2012b) note, the videos need not be perfect, they just need to be ready by class time.

An additional challenge that some of the participants faced was getting support for their implementation of the flipped classroom model. Two of the participants noted that their

department chairs did not like the flipped classroom concept. However, both also noted that they had principals and other administrators who supported them in their use of the model. This support by administrators, students, and parents is an important consideration for using the model in an attempt to engage students (Butler, 2014). Other potential challenges to implementing the flipped classroom model were that technology was seen as required, as well as need for training to use that technology. As all of the participants' schools had 1:1 technology programs, the teachers in the study did not bring up training, but they did bring up the problem of students without Internet access at home. However, all of the participants in the study felt that the challenges were far outweighed by the potential benefits they hoped to see in their classrooms.

While teacher motivation was one of the main goals of this study, the second part of the study's findings centered on at the second research question, how class time is currently structured in 6-12 flipped classrooms. This part of the study was designed to look deeply inside flipped 6-12 classrooms to see if class time, once the model had been fully integrated, reflected the use of activities claimed as benefits by research on the flipped classroom model. In other words, what were the learning activity goals that teachers had actually implemented once the flipped classroom model became a reality in their teaching. None of the participants in the study was a beginner at flipping their classes and while most were still refining the flipped process for their classes, none were struggling with the initial process of implementation. The participants' years of experience teaching with the model ranged from two to six years of use in the classroom.

Outside of Class Activities

In terms of activities taking place outside of the classroom, many associate the flipped classroom model with students watching recorded lecture videos at home (Bergmann, 2016; Bergmann & Sams, 2012b; Dagostino, Carifio, Bauer, Qing, & Hashim, 2014; Herreid, et al., 2014; Trogden, 2014; Vasquez & Chiange, 2015). Similar to other studies, all seven of the participants used screencast video lectures as assignments outside of the classroom. Some required notes to be taken over the video and sometimes these were in the form of guided notes that the students were required to complete. Others required that a short number of questions or problems be answered along with brief notes. In the case of three of the math teachers, Anthony, Kevin, and Lisa, one or two sample problems might accompany the lecture, which were then gone over at the beginning of the next class to check student understanding. Some, including Helen and Michelle, had recently moved away from having the lecture videos watched outside of school because of students without Internet access at home. They have made a switch to what is known as an in-class flip (Gonzalez, 2014), while others allowed students to watch videos in class if needed. Examples of both of which will be discussed when talking about activities in the classroom.

Not all of the homework activities centered on video lectures and the participants gave examples of several other activities including some traditional homework sets, listening activities for a foreign language class, or unit activity checklists. Helen and Lisa both noted that they occasionally gave students a traditional set of homework problems but noted that this was now rare. As a Spanish teacher, Julia sometimes gave homework that involved listening activities that might be a video or an audio recording where students identified parts of conversations. These usually included a worksheet or online set of questions corresponding to the information

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in the recorded conversations. A final area of outside of class activities was for students to finish an activity or assignment that they began in class but might not have completed. This also included Helen's checklist of activities, videos, and concept quizzes as students could work on the checklist both inside and outside of class time.

Inside of Class Activities

The second focus of the study was to find out what teachers are doing in the classroom time made by removing lectures and whether the level of classroom activities had increased. The flipped classroom model promises the more time for classroom activities at levels above remembering and understanding (Clark, 2015; Foertsch, et al., 2002; Hutchings, & Quinney, 2015; Jensen, et al., 2015; Lasry, Dugdale, & Charles, 2014; Prashar, 2015). It was projected that more time would be spent completing application and other cognitive level activities than might be witnessed in traditional classrooms (Moran and Milsom, 2015). Additionally, teachers hoped to use that extra class time to include more student collaboration while completing those activities (Dagostino, et al., 2014). The study's participants all reported that they perceived their students to be doing more activities in their classrooms since they implemented the flipped classroom model.

However, doing traditional homework exercise in class is not the only type of activities taking place during class time in flipped classroom. Moran and Milsom (2015) note that with the flipped classroom model in-class time has changed with, "in-class activities, including JITT [Just In Time Teaching], mini lectures, small group projects or discussions, project-based work, and guest speakers" (p. 36). The participants' interviews, lesson plans, and observed classroom activities all included the use of a variety of activities. The mathematics teachers, Anthony, Helen, Kevin, and Lisa all started their classes with either a mini lecture and review discussions

of the previous night's video lecture along with examples or, in the case of Helen, a shorter review of the concepts that they should be covering in their current unit checklist. Much of the rest of class time was used for working on what would be traditional homework problems either alone, in pairs, or in groups. Often, examples of those problems would be shared with the entire class. Helen's students were working on problems but might also be watching a short mathematics concept video, taking a concept quiz, or completing other activities on her unit checklist on functions (Appendix E). Kevin allowed students with home Internet access issues to watch videos if needed. Combined, these are some examples of the flexible delivery of content using the flipped classroom model as described by Schultz, et al. (2014) and of the kinds of activities listed by McCallum, et al. (2015) such as concept checks, problem solving, and evaluation. Helen also allowed students to watch lecture videos as part of her in class activities, as they were part of a guided set of requirements for each unit. In her class, Michelle often had students watching lecture videos as groups or as an entire class and then discussing the video-based guided notes they took as they watched.

Many of the activities in lesson materials and observed in observations met some of the need for constructivist type activities called for in CCSS (Hopson, et al., 2001; Huba & Freed, 2000; O'Down & Aguilar-Roca, 2009). Much like researchers such as Piaget, Dewey, and Vygotsky, CCSS points out that education needs to be more than learning facts for a test; instead it should be about knowledge, the ability to know how to use those facts. Bransford, Darling-Hammond, and LePage (2005) call for students to be able to connect ideas the ideas being taught and to apply those ideas to problems in the real world. Prashar (2015) also calls for this hands-on type of approach in the classroom and Krathwohl (2002) notes that many flipped classroom activities will represent higher-level cognitive activities in which students will be asked to

understand, apply, analyze, evaluate, and create as opposed to activities that simply ask them to remember. The practice of taking some direct instruction out of the classroom time is often mentioned in flipped literature as an opportunity for the use of that knowledge to check understanding, application, analysis, and more while in the classroom (Herreid, et al., 2014; Trogden, 2014). Prashar (2015) notes that the "flipped classroom offered more space for students to try out things themselves and thus, make necessary connections with the course content" (p. 133).

These types of higher-level cognitive activities were also part of the combined themes seen in the all of the participants' classrooms. Kevin felt that if they got the background knowledge at home then there was more time in class for collaborative activities and more. He liked it when students got to share their solutions in class because they could see how the use of different approaches to a problem could still result in the same answer. This led to discussions about more efficient strategies that students could now better understand. Seeing different approaches allowed for an improved conceptual understanding of the content as opposed to a procedural understanding. Anthony's classes also included working through problems as a class, usually guided by different students, to see others' differing approaches to the same problem. This led students toward a richer understanding of the content and improved their application of the content knowledge.

In Julia's Spanish classroom, while some of the activities observed were at the understanding level, the exercises still provided a lot of the practice necessary to be successful in a foreign language. Collaborative group work also took place in the classroom through exercises where student groups role-played various speaking scenarios in which they applied both prior and recently acquired knowledge. They did this through the process of creating dialog, then

speaking and listening to that dialog. This ability to have additional time to aid students did not just allow Julia to help them with problems; it also helped her to learn students' knowledge levels and to get to know the students better.

