2015-01-01

High School Mathematics Teachers' Connective Knowledge Of The Challenges And Possibilities In Implementing The Flipped Learning Model: An Embedded Mixed-Methods Study

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HIGH SCHOOL MATHEMATICS TEACHERS' CONNECTIVE KNOWLEDGE OF THE CHALLENGES AND POSSIBILITIES IN IMPLEMENTING THE FLIPPED LEARNING MODEL: AN EMBEDDED MIXED-METHODS STUDY

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Dedication

I want to share my gratitude for the many blessing that have crossed my pathway in life. I dedicate this great accomplishment to my son, who has been my driving force throughout the whole process. I also want to deeply thank my family for their words of inspiration and their infinite love. Without their care and reinforcement, I would have not been able to achieve this goal. Finally, I want to express my sincere appreciation to Professors Mourat Tchoshanov, Olga Kosheleva, and Eric Hagedorn for their guidance and encouragement.

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by

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DISSERTATION

Presented to the Faculty of the Graduate School of

The University of Texas at El Paso

in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

Department of Teacher Education

THE UNIVERSITY OF TEXAS AT EL PASO

May 2015

Acknowledgements

I acknowledge and value each person who has had an impact in my life and has contributed to my success in very special ways. I want to thank each professor in the doctoral program that motivated me to share ideas and led me to the development of newfound knowledge and construction of research philosophies. I also want to thank my colleagues who provided me with inspiration and support, unconditionally.

Abstract

The impact of technology advancements in our current society continues to transform the ways in which we interact with each other, and the educational field has not been exempt from this transformation. Integration of technology in schools has influenced educators to seek new ways of teaching that adapt to the needs of students who are impacted by a digital wave. That is the case of a new instructional approach, which is being known as the Flipped Learning Model (FLM). The FLM intends to use pre-recorded video lessons to teach outside the classroom and incorporate homework and problem solving inside the classroom. Nonetheless, there is a remarkable need to explore this model more extensively, as limited empirical research exists.

The purpose of this mixed methods study was to examine high school mathematics teachers' connective knowledge of the challenges and possibilities in implementing the FLM as they partook in learning networks. The embedded research design of this study employed narrative inquiry to recount participants' experiences (N=26). The emergent learning theory of Connectivism was used to interpret the results, which showed that participants went through a cyclical process of acquiring and distributing connective knowledge of the challenges presented when "flipping" a classroom and the possibilities that the FLM offered to them. Additionally, the stories of three key informants were conveyed to provide a more in-depth understanding of the findings. Data analysis for the informants consisted of a comprehensive examination of the four stages of their personal knowledge development, as presented by Pettenati, Cigognini, and Sorrentino (2007): (1) awareness and receptivity, (2) making connections, selecting, and filtering, (3) contribution and involvement, and (4) reflection and metacognition. Although the informants were all exposed to the same learning network related to the FLM, results indicated that each teacher formed a unique "personal network" of resources and filtered information based on their own needs as teachers, and thus, connective knowledge developed proved to be distinctive for each informant. A comparison of the informants' knowledge of the challenges and possibilities in implementing the FLM is discussed. Additionally, implications of the results and a discussion on the promising future research of Connectivism and connective knowledge are provided.

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Chapter 1: Introduction

The influence of globalization and multimedia technologies is indubitably altering the ways in which we communicate with each other. Thus, as technology continues to evolve, so does teaching and learning in schools. Classrooms around the world have been reshaped to adapt to the use of technological tools that reflect the changes of today's societal structures. From state-of-the-art calculators to the latest iPads, content-based websites, and interactive online resources, school systems have been turning to technological aids in an effort to keep students motivated and to provide them with avant-garde instruction (Engelward, 2012).

According to the U.S. Department of Education (2010), in the year 2009, teachers in the U.S. reported having various technology devices either available as they needed them or in their classroom, which included projectors, interactive whiteboards, and digital cameras. Amongst the teachers who had these devices available, the percentage that used them sometimes or often for instruction was 72 percent (projectors), 57 percent (interactive whiteboards), and 49 percent (digital cameras). These and similar statistics, which will be explained further in chapter two, illustrate how technology tools are becoming an ordinary and conceivably a significant part of classroom instruction. In fact, "the exponential growth of technology usage in education, via such applications of distance education, Internet access, simulations, and educational games, has raised substantially the focus and importance of educational technology research." (Ross, S. et al., 2010, p. 17). Therefore, as new technologies emerge, new areas of study do so as well. As such, we can continue to draw upon previous experience to understand and evaluate the present, alongside the opportunity to shape future action and formulate new knowledge (Abbott, 1994). This is particularly important in technology education as "digital learning has progressed greatly, and with it have come new opportunities and new challenges. Realizing the full potential of digital learning requires evolved thinking about education research and development and evaluation" (U.S. Department of Education, 2013). A critical stance to this last argument will be presented in chapter two as historical developments in epistemology are discussed.

1.1 Statement of the Problem

The rapid advances in technology have predisposed many educators to pursue novel ways of teaching that acclimate to the needs of students who are growing up as, what Prensky (2001) calls, "Digital Natives". He states that such students are native speakers of the digital language of computers, video games, and the Internet. Although his critics, such as McKenzie (2007), maintain that his arguably generational divide lack evidence or data; others (Green and Hannon, 2007; Klopfer, Osterweil, Groff, and Haas, 2009) state that our newest generation is in fact clearly demonstrating for us the impact of having grown under a digital trend that has become a fully assimilated feature of their subsistence.

Thus, despite the fact that Prensky and his supporters, or opponents, continue to dispute ways to better define students of today's classrooms, what is indisputable is the surfacing of new approaches to teaching that incorporate technology. Among those new instructional approaches is what is being known as the Flipped Learning Model (FLM). Such approach integrates the use of educational video lessons intended to facilitate instruction outside the classroom in order to maximize in-class learning; an idea that will be developed further in section 2.3 of chapter two. And although "quantitative and rigorous qualitative research on Flipped Learning is limited" (Pearson & The Flipped Learning Network, 2013, p. 6), the popular approach is spreading quickly. In fact, teachers across the nation are providing conjectural and exploratory accounts about their journeys in using this approach. Nonetheless, the limited empirical research that is available provides a narrow scope of the use of the approach in K-12 and post-secondary education. For instance, a search using thirty-three different databases, as shown on Table 1.1, provided only forty-one results when using "Flipped Classroom" as an identifier, with results from only eight of the thirty-three databases.