Anthony also felt that the flipped classroom model gave him the availability to have addition class time to work with and better understand his students. Unbeknownst to the students, he arranged his classroom to allow for improved access to students who struggled. Among other participants, Karen also noted that the flipped model helped her to work with students individually more often, not only to help and better understand their knowledge of the content, but to get to know them better as individuals. All told, the participants' perceptions of increased student engagement, of increased application and collaboration, and of improved understanding of both student content knowledge and familiarity with the student, seemed to match the benefits mentioned in most literature on the flipped classroom model.

Limitations

Like most studies, this one was not without limitations, which affect the findings and scope of potential implications of those findings. One major limitation is that the pre-flip versus post-flip levels of activities used in their classes are purely the perceptions of the individual teachers. There were no quantitative levels of activities used in each of the teachers' classrooms before their implementation of the flipped classroom model. The only way to truly measure this would be to identify teachers who are planning to implement the model, to measure the activity levels in their traditionally structured classes first, and then measure again after their switch to the flipped model.

Another concern is that not all teachers responded to the final follow up interview. One teacher who retired did respond, but one who moved out of state and two that changed schools

did not. However, those that did respond generally simply recapped the information they had stated earlier and the follow up interview led to no new information. One teacher provided a small clarification in a follow up interview and perhaps if all teachers had responded, an increase of information or some new information might have been obtained.

Since this study looked at not only what was happening inside of flipped classrooms but teachers' motivations for implementing the model as well, a quantitative component might have been useful to gather the perspectives of a broader range of flipped 6-12 instructors. A mixed methodology study that surveyed teachers over the questions in the interview protocol (Appendix C) that then selected a smaller number of respondents to conduct face-to-face interviews and classroom observations might have been a better option. Such a study would have provided additional data, as well as potentially generalizable information regarding both teachers' motivations for using the flipped classroom model and the activities they used in their courses.

Another limitation of the study was the 'one shot' nature of the classroom observations and gathering of class materials. Four of the seven teachers were only observed for one class period, another two participants for most of two back to back class periods, and a third was observed for two non-consecutive classes in two different subjects. A longitudinal study that looked at plans and materials over the course of a quarter or a semester that included multiple classroom observations, while being significantly more time consuming, would have yielded much richer data. One way to try to address this might have been to watch teachers for at least a full day of teaching, but the researcher is also a high school instructor and arranged observations around a full-time teaching schedule.

Finally, only the lower end of targeted number of participants partook in the study. The initial plan was to look for six to ten flipped classroom teachers and the final study gathered

seven in total. Local teachers were hard to find, many districts simply did not respond to requests, and there seemed to be a lack of interest to participate in the study. For example, of three known teachers in the area who used the flipped classroom model, two did not respond to multiple contact attempts, and the other was not flipping that school year having been assigned all new courses. Since the courses were new, the teacher was not planning to flip for the first year while the new course materials and plans were developed. The teacher stated the she would have liked to have taken part in the study, but felt she needed to teach the courses traditionally while developing the curriculum before she started to flip those courses. Additionally, finding more teachers outside of the math and science areas would have been a benefit to the study, as a significant number of studies have been conducted in those areas, yet those are not the only subject areas in which teachers use the flipped classroom model. This would have allowed for either the inclusion of more subject areas in the study or at least a better balance of subject areas. While participants were sought from regional school districts, only four were from the local area, with three of those participants coming from a single junior high school. The other three participants came from districts that were two or more hours drive away and made for full days with travel to the schools, observations, and then the return trip.

Implications and Future Recommendations

This study looked at teachers' motivations for implementing the flipped classroom model into their courses. It also investigated teachers' lesson materials and conducted observations to see if the activities used in their classrooms matched their initial aspirations for using the flipped classroom.   The next sections will address the implications of the study including its findings regarding teacher motivations for the use of the model as well as the types of activities used in the classroom. Implications of the model for veteran teachers, new teachers, and administrators

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are also discussed. Finally, there is a discussion on the state of the flipped learning model and its future.

Implications

Through its two main research questions, this study contributes to current research by demonstrating support for two major areas of inquiry regarding the flipped classroom model. The first is in the area of teacher motivations for wanting to implement the flipped classroom model. The study clearly showed that the motivations of teachers in this study closely match what other literature has stated are the reasons to use the flipped classroom model; more classroom time for activities and application, a better understanding of student content knowledge, and a better understanding of the students as individuals. The participants' responses and classroom observations undoubtedly add support to the idea that the flipped classroom model, with its removal of in-class direct lecture, helps to provide more classroom time for activities, collaboration, and teacher interactions with individual students.

Secondly, the study showed what activities are actually taking place in a variety of different flipped classrooms at grade levels 6-12. Most flipped studies looked at what has taken place in a section or sections of courses used to compare flipped and tradition classroom sections in the same subject. By conducting interviews with a variety of flipped participants, observing their teaching, and collecting their flipped classroom materials, this study gained a deeper understanding of the use of the flipped classroom model in action. This adds to the research on the flipped classroom model, as this data is richer than information gathered through the self-reporting of teachers in a survey or from the reports of studies that compared the flipped classroom model to a traditional classroom. The implications of teacher motivations and the use

of classroom activities provide useful information for veteran teachers, newer teachers, as well as for administrators.

Veteran teachers in the study reported that first getting started with the flipped classroom model takes a lot of time and work. They also noted that many of their colleagues do not flip their classes for that reason. Studies have noted that it does take time to plan and record lecture videos, but once made, those videos can be used again and again (McCallum, et al.; Pragman, 2014). There is also the option for them to use videos made by others that can be readily found, as Herreid, et al, (2014) noted that only about 20 percent of respondents in their flipped survey made their own videos.

Veteran teachers should also keep in mind that the flipped model is not an all or nothing proposition; they can start by recording lectures for a particular lesson or unit. Three of the seven participants in this study started flipping that way. Additionally, as more schools become 1:1 schools, the flipped classroom model is an additional tool that veteran teachers can use when moving from traditional to blended learning. This model can also address what is sometimes seen as the ineffectiveness of traditional homework (Goodwin & Miller, 2013). While veteran teachers are sometimes viewed as averse to using technology, sophisticated technology skills are not required for implementing the model (Gross, et al., 2015). At the same time, the flipped model can provide them with more classroom time to work with students as they apply information and concepts from lectures or readings. These are also the kinds of blending learning concepts and activities called for by ESSA (2015).

The move to 1:1 in schools is something that newer teachers face as well. Just like veteran teachers, they might be looking for ways to improve student performance and to gain more classroom time for activities. By removing lecture from the classroom, they can create

classroom time for students to apply concepts with the added benefit of being able to assist those students. This in turn helps teachers to better understand their students' thinking. New teachers might already be pressed for time, but they can make simple videos, or use those made by others. Like veteran teachers, this can allow them to teach using blended methods.

However, to encourage either new teachers or veteran teachers to embark on changing their classrooms requires backing. Administrators need to encourage and support teachers in making modifications like implementing the flipped classroom model. For newer teachers this might mean administrators could propose the flipped model as a suggested classroom technique, especially in a 1:1 technology environment. They might also recommend it to veteran teachers or encourage them if they are already interested. Not only does the flipped classroom model address many of the blended learning ideas called for under ESSA (2015) many studies have demonstrated that it improves teacher and student interaction (Alverez, 2012; Clark, 2015; and Fulton, 2013). With the changing nature of society and students, the flipped learning model might work to engage today's students, especially in 1:1 learning environments. Many studies noted student satisfaction with the use of the flipped model as a method of instruction (Butt, 2014; Findley-Thompson & Mombourquette, 2014; and McCallum, et al., 2015).

If administrators want to encourage newer and veteran teachers to incorporate the flipped learning model into their teaching, they need to provide ongoing support for them. Providing time for teachers and staff to implement the model is one way administrators can provide this support. In addition, teachers will need technology resources, as well as training on that technology and the model itself. As ESSA (2015) notes, effective training for technology integration means, "access to personalized learning experiences supported by technology and professional development for the effective use of data and technology" (p. 469). Besides time,

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technology, and training, administrators need to provide an environment that encourages teachers to take risks, like trying the flipped learning model, and they must also support teachers if those teaching risks do not always prove to be successful.

Future Flipped Recommendations and Concerns

One suggested area of need for the model is to develop a generally agreed upon description of what constitutes a flipped classroom. Although Bergmann and Sams (2012b) state, "there is no single way to flip your classroom—there is no such thing as the flipped classroom" (p. 10) the definition of a flipped classroom seems to be in a constant state of flux. Bergmann and Sams (2012b) state that there are in fact, "similarities between a flipped classroom and other blended educational models, reverse instruction, inverted classroom, and 24/7 classroom. All of these models have similar features and could possibly be interchangeable in certain contexts" (p. 7). Regarding descriptions, the Flipped Learning Network (FLN) defines flipped learning as consisting of four pillars of based on the word flip. The pillars are 1) flexible environment, 2) learning culture, 3) intentional content, and a 4) professional educator (FLN, 2014). That, however, is only one definition.

The FLN/FlippedLearning.org pillar model seems to be inclusive of a variety of flipped styles and methods. This is not always the case. The third and latest FLGI definition refers to Flipped 1.0 as the traditional model versus their new Flipped 3.0, which is more concerned with the pedagogy being used in the classroom (Ascione, 2017).   Yet some descriptions seem as if the FLGI designations of 1.0 versus 3.0 are more about what research on flipped classrooms is looking at, than a difference in the description of the flipped classroom model itself. In reality, there seem to be only minor differences between the FLN pillar model and the FLGI Flipped 3.0 description. Both groups' descriptions share many commonalities and both talk about a flipped

mastery model of teaching that works towards student mastery of material (Bergman & Sams, 2012b; Bergmann, 2016; FLGI, 2016). Somewhat concerning in this ongoing redefinition process of the flipped classroom model is the potential this may be perceived as a way to convince flipped teachers that they need to constantly get updated training on the model. While updating your knowledge through retraining is a good idea, it could potentially be seen as an attempt by groups like the FLGI to convince teachers that they need their certificate or additional ones to be a true flipped classroom teacher.

As noted, the Flipped Learning Global Initiative (FLGI) is currently on its third redefinition of what it means to be a flipped classroom. They now refer to Flipped Learning 3.0 in which they call flipped learning an operating system that allows teachers to add flipped mastery learning, problem based learning (PBL), the in-class flip, and gamification along with other teacher 'tools' (The Flipped Classroom, 2018). It should be noted that at the date of this writing, this organization currently sells training certification programs and much of their new material is overviewed in webinars that are only available for 24 hours after the webinar date. Unless you complete the training to become a Flip Certified Instructor, at $99 a year for Level 1, you do not have access to the library of recorded webinars (FLGI, 2017).

Another concern for the model is that it might be seen as simply too much work versus other blended learning techniques (Fulton, 2012b; and Pragman, 2014) and that it requires a changing of teaching styles from traditional teacher-centered teaching to student-centered (Moran & Milsom, 2015). Some teachers may wonder if the time and effort required is worth it compared to other blended learning techniques. Making lecture videos can take a lot of time, but searching for quality videos made by others can take a lot of time as well. Is blended an easier

option, or are blended and flipped two variations of the same thing? As noted, perhaps a comprehensive definition of the flipped learning model would help.

Another issue for the future of the flipped classroom model is the discrepancy between the number of members claimed by the FLGI and the seemingly low level of member activity on their site. While now claiming over 30,000 members (FLGI, 2018), posts on the site rarely get comments by users. Connected to this is the decreasing number of posts by the FLGI, Jon Bergmann, or the Flipped Learning Network about the flipped classroom on Twitter or other social media platforms. Not only have the number of posts dramatically declined—including newly flipped certified teacher announcements—these posts rarely are retweeted, have few likes, and almost no comments.   While this is not a scientific measure, it is not the only concern I have for flipped learning.   Fewer studies seem to be coming out on flipped learning, and the majority of those studies continue to be conducted in the higher education realm rather than K-12. Increasingly the studies are being conducted in smaller countries overseas (Alsowat, 2016; Betihavas et al., 2017; Chen Hsieh, et al., 2017; Foldnes, 2016; Jeong, 2017; le Roux & Nagel, 2018; and Thai, et al., 2017).

While the flipped classroom model can provide more time for active and engaging instructional activities (Bergmann & Sams, 2012a), these activities are not necessarily higher-order activities, engaging, or constructivist. While a variety of cognitive level activities were observed in the participants' classrooms, many of those were lower-level activities at the remembering, understanding, and applying levels in the revised Bloom's taxonomy (Krahwohl, 2002). The model does allow for the teacher or peers to assisted students in these tasks but, simply implementing the flipped classroom model does not mean that in-class activities are necessarily constructivist, high quality, or higher-order in nature. On the other hand, as it does

help provide additional classroom time; time that can be used for the inclusion of constructivist and higher-order activities. Teachers planning to implement the model should realize that to best take advantage of this additional class time, they need to implement high quality lessons, projects, and other activities that are engaging, higher-order, and potentially constructivist oriented.

A final concern is that the flipped classroom might be another educational fad that has run its course. Has it been subsumed by blended learning or was it ever anything other than a method of blending learning like hybrid courses or the station rotation model as claimed by Baggerley (2015)? Why make videos when Kahn Academy training videos are widely available and can be assigned. Kahn Academy is now even linked to the College Board website to provide free official SAT preparation training (College Board, 2015). Given the slowdown in academic studies, critics that claim flipped is just a blended learning technique, the apparent lack of activity by a majority of users in flipped organizations, and implementation moving to countries outside the west, perhaps flipped learning as a technique is at least past its prime.

Suggestions for Future Research

As suggested in the recommendations, a longer-term study of both flipped teachers' plans and activities, along with multiple observations would provide an even richer set of data and an improved understanding of the day-to-day operation of classrooms taught using the flipped classroom model. This would be able to provide researched based recommendations that could provide some best practices for teachers implementing the flipped classroom model including how to begin and how to address common flipped classroom concerns such as holding students accountable for watching the lecture videos. Additionally, adding a research component that looked specifically at how to address concerns with the flipped classroom model—making

videos, student accountability, planning for lack of home Internet access among others—could provide research that might encourage more teachers to try the flipped classroom model.

Another area of research could be a study similar to this one, looking at motivations for use and what was happening inside flipped classrooms, using a mixed methodology approach. This would involve the addition of an initial quantitative aspect of the study, via a survey to a larger group of flipped classroom teachers that could then focus in on a few of the respondents for a qualitative part of the study. This would provide a base of data on both teachers' motivation for using the flipped classroom model and what they are doing in their classrooms that might allow for the generalization of those finding. Additionally, such a study would also provide the rich understanding of those motivations, benefits, and classroom activities gained through the qualitative portion of the study.