The eight databases varied in number of sources and type of sources, and included *ProQuest Dissertations and Theses-Full Text, ProQuest Historical Newspapers, ProQuest Religion, ERIC*, *COS Conference Papers Index*, *Library and Information Science Abstracts* (LISA , *Biological Sciences, and Environmental Sciences, & Pollution Management*.

Table 1.1: Database Results of FLM Studies

No evidence of FLM Studies	Evidence of FLM Studies
• American Periodicals • Applied Social Sciences Index and Abstracts (ASSIA) • ARTbibliographies Modern (ABM) • BioOne Abstracts & Indexes • British Periodicals • Dissertations & Theses @ University of Texas - El Paso • ebrary® e-books • Engineering Research Database • GeoRef • International Index to Music Periodicals Full Text • Linguistics and Language Behavior Abstracts (LLBA) • Materials Research Database • National Criminal Justice Reference Service (NCJRS) Abstracts Database • NTIS Database (National Technical Information Service) • PAIS International • Periodicals Archive Online • Philosopher's Index • Physical Education Index • PILOTS: Published International Literature On Traumatic Stress • ProQuest Criminal Justice • ProQuest Historical Newspapers: The New York Times (1851-2010) • Social Services Abstracts • Sociological Abstracts • The Wall Street Journal • Worldwide Political Science Abstracts	• Biological Sciences • COS Papers Invited • Environmental Sciences and Pollution Management • ERIC • Library and Information Science Abstracts (LISA) • ProQuest Dissertations & Theses Full Text • ProQuest Historical Newspapers: Los Angeles Times (1881-1990) • ProQuest Religion

After examining the 41 results, the publications were organized by publication type, source type, and classification. For example, one of the results was published as conference proceedings to a manuscript in the field of educational geology. Therefore, the publication was categorized under the grouping of "Conference Papers & Proceedings" with a source type of "49th Annual Meeting of

the Northeastern Section of Geological Society of America", and classification of "Education, Science". Table 1.2 portrays the results for the forty-one publications once they were categorized.

Table 1.2: Publications on the FLM

Publication	Source Type	Classification
Scholarly Journals (19 Publications)	Christian Education Journal (Book Review)	Education, Religion (1)
	Biochemistry and Molecular Biology Education (Opinion Paper- Journal Article)	Education, Science (1)
	Education Canada (Opinion Paper-Journal Article)	Education (2)
	Education Canada (Descriptive Report- Journal Article)	
	Advances in physiology education (Journal Article)	Medicine (6)
	American journal of pharmaceutical education (Journal Article)	
	Current opinion in anesthesiology (Journal Article)	
	The virtual mentor: VM (Research Support- Journal Article)	
	American journal of pharmaceutical education (Research Support- Journal Article)	
	Academic medicine: journal of the Association of American Medical Colleges (Research Support- Journal Article)	
	The Journal of nursing education (Comparative Study- Journal Article)	Nursing (5)
	Journal of continuing education in nursing (Journal Article)	
	Nurse educator (Journal Article)	
	The Journal of nursing education (Journal Article)	
	Campus Technology (Descriptive Report- Journal Article)	Education, Technology (2)
	Learning & Leading with Technology (Descriptive Report- Journal Article)	
	Journal of College Science Teaching (Evaluative Report- Journal Article)	Education, Science (1)
	College & Research Libraries News (Journal Article)	Education, Literacy (1)
Historical Newspapers (1 Publication)	Los Angeles Times (1923-Current File)	None (1)
Trade Journal (1 Publication)	Today's Catholic Teacher	Education, Religion (1)

Conference Papers & Proceedings (3 Publications)	49th Annual Meeting of the Northeastern Section of Geological Society of America	Education, Science (1)
	2013 Southeastern Regional Meeting of the American Chemical Society (SERMACS 2013)	Education, Science (1)
	2013 Annual Meeting of the American Institute for Chemical Engineering (AIChE 2013)	Engineering (1)
Editorials (2 Publications)	Radiographics : a review publication of the Radiological Society of North America, Inc	Index Medicus (2)
	Critical Care Medicine	
Dissertations & Theses (15 Publications)	ProQuest Dissertations and Theses	Education, Science (4)
		Education, Technology (5)
		Education, Language Arts (1)
		Education, Mathematics (5)

Similar results were obtained when using identifiers found in the literature, like "Flipped Learning", "Flipped Instruction", and "Inverted Classrooms" with 21, 19, and 25 results, respectively. After examining the 41 results, it was noted that most results were published fairly recently. Nonetheless, one publication was far from recent, with a publication date of August 1954. Further analysis of this publication led to the conclusion that it did not characterize the concept of Flipped Learning as being studied in this investigation. The 1954 publication, titled "Nation Will Get Dr. Baxter's Now and Then Program Today: TV Literary Wizard to Be Heard by Millions", instead, was a historical newspaper journal presented by the Los Angeles Times, with no direct relevance to Flipped Learning. Therefore, only forty of the forty-one results provided pertinent information on Flipped Learning, as intended to be examined by this study. It is also important to note that the oldest publication was from 2012, which depicts the recent nature of the examination of the FLM and the need to continue to examine such instructional approach more in depth.