Additional suggestions for studies might involve looking at students in flipped classrooms as well. Many studies have measured whether or not students prefer the flipped classroom model to traditional teaching, but those have generally been in studies that looked at direct comparisons of flipped versus traditional sections of the same course. Conducting such research across a variety of class types and subject areas, especially at 6-12 and even K-12 levels, would yield a greater understanding of the flipped classroom's impact on students at the levels where the majority of its practitioners employ the model (Sophia & FLN, 2014). New research looking at students in flipped classrooms would be insightful as the flipped classroom model specifically, and blended learning in general, have become almost mainstream with the proliferation of schools with full classroom sets of computers, 1:1 computer programs, and even bring your own device or BYOD programs (Dolan, 2016; Herold, 2016; Hutchings & Quinney, 2015). With these changes in education, blended and flipped are less likely to be novel ideas to

students. Past research studies of student perceptions of the flipped model might have been biased by students simply because they might have a negative reaction to a method that is new and involved a different way of organizing a course.

Another potential area for research would be one that identifies teachers who are not currently using the flipped classroom model, but who plan to implement it in the future. If such teachers could be identified, a base level of class activities, student and teacher interaction, and the level of teacher knowledge of the students in their classrooms could then be identified and quantified. Once a base level measurement of the amount of in-class activities was established, a follow up investigation these levels, after the flipped classroom model was fully implemented, could provide quantifiable data. This would allow for a measure of the differences in the number of activities in flipped classrooms versus traditionally taught classrooms as well as the engagement and cognitive levels of those activities. That data potentially would be more valuable than the perceived differences of participants found by this study.

Finally, an area to research might be the member databases of flipped learning organizations including the Flipped Learning Global Initiative. A study might involve surveying members to see how many are still actively using the flipped learning model in their teaching. This might also provide insight into how many of those organization members should still be considered active members. Short of directly contacting the FLGI, there was no real way for members to remove themselves from the group. Many of those members joined the Flipped Learning Network and were later transferred to the FLGI. If people in the membership database no longer claim to be users of flipped learning or members of the organization, finding out why would be helpful to educators and the organization itself. Such as study would probably be unlikely as it might result in the FLGI having to adjust its membership numbers downwards.

Conclusion

While many view the flipped classroom model as a comparatively new classroom approach, this teaching method has a rich background. The flipped classroom model, at least the name as popularized by Bergmann and Sams (2012b), is now well over ten years old. If you also include the concept of the inverted classroom of Lage, et al. (2000), whose initial research they conducted between 1995-1996, then the flipped classroom concept is over two decades old. The majority of flipped studies have looked at two areas, either student perceptions of the model, student achievement under the model, or both. As noted, these studies have mostly taken part in post-secondary settings. This study looked at classrooms at 6-12 grade levels, a grade range that research has demonstrated is where the majority of flipped classroom practitioners teach (Sophia & FLN, 2014). Teachers from two middle schools and two high schools participated in this study that looked at teachers' motivations for using the flipped classroom model and the activities they used both inside and outside of the classroom. The majority of the teachers taught mathematics, but the study also included a science teacher, a social studies teacher, and a Spanish teacher. All of the participants reported that they flipped the courses observed on a full-time basis.

This study was an analysis of collected lesson plans, interviews, and classroom observations that clearly demonstrated that the participants' motivations for flipping their classrooms matched the reasons for using the model in other studies. Among those motivations were the desires to have more classroom time for application of knowledge and other engagement activities, the ability to aide students, to better understand the content knowledge levels of their students, as well as the ability to get to know their students better as individuals. The study also found that all of the participants perceived an increase in their ability to provide

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gains in all of those areas.

However, as noted earlier, it would be beneficial to flipped classroom teachers, flipped classroom researchers, and education in general if there was a better description of the flipped classroom model and this might help provide a better understanding of teachers using it. The FLGI and its Flipped Learning 3.0 seem to believe that many flipped classroom teachers are working from outdated concepts of the model and that their new description of the model addresses the changes they feel flipped teachers need to make (FLGI, 2017). However, most of the teachers in the study had already made similar changes to their flipped classrooms, specifically those using variations of the in-class flip. Given that early flipped classroom adopters were told there is no single way to flip, perhaps a generally accepted description of the model and its variations would help teachers implement the model more effectively and potentially have a greater impact on the learning of students in flipped classrooms. This might also help to address critics such as Baggaley (2015) who contends that the flipped classroom model is nothing new, just another form of blended learning.

Finally, this study's results provided insights for future research on the flipped classroom model. A longer-term study, of a semester or more with multiple observations, is one area that could provide additional insights in to the flipped classroom model and its application in grade levels 6-12. A mixed methodology study could provide both generalizable data as well as the deep insights provided from this qualitative study with a longer-term mixed study being able to offer even greater comprehension of the model and its impact on students. Other suggested areas involved student perceptions of the model; especially as blended learning has increased, as well as the idea of identifying and studying teachers before and after their implementation of the flipped classroom model. This study was an attempt to further the investigation into flipped

classrooms by looking into a variety of course subject areas in 6-12 grade levels, a range that includes a large number of self-identified flipped teachers. The study provides a better understanding of teachers' motivations for using the model and the activities taking place inside of their flipped classrooms.

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APPENDIX A: RECRUITMENT LETTER

Date:

Dear Faculty,

I am a staff member in Fieldcrest CUSD #6 and a graduate student under the direction of Dr. Rena Shifflet in the School of Teaching and Learning at Illinois State University. I am conducting a research study to explore the motivations and reasons teachers have for implementing the flipped classroom model in their classroom. The study will also be looking at the activities taking place in the classroom time freed up by moving lectures out of the classroom, through the analysis of lesson plans, activity, and curricular materials. The questions of interest are: 1. What are the motivations—including reasons, purposes, and goals—that instructors have for employing the flipped classroom model in their K-12 classrooms? 2. How is the classroom time formerly occupied up by lectures structured in K-12 flipped classrooms?

I am requesting your participation, which will involve two audio taped interviews with me that will take place at school and last about 40 minutes to an hour for the first interview and 20 to 30 minutes for the follow up interview. You will be given the option of choosing a location for the interviews based on your level of comfort. Possible locations include the your classroom or my classroom or office. The door will be closed during the interview to ensure confidentiality. Longer distance interviews will be conducted using video conferencing.

Your participation is voluntary and you may stop your participation in the study at any time. During the study, precautions will be taken at all times to maintain the confidentiality of you responses to the interview questions. Pseudonyms will be used in both the transcriptions of the interview and the final report. Please be aware that your responses in this study will have no effect on the evaluation of your performance as an instructor now or in the future.

If you would like to be part of this research study, please sign your name at the bottom of this request and send this letter back to me in the enclosed self-addressed envelope or you can use email to acknowledge your participation using one of the email addresses below. I will call you in a few days to set up a time for the interview to take place.

Thank you for your time and your interest in this study. Your opinions will be invaluable to the success of this research into the influence of professional development on the implementation of educational technology. Please feel free to contact me at ██████████.