Moreover, as this study emphasizes on the connective knowledge of high school mathematics teachers of the challenges and possibilities of the FLM, it was important to closely examine any existent studies within the field of mathematics. Thus, it was found that five of the forty results (12.5%) focused

on mathematics education. These studies were examined carefully to understand the existent collection of data and analyses that have been conducted in the field of mathematics education as it relates to the FLM. One of those publications was a master's thesis, which conducted the investigation in a rural southwestern Minnesota secondary school in an "Integrated II" mathematics class, centering on 9th and 10th grade students' *achievement* and *perceptions*. Another publication was a dissertation study conducted in a rural southwest Louisiana secondary school in an "Algebra I" class setting centering on 9th grade students' *engagement* and *performance*. There was also a publication of a dissertation study conducted in a Texas state university in a "College Algebra" class setting, which focused on students' *perceptions* and *engagement* and their effects on *grade outcomes*. The fourth publication focused on students in an "Adult Upgrading Mathematics Class" in Canada and examined their *autonomy, goals, self-efficacy, and anxiety*. Another publication provided a description of experiences of one teacher of mathematics and one teacher of science in Okanagan Mission Secondary School in British Columbia. However, this last publication did not provide substantial data that could aid in the profound understanding of the FLM as being experienced by secondary teachers. A further discussion on the results of these studies, along with other significant findings, will be presented in chapter two. Moreover, the gaps and stated limitations on Flipped Learning, suggest that additional and closer examination of the FLM is needed, particularly as this may provide with noteworthy knowledge about the implications of Flipped Learning in schools, as well as a better understanding of how to operationalize this construct in classrooms.

1.2 Purpose of the Study

The purpose of this mixed-methods study was to examine high school mathematics teachers' connective knowledge of the challenges and possibilities of the FLM as they partook in learning networks. The study aimed at contributing to the present collection of research by focusing on the ways in which individuals created and distributed knowledge related to Flipped Learning, while participating in learning networks composed of diverse high school mathematics teachers (e.g., Algebra I, Geometry, Advanced Quantitative Reasoning- AQR, Pre-Calculus). Additionally, the study sought to narrate the

story of three key informants as a way to enrich the arguments made throughout the data collection, data analysis, and the results of the study.

The investigation used an embedded research design as a way to incorporate both quantitative and qualitative data to deepen the understanding of the emergent themes constructed by the findings. Nonetheless, a major emphasis was given to the qualitative data, with various instruments being used for the data collection process, including interview transcripts, participants' observations, and participants' written reflections. The study intended to contribute to positive change in education, as it offered a deeper look into an innovative instructional approach and its examination through the emergent learning theory of Connectivism. The study also provided emergent themes of the challenges and possibilities of the FLM as a way to better cognize the experiences of teachers participating in the study.

1.3 Significance of the Study

Although significant research (e.g., Groff & Mouza, 2008) has been accomplished related to the use of technology in U.S. schools, most of this research highlights more universal premises, such as access, equity, effectiveness, policies, and practices. A portion of such research focuses on a prevalent component of technology integration in the classrooms, such as online learning (e.g., Bergmann & Sams, 2012; Frederickson, Reed, & Clifford, 2005; National School Board Association, 2007). These studies provide valuable information, including an examination of distance education, blended instruction, and social networking (e.g., Baker, 2012; Berrett, 2012). Nonetheless, as noted earlier, only a limited number of studies provide findings related to Flipped Learning and a marginal number of them within mathematics education.

Moreover, the extant research related to flipped learning in mathematics focuses primarily on students' exposure to a flipped classroom. Scarce studies focus on teachers and none of them use connective knowledge as a construct of examination. Therefore, this study aimed at providing novel information related to teachers' connective knowledge of the challenges and possibilities of the aforementioned approach. The study was conducted in a predominantly Hispanic region of low-social economic status, with a high number of English Language Learners (ELLs) and other unique student populations, such as students identified as hard of hearing or special education students; thus, unique

information was expected to be obtained from the study, which in fact provided new findings regarding the use of Flipped Learning in schools and contributed to the gaps in the current research. Finally, the study interpreted the results using the evolving theory of Connectivism, which has not been used in other studies related to Flipped Learning, and which provided a specific lens for examining the results.

1.4 Definition of Key Terms

Definitions and terminology used in a study vary depending on the author's philosophy, context of the study, purpose of the study, and the focus of the research questions, among other considerations. Thus, it is important to ensure readers understand the meaning of various constructs, concepts, theories and/or labels as they are used in this study:

- Flipped Learning Model (FLM) – Refers to an instructional approach that intends to improve student engagement and performance by moving direct classroom instruction outside the school with the aid of technology tools (e.g., Khan Academy) and moving homework and exercises with concepts inside the classroom via learning activities (Clark, 2013).
- Flipped Mathematics Learning – Utilizing the Flipped Learning Model within a mathematical instructional context.
- Flipped Classroom – A classroom that employs Flipped Learning as the main instructional approach.
- Connective Knowledge – Knowledge that consists of the network of connections formed from experience and interactions within a learning network (Downes, 2012).
- Learning Network– A learning community with similar interests aimed at interacting, sharing ideas, and reflecting together to create knowledge (Downes, 2006).
- Connectivism – Refers to the "thesis that knowledge is distributed across a network of connections, and therefore that learning consists of the ability to construct and traverse those networks" (Downes, 2012, p. 9).
- English Language Learner (ELL) - Refers to a student who comes from an environment where a language other than English is dominant and whose difficulties in speaking,

reading, writing, or understanding the English language may be sufficient to deny the individual the ability to successfully achieve in classrooms where the language of instruction is English or the opportunity to participate fully in society. (U.S. Department of Education, 2002).

- Limited English Proficient (LEP) – Limited English Proficient is used to describe who is in the process of acquiring English and has another language as the first native language (Texas Education Agency, 2012).
- Special Education Student – A child with a disability (e.g., deaf-blindness, auditory impairment, learning disability) as defined by federal regulations by the Texas Education Code §29.003. (Texas Education Agency, 2001).

1.5 Researcher's Background

To deepen the narrative that will be provided in subsequent chapters, I will first discuss my experience as a former student and educator in the district where this study was conducted. For the purpose of this study, I will refer to the school district where the research was conducted as *District Bravo*, for its position in the Rio Bravo Basin. This section of chapter one aims at providing an overview of my individuality as a researcher, in order to better understand the selected research design and the organization of the study.

1.5.1 Schooling in District Bravo

District Bravo is an urban school district in southwest Texas, in a U.S.-Mexico borderland region, that serves approximately 63,000 students in grades PK-12. Approximately 81% of the students are Hispanic, 5% African American, 12% White, less than 1% Native American, and approximately 1% Asian. Additionally, close to 70% of students are considered economically disadvantaged and 60% At-Risk of not graduating from high school. Nearly one third of students are identified as Limited English Proficient (LEP), and about 5,200 students are part of a Special Education Program. There are about 5,700 teachers (approximately 60% Hispanic) serving students in this district. Cline & Necochea (2006) state that "teacher dispositions, attitudes, and motivation play important roles in educating students so that they are highly successful in school; this is particularly true for students in borderland areas who

frequently need to negotiate two cultures, two languages, and two worlds" (p. 268). As a former immigrant student in the United States, I certainly concur with such statement. I was born in a borderland community, in Mexico, where I completed my schooling up to the 8th grade. In 1996, my parents decided to migrate to the United States. It was then when I realized that being an immigrant student, labeled as an English Language Learner (ELL), in a borderland region was perhaps somehow a multifaceted journey. I felt fortunate to be able to learn about a new culture, to meet new people, and simply reinvent myself as a new learner. However, there were also challenges that came with such fortune, including acquiring new content knowledge concurrently with the acquisition of a new language (English). Additionally, some school practices seemed to be different than those I had experienced in Mexico. For instance, as a high school student in the U.S., I would travel from classroom to classroom as I followed my schedule of courses; in Mexico, I instead stayed with a cohort of students in one classroom, while teachers traveled from class to class. Similarly, other differences, such as having an identification card (ID) to eat a free lunch at the cafeteria, diverse extracurricular opportunities, and even having a locker space to keep my textbooks, all were part of the adjustments I faced as an immigrant student in the U.S.

The culture of the border town can be considered very unique with a large number of Hispanic students, both immigrants and non-immigrants, enrolled in U.S. schools. Many of these immigrants are typically from Mexico, as this country is adjacent to the border with its neighboring American country. According to Ramirez (2013), U.S.-Mexico borderland regions are "characterized by strong social and economic cross-border connections and cooperation" (p. 69). This proved to be true for my family and many of the people (other immigrant students) who I met. We traveled back and forth from Mexico to the U.S. and kept a strong connection with family and friends in both sides of the border. My siblings (two brothers and a sister) and I encountered various phases, per se, during our transition to schooling in the U.S., particularly in District Bravo. We initially felt apprehensive to the idea of leaving family and friends "behind" in Mexico in the attempt to have a "better life". Violence, back then, was growing in our native country, and our parents were seeking a safer environment for us. Nonetheless, as a teenager, at age 13, this was difficult for me to understand. I wondered how I was going to make new friends and

how my education was going to change. My dedication to school provided me with good grades and I was certainly worried that my grades were going to decline due to limitations in speaking the English language and other factors that at the time were unknown to me. One of the most difficult things was for me to see my little sister cry everyday for about one month, not wanting to go to school because she couldn't understand her 2nd grade classmates. My heart hurt to see the pain that she was going through in trying to adjust. However, as time progressed, we learned English and learned to adapt to a new life style. District Bravo became home to my siblings and I. We met people, we participated in activities at school, and we tailored our needs to embrace a new culture that seemed, initially, an almost impossible thing to do. It was then when I decided, after my high school graduation, to continue a path in the field of education. I was not only captivated by how educators can transform the lives of others, but also about the uniqueness of educational systems. Two years later, I applied for a job in District Bravo as a mathematics tutor and was hired at one of their high school campuses. After I completed my bachelor's degree, I was then hired as a mathematics teacher at that same school. Following is an extension of such story, with a focus on my former teaching career at District Bravo. Although this undoubtedly only represents my personal story, it was important for me to share it, with the intent to immerse the reader in understanding my persona to better appreciate the elements that brought this study all together and offer a lens to better comprehend the research design. Keep in mind that the participants of this study were high school mathematics teachers selected from this district. As such, I was conscious of the conceivable predispositions that I carried with me and meticulously reviewed each step in the development of the study to avoid any susceptibilities that my personal experiences could present in examining teachers' connective knowledge of the challenges and possibilities of the FLM as they partook in the learning networks.

1.5.2 Teaching in District Bravo

Teaching in District Bravo was a fascinating journey, with diverse learning experiences for me, not only as an educator, but also as a member of a borderland community. The transition from being an ELL student into being a teacher with a prominent number of ELL students was fairly interesting. Every new school year, it was apparent that more ELLs continued to enroll in school. This concurs with

statistics from the National Clearinghouse for English Language Acquisition (2011) states that the number of English Language Learners (ELLs) enrolled in public schools increased 51% from the 1997-98 school year to the 2008-09 school year, making ELLs the fastest growing school population in the United States. Such statistics indubitably characterized District Bravo, where ELLs became a significant subgroup within their student population. As a teacher in District Bravo, I taught mathematics to students in grades nine through twelve. I was assigned a wide range of courses, from Algebra 1 to Geometry and even intervention courses designed to support "struggling students".

It was during those teaching years that I realized my interest, which soon after transformed into a passion, for finding new ways to enhance mathematics instruction in ways that could address the diverse needs of students in my classroom. I sought guidance from mentors, colleagues, and administrators. I was determined to see how I could engage students in rich lessons that they would be motivated to be part of. I went from "hands-on" activities where students had to use problem-solving techniques to take ownership of their learning, to using "manipulatives" to help students construct products related to the mathematics they were learning, to finding new technology tools that could help me sustain high engagement in the classroom. I requested a new Smart-Board from my principal and asked for motion detectors to have students collect and analyze data. Every new school year, I continued to request anything else that I could find that could aid students in the conceptual understanding of mathematics ideas. I was fortunate enough to have support from the campus and district in providing me with new tools for my mathematics classroom. This was important for me, as I felt like I had to go beyond the traditional way of teaching to reach all students in my class. I was especially concerned about students like "John". The campus identified John as a "struggling" student and most teachers simply did not want to "deal" with him. His attendance was far from perfect and his grades tended to be at the lower end of students in my class. He would sit at the very back of the room and rarely talked to other students. He seemed to be apathetic to anything that had to do with mathematics and simply failed to turn in his class assignments or homework. When I enquired about him with the campus administrators, the response was that John had a history of "bad behavior" and that he was behind on his credits required for graduation. At that point, he was a junior student, in the 11th grade. I simply refused the idea that John was defined

by everyone as a struggling student destined for defeat. I met with John, in a teacher-student conference to find out who he really was. It was then that I met the real "John". John had a job at night and grappled with the challenge to sleep at least five hours a night. He was living with a single parent, as his dad went to jail in a drug-dealing charge. He was trying to provide emotional and financial support for his two little sisters and his mom, and had taken the role of "the man of the house" quite seriously.