Sincerely,

Philip Pulley
Teacher, Fieldcrest High School
Graduate Student, Illinois State University
████████

Name: _____   Telephone Number: _____

APPENDIX B: LETTER OF CONSENT

Title of Research: Influence of professional development on the implementation of educational

technology by K-12 classroom teachers.

Principal Investigator: Philip Pulley

Department: Teaching and Learning

Purpose of Research: The purpose of this study is to explore the motivations and reasons
teachers have for implementing the flipped classroom model in their classroom. The study will
also be looking at the activities taking place in the classroom time freed up by moving lectures
out of the classroom, through the analysis of lesson plans, activity, and curricular materials.

Procedures: I am requesting your participation, which will involve two audio taped interviews
with me that will take place at an agreed upon location or via videoconference. The first
interview should last about 40 minutes to one hour and the second should take approximately 20
to 30 minutes. You will be given the option of choosing your location for the interviews based on
your level of comfort. Possible locations could include your classroom or office. The door will
be closed during the interview to help ensure confidentiality. Please keep in mind that the focus
of this is the influence of professional development on the implementation of instructional
technology. As such, all discussions will be focused on this purpose.

Risks and Discomforts: This study involves no risk of physical injury or discomfort. A possible
risk might be revealing your dissatisfaction with the current professional development system.
To prevent this I will make sure that our discussions are focused on the purpose of the study as
indicated in this consent form. During the interview and at any point during the study, you have
the right to skip over any question that makes you feel uncomfortable. You are not expected to
discuss any emotional sensitive material that will make you feel uncomfortable in any way. If
you choose not to participate or withdraw from this study ant any time, there will be no penalty
of any kind. Please be aware that the results of the study may be published, but your name will
not be used. I will take all precautions to maintain your confidentiality. Pseudonyms will be
used in the transcriptions, storage, analysis, and presentation of all data. The information
provided or collected will not be used in any way to evaluate you as a staff member of your
school, now or in the future.

Benefits: While you might not directly benefit from the study, the knowledge gained from the
study may have implications for the type of educational technology professional development
workshops that are offered to faculty. This may lead to an improvement in the implementation
and use of educational technology. This process will also help provide you with the opportunity
to reflect on your experiences using educational technology in your teaching.

Confidentiality: Any information collected during the course of this study will be kept in a locked desk in the principal investigator's home. All digital files will be stored on a password-protected computer in password-protected folders. Your results will be combined with those of other participants and they will be studied only in this fashion. If the data is used for conference presentations, publication in research journals, or for teaching purposed, no names or identifiers will be used. Any data collected and used will be destroyed after completion of the study.

I certify that I have read and understand this consent form and agree that known risks to me have been explained to my satisfaction and I understand that I will receive no compensation for participating in this research. I certify that I am 18 years of age or older. My participation is this research is given voluntarily. I understand that I may discontinue participation at any time without penalty or loss of any benefits to which I may otherwise be entitled. I certify that I have been given a copy of this consent form to take with me.

_____

Participant

_____

Date

Research Questions

1. What are the motivations—including reasons, purposes, and goals—that instructors have for employing the flipped classroom model in their K-12 classrooms?

2. How is the classroom time formerly occupied up by lectures structured in K-12 flipped classrooms?

Interview Protocol

1. How long have you been teaching and what subjects and grade levels do you teach?

2. How long have you been using the flipped teaching model in your teaching?

3. What ideas first drew you to the flipped classroom model? (RQ1)

4. What were your motivations for implementing the flipped classroom model into your teaching? (RQ1)

5. Did you have any specific goals, purposes, or reasons for wanting to use the flipped classroom model in your teaching? (RQ1)

6. Can you explain how you perceive the benefits of using the flipped classroom model in your classroom? (RQ1, RQ2)

7. What do outside of the classroom assignments look like in you use of the flipped classroom model? (RQ2)

8. What are the challenges you have experienced using the flipped classroom model in your instruction? (RQ1, RQ2)

9. How do you make decisions about what types of educational activities to use in your classroom? (RQ2)

10. What types of activities are you currently using in your classroom time? (RQ2)

11. Were you able to do those activities in you classroom before your implementation of the flipped classroom model? (RQ1, RQ2)

12. Were you able to use those activities as frequently before you used the flipped classroom model? (RQ1, RQ2)

13. Are there any additional comments that you would like to make regarding the influence of the flipped classroom model and your approaches to teaching and the activities that you use? (RQ1, RQ2)

14. Is it okay to contact you with additional questions?

APPENDIX D: FOLLOW UP INTERVIEW QUESTIONS

1. After reviewing the transcript of our first interview, are there any clarifications or additions that you would like to make?

2. Are there any additional flipped lesson materials that you would like to share, or changes to the ones that you have shared?

3. Are there any clarifications or concerns that you might have regarding the lesson that I observed?

4. Are there any questions that you may have for me concerning this study or the flipped classroom model?

APPENDIX E: FUNCTIONS CHECKLIST

Name: _____

- **Functions Checklist (8.F.1 and 5)** *Be sure to have packet checked at appropriate times and follow directions for bookwork assignments!*
   - ○ **Assessment and packet due: ____1.31.17_____**

_____1. Function Intro: Crash Course Video https://www.youtube.com/watch?v=YzSUsdkvmdA (1.6)

_____2. Mangahigh: Algebra Meltdown (Start with easy or medium) https://www.mangahigh.com/en-us/games/algebrameltdown (1.6)

   Level _____   Longest Chain_____

_____3. View Relations and Functions part 1 videos (3 - abc) (1.6 and 1.9)

   a. Function machine/Input-Output
      a. Notes (part 1)
      b. Guided Practice pg 259: 10, 14, 15, 19 **or** ©pg. 260: 27 – 30 (check)
   b. Mapping
      a. Guided Practice page 259: 1-4 (check)
      Mini-lesson (rate)
   c. Distance and Time problems

_____4. **Concept Quiz #1** (see Mrs. ▇) (1.10)   _____**Mrs. ▇ check**

_____5. View Functions part 2 videos (2 – a and c) (1.10)

   a. Vertical Line Test
      a. Guided Practice pg 260: 32 – 35 (check)
   b. Function or Not
      a. Lesson 5 notes p. 36, 37, 39 ("Engage" in google drive)   _____**Mrs. ▇ check**
   c. Function Notation and Function Notation WS (check) **or** © pg. 261: 43 – 46 (check)

_____6. Functions Doodle **and Concept Quiz #2** (see Mrs. ▇)   _____**Mrs. ▇ check** (1.11)

_____7. Watch Modeling.functions.1 video (three views of a function) **and** complete function identification WS (google drive)(1.12)

_____8. Bookwork page 266-268: 2 – 8e, 11, 38, 43, 44, and 45 (check) (1.12)

_____**9**. Mini-Lesson, Mangahigh: Represent filling containers https://www.mangahigh.com/en-us/math_games/algebra/sketch_graphs_/represent_filling_containers_using_graphs **and** Relating Graphs to Events WS
   _____**Mrs. ▇ check** (1.17)

_____10. Watch Discrete or Continuous **and** Types of Function videos and take notes on both (1.17)

_____11. Bookwork page 266-268: 12-14 (discrete or continuous and why),18, 19, 30, 32, 34, 36, 46 (check) (1.18)

_____12. View and Take Notes on Function Rules video **AND** Bookwork page 272-275: 6, 10, 17, 24, 26, 29, 38, 45, 34© (check) (1.20)