John had not passed any of the mathematics state assessments after his dad went to jail; but had passed them successfully prior to that. It was obvious that the tough events that John went through with his family changed his priorities. He no longer worried about attendance and "good" grades. He instead worried about his family and survival. That was the real John. I continued to talk to him individually every day for the next two weeks. I found out his likes and dislikes, and met with his mom. I then found instructional approaches to engage John in ways that could help him "forget" about his difficult problems outside of school, to focus on the mathematics that I was teaching at the time. I used a self-paced computer aided program to help him move from concept to concept without having to deal with structures that he couldn't follow because he had fallen too behind to be at the same level of understanding as his classmates. John went from a grade of a low D in the class to a high B. He was willing to do the work and put the effort into doing well in the class. He just didn't seem to have the tools to do so. After the school was over, John wrote me a note thanking me for "believing" in him. What I wanted him to understand is that I was just doing my job. I simply found a way to teach him that could fit his needs.

John's story is simply one of many stories that I encountered as a high school mathematics teacher at District Bravo. Every story became an opportunity for me to find new methods or fine-tune the ones I was already using, in order to adjust instruction to meet the needs of my students. From working with ELLs to participating in committees that contributed to the campus improvement plan and advocating for new initiatives in the campus to make the learning environment a better place for students, I certainly had an abundance of tasks at hand trying to heighten mathematics instruction.

Such passion to turn my students' stories into opportunities to explore new ways of teaching and learning mathematics, have taken me to a new job working with teachers in District Bravo to do just that,

and at a bigger scale. As such, I became the high school mathematics facilitator with a mission to support teachers and study new instructional approaches that have emerged throughout time and which promise to offer innovative ways of teaching that can perhaps enhance learning for students like John. Therefore, this study intended to examine the FLM, as a way to delve into the connective knowledge of the challenges and possibilities of this model as being explored by high school mathematics teachers in district bravo.

1.6 Research Questions

This study collected and analyzed quantitative and qualitative data to answer the following two research questions:

- What are the emergent themes of high school mathematics teachers' connective knowledge of the challenges and possibilities of the FLM as they partake in learning networks?
- What can we learn from the experiences of three high school mathematics teachers as they explore the FLM and develop connective knowledge, through their participation in learning networks?

1.7 Assumptions

This study made the assumption that the teachers participating in the investigation had a genuine interest in exploring the FML; thus, partook in learning networks to create and distribute knowledge about Flipped Learning. Moreover, the study also made the assumption that participants of the study would develop connective knowledge at a personal level and that such knowledge would be distributed amongst the members of the learning networks to construct social knowledge. Additionally, challenges and possibilities of the FLM were expected to emerge as teachers explored the model in their mathematics classrooms. Finally, the study also assumed that teachers were familiar with the structures of the written reflections (task-sheets) that were used in the study, as they had been continuously used at District Bravo during meetings and professional development sessions. Nonetheless, the content within each reflection was new to the participants.

1.8 Limitations

This study is limited to a small number of participants (N=26), which will make it inappropriate to generalize the results or perhaps replicate the research design. Nonetheless, the study does not intend to gather information as a way to develop generalizations, but rather to examine teachers' Connective Knowledge of a recent phenomenon in education, Flipped Learning. Therefore, the results of the study may support future research with a greater number of units of analysis that will allow a distribution of the population to be considered representative of groups of people to whom results can be generalized or replicated. Moreover, the lack of research associated to the main construct being investigated by this study, connective knowledge, as it relates to the FLM, limits the comparisons that can be made to other findings. Thus, further research is also supported by this study. Additionally, self-reported data from participants can be considered a limitation to this study, as some of the data that will be collected will be taken at face value. This may influence data presented by participants due to personal recall of facts, exaggeration, or specific representations of events dependent upon individual interpretations. Lastly, I acknowledge the possibility of unintended personal predispositions in the study due to my experiences both as a student and educator at District Bravo. Nonetheless, this awareness helped me to continuously check for bias throughout the duration of the study and emphasize on ways to increase the credibility and trustworthiness of the data collection, data analysis, and findings.

1.9 Delimitations

This study embraced specific delimitations, including the participants of the study- high school mathematics teachers exploring Flipped Learning in their classrooms. Furthermore, the study was conducted in nine school campuses within District Bravo in order to have participants use the district's curricular lessons and resources to avoid a greater range of mathematical resources used by teachers in the classrooms being observed. A U.S.-Mexico borderland region was selected as the main area to conduct the study as a way to contribute new information about Flipped Learning in areas in which this construct has not yet been studied. Within this region, District Bravo enrolls approximately 81% of Hispanic students, which may impact this study as research states that about two-thirds of White and Asian/Pacific Islander children have the ability to access the internet at

home, compared to only half of Hispanic and African American kids (Child Trend, 2012). Moreover, approximately a third of those Hispanic students are English Language Learners, a group that has not been part of past research of Flipped Learning.

1.10 Organization of the Study

The study was organized in five chapters. Chapter one presented an introduction to the study as a means to familiarize the reader with the overall constructs that were examined. Chapter two focused on presenting a literature review of the extant research on Flipped Learning and Connective Knowledge, which are the main ideas being studied, as well as a theoretical framework that served as the vehicle to interpret the data and offer conclusions based on the results of the study. Chapter three offered a detailed description of the research design, including a description of the research setting, sampling of participants, and methodology that was used to conduct the study. Chapter four presented the results of the investigation and chapter five offered a discussion and interpretation of the results.