_____13. **Concept Quiz #3** (1.23)

_____14. Lesson Four notes p. 21-27 ("Engage" in google drive) **and** Lesson Four exit ticket.   _____**Mrs. ▇ check** (1.23)

_____15. In and Out Burger Task (google drive) (check) (1.24)

_____16. Watch Direct and Inverse Variation videos **AND** take notes (4 videos) (1.25)

_____17. Bookwork page 280-283: 4, 8, 12, 16, 20, 24, 28, 30, 32, 42, 44, 57 **or** ©4, 6, 10, 14, 24, 28, 30, 32, 42, 44, 56, 57, 48

_____18. **Concept Quiz #4; Snapshots;** and Review for Function assessment (1.27)

_____19. **Assessment and packet due _____1.31.17_____**

Page 259	Page 260 (27-30)	Page 260 (32-35)
Page 261 and F(x) WS (#5)	Page 266 – 268 (#8)	Page 266-268 (#11)
Page 272 – 275 (#13)	Page 280	Page 280 ©
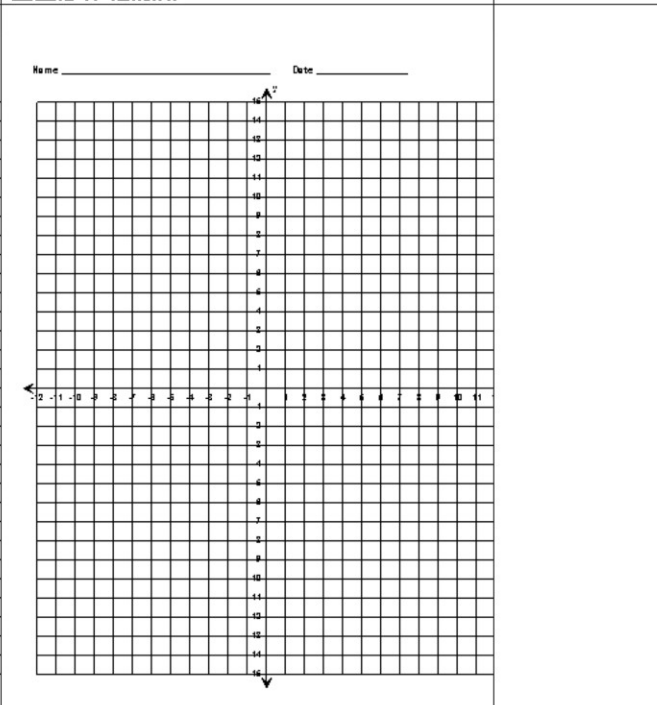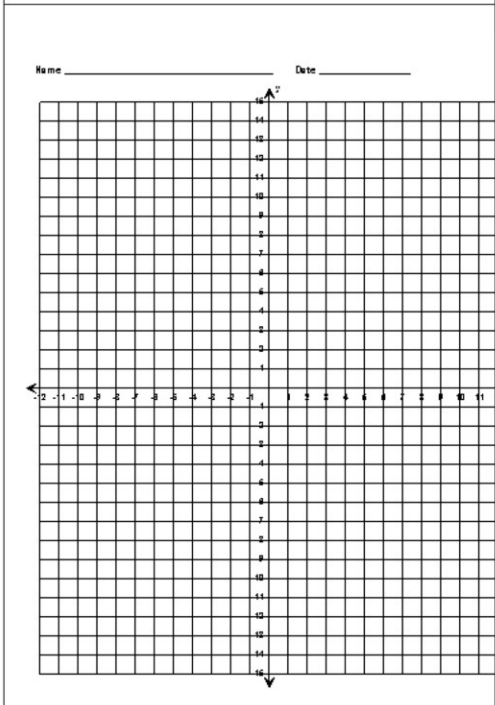
8-2 Scientific Notatio ▶ ▲ ▲ ▲

0:00:00

Objectives:

↻ ▼ ▼ ▼

- To convert numbers between scientific and standard
- To multiply a number in scientific notations times a constant.

Warm Up: Complete the two questions below on your note template.

1.) Write the following expression with only positive exponents.

$$\frac{x^3 y^{-2}}{z^{-5}}$$

2.) Why would the topic of scientific notation be included in this unit?

3.) Three students were asked to convert the number 0.0000000043 into scientific notation. Each got a different answer. Identify each answer as correct or incorrect and explain why you made the choice you did.

Student 1: 4.3×10^9 Student 2: $.43 \times 10^{-8}$ Student 3: 4.3×10^{-9}

160

1

Document 402

Causes of the Mexican-American War

Directions: You will be reading a variety of quotes that relate to causes of the Mexican-American War. After reading each quote, translate the text into your words beneath it. Remember you may need to use synonyms to help you. Finally, you will create a picture that shows the theme in action!

Document A:
Source: The Illinois State Register

"Shall this garden of beauty be suffered to lie dormant in its wild and useless luxuriance?... Myriads of enterprising Americans would flock to its rich and inviting prairies; the hum of Anglo-American industry would be heard in valleys; cities would rise up on its plains and sea coast, and the resources and wealth of the nation shall be increased to an incalculable degree."

> In your own words, what does this quote mean?
>
> This source is stating that the land is beautiful but isn't being used. It will be used for American businesses, many people would flock to the area, and cities would pop up. The land would be put to good use!

Document B:
Source: Ashbel Smith, (former) Sec of State of Texas Republic

"The Mexican War is part of the mission of the destiny allotted to the Anglo-Saxon race on this continent. It is our destiny, our mission to Americanize this continent...The sword if the great civilizer."

> In your own words, what does this quote mean?
>
> It is part of the American destiny to conquer the territory. This goes hand-in-hand with Manifest Destiny.

Document C:
Source: congressional Globe

"War has its evils. In all ages it has been the minister of wholesale death and appalling desolation; but however inscrutable to us, it has been made, by the Allwise Dispenser of events, the instrumentality of accomplishing the great end of human elevation and human happiness...We must march from Texas straight to the pacific Ocean, and be bounded only by its roaring wave...It is the destiny of the white race, the Anglo-Saxon race..."

In your own words, what does this quote mean?

War is bad and wrong, however in our case it is different. It will accomplish great human elevation and happiness. We will only be bound by the Pacific!

Document D:
Source: U.S. Representative David Wilmot

"We are fighting this war for Texas and the South...For, this, sir, Northern treasure is being exhausted, and Northern blood poured on the plains of Mexico...Slavery follows in the rear of our armies. Shall the war power of our government be exerted to produce such a result? Shall this government...lend its power and influence to plant slavery in these territories?"

In your own words, what does this quote mean?

Wilmot is questioning the reason for this war, and it seems many wish to expand slavery into the South. He is arguing the war is being fought by the North for the South and is being fought to expand slavery into the West.