Chapter 2: Literature Review

"Meaning is not given to us in our encounters, but it is given by us, constructed by us, each in our own way, according to how our understanding is currently organized."[1]

2.1 Introduction

The review of literature that follows focuses on two main areas: the FLM and the notion of Connective Knowledge, both of which are necessary to understand in order to comprehend the development of this study. The literature is presented in seven sections: (a) an overview of research on technology integration in U.S. classrooms, (b) historical background of Flipped Learning, (c) findings of empirical studies related to the implementation of flipped classrooms, (d) critiques of Flipped Learning, (e) conceptual framework, and (f) conclusions. It is important to note that section (e) will focus on the theoretical lens that was used to analyze the data and interpret the results for this study. Moreover, due to the limited amount of empirical research on both connective knowledge and Flipped Learning, some selected references of hypothetical examinations were used to deepen the literature being presented in this chapter. For instance, a search for "flipped classrooms" in Google search yielded 675,000 results, including teacher blogs, newspaper reports, images, videos, advertisements, books, technology software applications, and learning management systems. One of the results provided a figure representing the benefits for teachers and students of the flipped classroom as a teacher who flipped her classroom and posted on a teacher blog interpreted it. Examples like this one will be used only to develop, explain, or simplify an idea or information obtained from the existent empirical research.

2.2 Extant Research on Technology Integration

It is well known that technology integration in schools has been continuously and extensively examined. Within such examinations, a broad range of topics has surfaced, such as the benefits of utilizing technology, the challenges, and limitations. Scheffler and Logan (1999) argue that integrating technology in the classrooms enhances computer skills and supports learning in the process of reflecting, communicating, and collaborating with others. This, they argue, encourages students to use problem-solving and higher-order thinking skills to achieve learning goals. Nonetheless, they caution that

[1]Duckworth, 1987, p. 112

technology integration does require a change in school, where all stakeholders are involved, such as students, teachers, administrators, and even parents. Becker (1994) also states that technology integration requires support at the campus and district levels in order for it to be implemented successfully.

Moreover, according to Hadley & Sheingold (1993), technology integration requires flexibility, and involves active learning, less whole-group classroom instruction, as well as independent and self-motivated learning. Healy (1998), states that integrating technology has to be planned well, with "intrinsic meaning" behind it, and not to simply get on board with the costly technology movements that have spread over our field of education, in our nation overall, and across the world. Honey and Moeller (1990), for instance, argue that pedagogical beliefs on teaching and learning are essential in order for technology integration to be successful. This requires teachers to examine their teaching practices and structures in the classroom in an attempt to increase collaboration and active learning. More recently, Koefler et al. (2009) have stated, "While many technologies have emerged throughout history, so has the cry for educators to find meaningful ways to incorporate these technologies into the classroom". For example, Groff & Mouza (2008) have developed a framework for addressing challenges to classroom technology use, to include how to create an effective and equitable learning environment that integrates technology.

Furthermore, the National Board Association (2007) as well as Frederickson, Reed, & Clifford (2005), among others, have focused specifically on the implementation of online learning. Such studies emphasize contemporary topics like distance education, social networking, and blended instruction (Baker, 2012; Berrett, 2012). This interleaves to the already existent research on online learning. In fact, according to the U.S. Department of Education (2010), "a systematic search of the research literature from 1996 through July 2008 identified more than a thousand empirical studies of online learning" (p. ix). This coincides with other studies that have focused on Science, Technology, Engineering, and Mathematics (STEM) fields as the nation continues to promote STEM education. A clear example of this is a request from President Obama in the fall of 2009 to have his Council of Advisors on Science and Technology (PCAST) develop specific recommendations regarding the key actions that the nation

should take to ensure that the United States is a leader in STEM education for the coming decades. The report provided by PCAST states that "courses with online components may prove particularly worthy of investigation" (PCAST, 2010, p. 65).

Within the sphere of these type of online ideas, we find a modern-day instructional approach to teaching that integrates technology and intends to enhance learning; namely, Flipped Learning. This type of learning incorporates a pedagogical model that "flips" the typical lecture given by the teacher and the homework assigned to students to take home. Thus, students use short video lessons at home to learn new concepts that can then be discussed more in depth in the classroom. In-class time is aimed at promoting rich conversations, collaboration amongst students and with the teacher, as well as projects or other tasks that can expand or clarify students' knowledge of the intended learning goals. The governing board and leaders of the Flipped Learning Network (FLN), which is composed of educators experienced with flipped learning have developed a formal definition of Flipped Learning: "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" (Flipped Learning Network (FLN), 2014, p. 1). Other researchers have defined it similarly. Schwankl (2013) defines a flipped classroom as "the presentation of information via a prerecorded lecture and traditional classroom time used for assignments" (p. 11). Clark (2013) describes it as "a relatively new teaching strategy attempting to improve student engagement and performance by moving the lecture outside the classroom via technology and moving homework and exercises with concepts inside the classroom via learning activities" (p. ii). Regardless of the specifics behind its definition, what is clear is that this approach to teaching is in dire need to be explored more in depth.

2.3 Historical Background on Flipped Learning

Although Flipped Learning is quite a new undertaking, the ideas behind it are not. According to Oni (2012), the use of Information and Communication Technologies (ICTs), particularly electronic, has played a major role in the "acquisition and diffusion of knowledge, which are fundamental aspects of the education process" (p. xvii). He also states that ICTs can increase the possibilities to deliver learning

anywhere, at any time. Tosun and Baris (2011) argue that the use of electronic ICTs in education has been continuing for about a century. For instance, in the 1920s, radio transmissions began to be used for instructional purposes. Radio transmissions then developed into television transmissions after 1976s then followed by the use of computers and the Internet after 1995. This concurs with the International Research Foundation for Open Learning report (Perraton & Creed, 2000) that states school institutions, notably in Latin America, have provided an alternative to formal schooling through the use of radio and television as well as open and distance learning to raise school quality and especially to enhance adult education. For instance, out-of-school programs "are addressed to various different audiences including geographically remote, marginalized communities, and minorities seeking supplementary schooling" (p. 37). Thus, students who may be identified as "working class", for example, and cannot study full-time can have access to education with the help of technology. The foundation also argues that universities, notably in Asia, have also promoted distance education through the use of computers, particularly to encourage international cooperation.