Name:_____Date:_____Period:_____

Algebra 1 Notes
6.1 – Solving Systems by Graphing

● **Objectives**

To solve systems of equations by graphing and to analyze special systems of equations

● **Vocabulary**

System of Linear Equations   Solution of a System of Linear Equations

3 ways to solve a system of linear equations   Three Types of Solutions of Linear Equations

                                                   One Solution   ∞ Solutions   No Solution

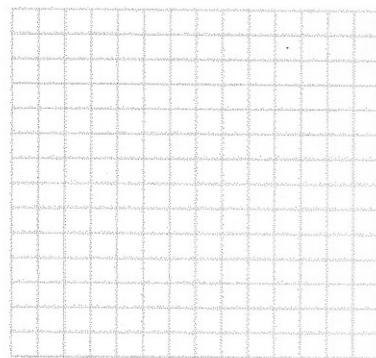Consistent   Independent

Inconsistent   Dependent

Examples

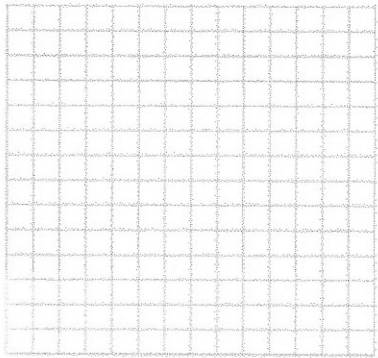● What is the solution of the system? Use a graph.

     $y = x + 2$ $y = 2x + 4$

     $y = 3x - 2y$ $y = x + 2$

● Scientists studied the weights of two alligators over a period of 12 months. The initial weight and growth rate of each alligator are shown below. After how many months did the alligators weight the same amount?

● One satellite radio service charges $10 per month plus an activation fee of $20. A second service charges $11 per month plus an activation fee of $15. After how many months was the cost of the service the same?
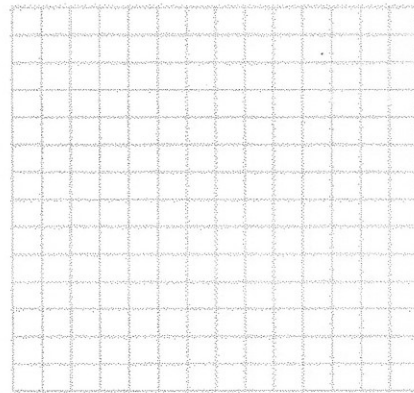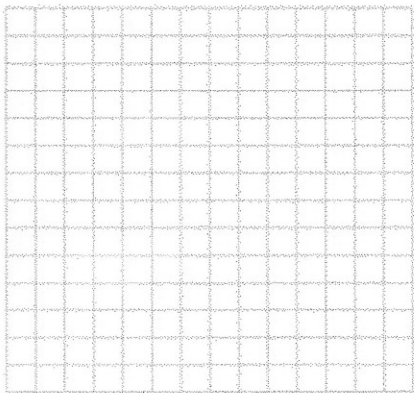
● What is the solution of each system? Use a graph.

$$2y - x = 2$$
$$y = \frac{1}{2}x + 1$$

$$y = 2x + 2$$
$$y = 2x - 1$$

Protein Synthesis: Transcription Activity

INTRODUCTION: Transcription and translation are dual processes that must occur for a protein to be formed or a gene to be expressed. DNA is an example of a complex biological polymer called a nucleic acid, which is made up of small subunits called nucleotides. The components of the DNA nucleotide are deoxyribose (a simple sugar), a phosphate group, and a nitrogen base. There are four possible nitrogen bases in DNA—adenine (A), guanine (G), cytosine (C), and thymine (T). In DNA, the nucleotides pair using hydrogen bonds to form a double strand. Because these two strands are twisted together, it is referred to as a double helix. When base pairs are formed, adenine will only pair with thymine and guanine will only pair with cytosine.

How is information from nuclear DNA brought to the ribosomes for protein synthesis? The answer is simple—by a single strand of RNA called messenger RNA (mRNA). RNA is composed of a single strand rather than a double strand as in DNA. RNA contains a sugar called ribose, a phosphate group, and four nitrogen bases. Rather than thymine (T), RNA contains uracil (U). Messenger RNA molecules that are complementary to specific gene sequences in DNA are made in the nucleus by a process called **_transcription_**. The genetic information from DNA is transcribed into a single strand RNA "message" to be sent from the nucleus to the ribosomes for protein synthesis.

During protein synthesis at the ribosome, mRNA sequences are read and **_translated_** into amino acids. The amino acids are linked together into chains by enzymes to form proteins. The 20 amino acids are brought to the ribosomes by transfer RNA (tRNA). Every three nitrogen bases on a tRNA molecule are called an anticodon. This anticodon must match a codon, three nitrogen bases of the mRNA molecule, to translate into an amino acid. An infinite variety of proteins can be formed from the 20 amino acids, which can occur in any number and in any order.

OBJECTIVE: In this activity, you will use a specific segment of DNA to demonstrate the steps of transcription and translation. You will also identify the introns and the exons on pre-mRNA and perform the necessary alterations to create functional mRNA.

MATERIALS: Pencil, Scissors, Tape, 5 different colored pencils: yellow, green, red, blue, orange.

TRANSCRIPTION PROCEDURE:

PART ONE: PREPARE YOUR DNA SEQUENCE

1. Cut out the three and a half DNA sections and tape them together end to end so that you now have a 100 base pair segment beginning with base pair one and ending with 100.

BEFORE MOVING FORWARD WITH THE ACTIVITY, ANSWER THESE REVIEW QUESTIONS (AND CONTINUE TO ANSWER AS THEY COME!):

    A. What are the two DNA bases that are **purines**? Do they have a single ring structure or a double ring structure?

    B. What are the two DNA bases that are **pyrimidines**? Do they have a single ring structure or a double ring structure?

14. Your scissors represent this specific enzyme. Cut the mRNA sequence <u>before the G's in GU</u> and <u>after the G's in AG</u>. THINK: look at ALL of your mRNA fragments... what fragment MUST be an EXON... then every other must be an INTRON.   Keep the <u>non-coding fragments</u> and tape them below:

15. Attach the EXONS together, in numerical order, with <u>tape</u> to create a model of the functional mRNA.

    M. What does tape represent?

16. Cut out and add the **5' cap (methyl guanine, "mG")** to the 5' end of the newly formed mRNA on the extreme left side of your processed mRNA sequence by taping it into place. The 5' cap is added on before the mRNA sequence leaves the nucleus to help to protect the mRNA from degradation by enzymes and it also helps the mRNA strand attach to the ribosome.

17. Cut out and add the **poly-a-tail** to the 3' end of your processed mRNA sequence. This molecule has the same function as the 5' cap, but is put on after the sequence leaves the nucleus and designates that this is the tail end of the mRNA.

    N. What **nitrogen base** sequence is the poly-a-tail composed of?

18. NEATLY <u>*staple*</u> your completed mRNA sequence to the <u>**FRONT**</u> of this lab. It is now ready to leave the nucleus and undergo *translation*!