Furthermore, a renowned professor at the University of Cedarville, in Ohio, Dr. Wesley Baker, has continuously explored the effect of new communication technologies on society, and particularly on media and journalism. His multiple awards, such as the *Innovative Excellence in Teaching, Learning, and Technology Award*, and the *International Conference on College Teaching and Learning Award* earned him respect in the field of technology education. As far back as 1982, Baker had examined the use of technology to teach content outside the class (Baker, 2000). In the mid-1990s, Baker changed his teaching practices by implementing online lecture notes for students to be able to see before class. This allowed him to maximize his instructional time. As a result, he developed a plan that focused on four main ideas intended to clarify, expand, apply, and practice the content that he was teaching. This plan helped him provide students with learning that they had more control over (Driscoll, 2012). The four ideas were intended to provide time for students to preview the content that was going to be discussed during class time, and have them apply their understanding by expanding their knowledge and practicing with others or reflecting by themselves. Likewise, King (1993) offered related ideas and emphasized on teacher roles in the classrooms. He proposed the notion of the "Sage on Stage" traditional learning

approach, which he contrasted with "Guide on the Side" constructivist paradigm that "places students at the center of the process- actively participating in thinking and discussing ideas while making meaning for themselves" (King, 1993, p. 30). Jones (2006) differentiates between these two roles: "facilitating student learning (guide) rather than actively teaching/lecturing (sage)" (p. 16). He states that this shift in pedagogical methodology implies faculty and teachers will become mentors, coaches, and facilitators instead of the typical "lecturers" or "teachers" as we have seen in the past. Thus, a guide would use the Socratic method, for example, to support students' learning by using a variety of questioning techniques rather than delivering instruction through a lecture.

The growing interest in this type of "student-centered instruction" led to the emergence of the "Inverted Classroom" (Bland, 2006; Gannod et al., 2008; Lage, Platt, & Treglia, 2000; Strayer, 2009). The model was intended to provide students with outside course lectures that they could use to enhance the learning occurring within the class time (Cole & Kritzer, 2009). Nonetheless, it wasn't until 2007 that the idea of an Inverted Classroom, now known as a "Flipped Classroom" began to gain popularity when two rural Colorado chemistry teachers, Jonathan Bergmann and Aaron Sams, began to use video lessons to enhance instruction in their classrooms. The media coverage on Bergmann and Sam's story gained much recognition, and the ideas behind "Flipping" began to spread. In 2011, Salman Khan, executive director of Khan Academy, a free online education platform, provided a talk regarding Flipped Learning at a prevalent stage for sharing and spreading ideas called Technology, Entertainment, Design (TED). This talk by Khan received millions of views and Flipped Learning became even more widespread. In 2012, Sams and Bergmann created the Flipped Learning Network (FLN) and short thereafter collaborated with Pearson Education and the George Mason University to review research on Flipped Learning and developed a Flipped Learning Model (Pearson & The Flipped Learning Network, 2013). The model included four main pillars for a Flipped Classroom: Flexible Environment (e.g., rearranging learning spaces), Learning Culture (e.g., learner- centered approach), Intentional Content (e.g., helping students develop conceptual understanding and procedural fluency), and Professional Educators (e.g., reflective teachers, collaboration, and constructive criticism). A discussion on the Flipped Learning Network will be presented later on this chapter, as part of the critique section.

Currently, the scarce scientific research that is available on Flipped Learning, together with the assumptions from non-empirical studies or reports, as the example mentioned at the introduction of this chapter, point to the growing use of Flipped Learning and the rising interest of educators to continue to "flip" their classrooms as part of their teaching approach. However, there is no "scientific research base" to suggest the impact of flipped classrooms in learning; yet, preliminary nonscientific data suggest that flipping the classroom may produce benefits (Goodwin & Miller, 2013).

Flipped Learning promises to integrate technology in a way that would allow students to use today's technologies outside the classroom and would create a student-centered environment inside the classroom in an attempt to support student learning. This type of approach, according to Clark (2013), describes, "how students should construct their knowledge through engaged learning activities" (p. 11). McClintock (1992) states that in this type of learning environment, technology plays a purposeful role in classroom activities, which supports student learning. However, technology does not become the only object of instruction; collaboration and hands-on activities also supplement it. This way, students learn with technology to explore, process information, and share meaning. Jonassen (1991) argues that the best way to use technology in classrooms is in an environment where technology supports and scaffolds the learning.

2.4 Findings of Empirical Research on Flipped Learning

As stated in chapter one, a limited number of studies was found that were relevant to the constructs being explored in this study, including research that addresses the FLM. The findings of those studies varied dependent upon what was being examined. Nonetheless, in order to further analyze the findings in a systematic way, a deeper exploration was conducted to find patterns among the existing studies. Thus, the studies were saved and then imported to computer software that analyzes qualitative data, named NVivo. The studies were saved in various forms, including PDF files, word documents, and web files. A query was then run to identify frequency of words, coding, and text search that could aid in identifying any patterns in the studies, to include in the findings.

Table 2.1 portrays the most relevant words that had some of the highest frequencies, as it relates to flipped learning. This query was run with a total of 374,317 words, using words that had a length of

at least 3 letters and including similar words. For example, when a query was run to find the word that was the most frequent, the result was "Flipping", with 2.63% of that word in the literature. However, this percentage also included similar words, such as "Flip" and "Flipped".