The mRNA Codon Wheel (read from the center out)
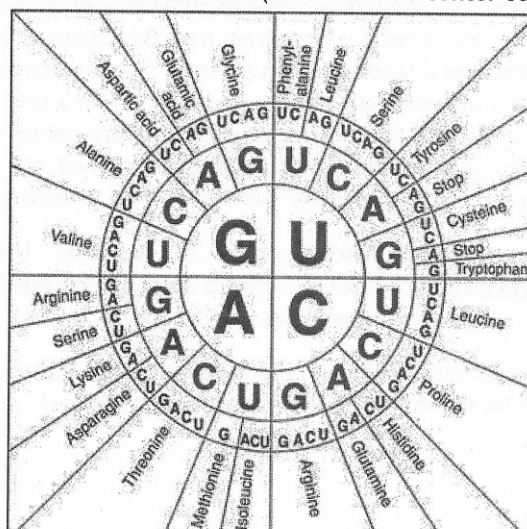
For Part One: DNA SEQUENCE:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
G	A	A	T	T	C	A	A	G	T	T	G	A	C	G	T	A	G	A	T	A	T	A	A	A	A	G	C	T	T	A	C
C	T	T	A	A	G	T	T	C	A	A	C	T	G	C	A	T	C	T	A	T	A	T	T	T	T	C	G	A	A	T	G

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
A	T	G	A	C	A	T	G	A	G	T	T	C	A	A	T	C	C	G	A	A	T	T	C	T	A	G	A
T	A	C	T	G	T	A	C	T	C	A	A	G	T	T	A	G	G	C	T	T	A	A	G	A	T	C	T

61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
A	C	T	G	A	A	T	A	C	A	G	G	T	T	T	G	T	A	A	A	A	A	A	C	T	C	T	T
T	G	A	C	T	T	A	T	G	T	C	C	A	A	A	C	A	T	T	T	T	T	T	G	A	G	A	A

89	90	91	92	93	94	95	96	97	98	99	100
G	A	A	A	T	C	C	A	T	T	G	C
C	T	T	T	A	G	G	T	A	A	C	G

POLY-A-TAIL

5' CAP
(mG)

RNA POLYMERASE

RNA POLYMERASE

Part Two: Pre-RNA SEQUENCE:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49

50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69

7. Read down the 3' to 5' strand of DNA and locate the underline termination signal. (one of the DNA sequences from H above). This is the sequence of DNA that triggers the RNA molecule to STOP and separate from the DNA strand. Highlight this sequence with a RED color.

   I. The RNA Polymerase enzyme also adds RNA nucleotides to the transcribing DNA to create a *pre*-mRNA molecule. This enzyme, like DNA polymerase, can only add RNA nucleotides to **what end** of the growing RNA, the **3' end or the 5' end**?

   J. Now, use your RNA POLYMERASE enzyme to open a transcription bubble, beginning at the initiation sequence (AUG) and ending at the termination sequence (STOP). What "tool" will you use to simulate the action of RNA Polymerase?! What is RNA Polymerase specifically breaking?

PART TWO: MAKE YOUR PRE-mRNA STRAND

8. Preparation: Cut out your mRNA sequence strips. Tape them together as you did for the DNA.

9. Use your pencil to divide the strip into codons. Put a vertical line after every 3 numbers.

10. Simulate transcription of DNA into mRNA. Line up the first number of the **mRNA** strip with the first base of the **DNA start sequence**. Write the mRNA bases that are complimentary to the DNA under the appropriate number on the mRNA strip. Remember to use the correct complimentary **RNA nucleotides**!

1. Like DNA, the mRNA strand is also formed running from a 5' to a 3' end. Label the ends of the newly constructed mRNA strand with 5' and 3'.

   K. Why is the mRNA *shorter* than the DNA it was transcribed from?

12. You are now ready to **splice** (process) your mRNA!

RNA SPLICING PROCEDURE:

After processing of the pre-mRNA is completed, the strand of mRNA is ready to be spliced. Splicing is the stage during which introns (non-coding regions) are removed from the strand, and the exons (coding regions) that remain are assembled into a finished strand of mRNA that is ready for translation. RNA splicing occurs inside of the nucleus. If this process were actually occurring within a cell, the pre-mRNA strand would average 8000 nucleotides in length. For simplicity's sake, your pre-mRNA will be considerably shorter! Remember, mRNA is a single stranded sequence. Once it is formed, the pre-mRNA strand will peel off of the DNA strand that it was copying, allowing the two DNA strands to reunite.

13. Introns start and end with sequences that splicing enzymes can recognize. Using the **BLUE** and **ORANGE** colored pencils, find the mRNA codons that **BEGIN with GU** and highlight the G and U in BLUE. Then find the codons that **END with AG** and highlight the A and G with ORANGE.

   L. The non-coding sequences must be deleted out before mRNA can leave the nucleus. What enzyme is responsible for the cutting out these non-coding regions?

Fraction Practice:

1) $\dfrac{2\pi}{12}$

2) $\pi + \dfrac{\pi}{2}$

3) $\dfrac{1}{4} \bullet \dfrac{\pi}{2}$

4) $\pi + \dfrac{\pi}{8}$

5) $\dfrac{9\pi}{8} + \dfrac{\pi}{8}$

6) $\pi + \dfrac{3\pi}{2}$

7) $\dfrac{1}{2}\left(\dfrac{5\pi}{2}\right)$

8) $\pi + \dfrac{5\pi}{4}$

9) $\dfrac{1}{2}\left(\dfrac{9\pi}{4}\right)$

10) $\dfrac{5\pi}{4} + \dfrac{3\pi}{2}$

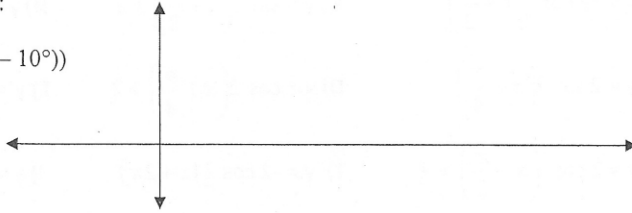11) $\dfrac{1}{2}\left(\dfrac{11\pi}{4}\right)$

12) $\dfrac{2\pi}{\dfrac{\pi}{3}}$

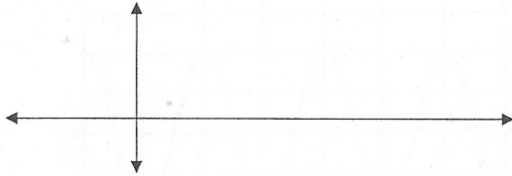F-AATH   Name _____ Period ___ Date _____
Warm-Up Ch. 4 Graphing

Graph using **degrees**:
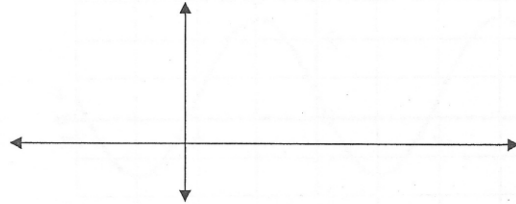
1) $y = 5 - 3\cos(4(x - 10°))$

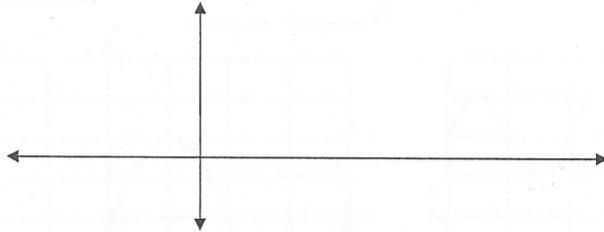Graph using **radians**:

2) $y = 7 + \sin 4(x - \pi)$

3) $y = 8 + 2\cos\dfrac{\pi}{10}(x + 4)$

Solve using **degrees**:

4) Find the equation of a sinusoid that has a maximum value of (-8, 20) and a minimum of (12, 6). It will be helpful to draw a sketch first.

Solve using **radians**:

5) Bo the dolphin swims in a manner that models a sinusoid. Five seconds after I start my stopwatch to time Bo, I notice that he is at his lowest point, 15 feet below the surface of the water. He jumps into the air and reaches his highest point, 19 feet above the surface of the water, 3 seconds later. Draw a sketch and find the equation of the sinusoid that models this situation.