Table 2.1: Literature Review-Word Frequency of FLM Studies

Word	Length	Count	Weighted Percentage	Similar Words
Flipping	8	9,844	2.63%	Flip; Flipped; Flipping
Videos	6	7,112	1.90%	Videos; Video
Learning	8	4,904	1.31%	Learn; Learned; Learning
Watch	5	3,818	1.02%	Watch; Watches; Watched; Watching
Help	4	3,257	0.87%	Help; Helps; Helpful; Helping
Instruction	11	3,182	0.85%	Instruction; Instructional; Instructions

It is important to note that this six words that appeared as the most mentioned in the literature, are also essential concepts and/or ideas that are developed throughout the chapters. There were other words that also shown to be highly frequent in the literature, such as the word "use". This word appear 1.20% of the time in the literature and was one of the most frequent words throughout the articles, dissertations, and other documents that were included in the query. The word "use" appeared 4,492 times in the literature; however, no direct relevancy to this study, or great importance is given to it, as part of this study.

Although the word frequencies offered insight into the literature, further analysis was necessary as no specific patterns were found, but rather general terms within the studies were discovered, such as "classroom" and "videos". Thus, an extensive process of examining the studies and coding them using focused-coding to obtain clusters of meaning created more concrete categories of the existent research on Flipped Learning. Further discussion on coding will be provided in chapter three.

NVivo was also used to run a query to create a matrix coding. After the extensive process, the following categories emerged:

- Students, Teachers, Administrators, and Parents' Perceptions Towards Flipped Learning
- Students' Academic Achievement in a Flipped Classroom
- Recommendations when Flipping a Classroom
- Additional Non-empirical Claims and Other Considerations

2.4.1 Students, Teachers, Administrators, and Parents' Perceptions of the FLM

This category focused on how students, teachers, administrators, and parents perceived the use of Flipped Learning. Most studies agreed that perceptions of both students and teachers were positive towards Flipped Learning. For example, a study conducted by Marlowe (2012) states that students showed a positive attitude towards Flipped Learning and enjoyed the benefits of exploration of science concepts. Similarly, in a study conducted by Schawankl (2013), students had, overall, a more positive attitude towards learning in a flipped classroom, and students perceived themselves as being more successful in the flipped class than when using a traditional method of lesson delivery. Clark (2013) also states that "quantitative results and qualitative findings revealed the student participants responded favorably to the flipped model of instruction and experienced an increase in their engagement and communication when compared to the traditional classroom experience" (p. ii). Moreover, Johnson (2013) states that, "students enjoyed learning in a flipped classroom environment, and students benefited from watching their lectures in condensed lesson videos" (p. ii). McLaughlin et al. (2014) also stated that students found it valuable to be part of a flipped classroom. Missildine et al. (2013) concur by stating that Flipped Learning blends new teaching technologies with interactive classroom activities that can improve student satisfaction.

Snowden (2012) states that results of her study showed that perceptions of teachers towards flipping their classrooms was positive. Furthermore, Pearson (2012) states that no negative feedback was given from parents regarding Flipped Learning, and that students felt good about having a better control of their day-to-day learning in a flipped classroom. Additionally, the SpeakUp organization surveyed over 6,000 administrators; many of whom expressed concerns with Flipped Learning,

particularly within three areas: 1) students who have no access to computers or internet at home; 2) staff development for teachers in creating or finding videos; 3) use of additional classroom instructional time (Speak Up Survey, 2012).

2.4.2 Academic Achievement of Students in a Flipped Classroom

Category two of this findings' section focused on students' academic achievement after being exposed to Flipped Learning. The studies showed different results related to students' academic performance in a flipped classroom. For instance, Marlowe (2012) stated that mixed outcomes were obtained from assessments students took while being enrolled in a flipped classroom. He states, "while semester grades showed improvement, exam grades did not show significant improvement" (p. vii). Clark (2013), however, argues that no significant changes were shown between students in the flipped classroom and those who were in a traditional classroom environment in terms of academic performance. Likewise, Bishop (2013) argues that average scores on examinations, quizzes, and the conceptual test attained by both groups (controlled and experimental) were not significantly different. On the other hand, Missildine (2013) states that examination scores were higher for the flipped classroom group than for the group that was not exposed to Flipped Learning. Similarly Schawankl (2013) stated that student performance is enhanced with a flipped classroom delivery and that "three of the six quizzes had significantly higher scores for the students who received instruction through the flipped-classroom" (p. 2). Tune et al. (2013) concurs and states that exam averages for students in the flipped course tended to be higher than for those not in a flipped classroom. Finally, Pierce et al. (2012) also state that vodcasts and active-learning exercises in a flipped classroom contributed to students' improved scores.

2.4.3 Recommendations for Flipping the Classroom

This category of the research findings emphasizes on the recommendations made by researchers regarding flipping a classroom. For instance, Dr. Renner, from the Concordia University in Portland, Oregon stated "the interesting thing about the flipped classroom is a lot of people are talking about it, a lot of people are implementing it, but very few people are actually researching the effectiveness of it" (http://education.cu-portland.edu). He, along with a colleague conducted a study in a high school

computer class with a controlled and experimental group. They examined both groups and developed several conditions for successfully flipping a classroom. The following were guidelines that they developed to promote a successful experience in implementing the flipped classroom:

- The expectation of spending time doing homework should be clear
- A flipped class implementation does not have to be "all or nothing"
- Students do not automatically prefer cooperative group work, nor do they intuitively know how to work in a group successfully.
- Teachers do not have to create all of their own content for a flipped class
- Lecturing is not bad pedagogy, but it should not be the primary or sole means of instruction.
- Pre-testing in K-12 classes warrants further study
- Students respond to multiple means of representation

Moreover, Torkelson (2012) also conducted a synthesis project that aimed at developing a handbook for changing teachers' methodology from a traditional classroom to a flipped classroom. Her research design included feedback from students who were exposed to Flipped Learning in a chemistry high school class and feedback from Johnathan Bergmann and Aaron Sams, who were mentioned earlier during this chapter. The resulting handbook included a literature review and the following topics:

- How to begin the flipping process
- Equipment and technology used to instill the flipping process
- How to support struggling learners with a flipped classroom
- How to assess and grade students
- One chemistry sample unit
- Frequently asked questions
- Web resources

Additionally, Brown (2012) discussed the phenomenon of college instructors using Flipped Learning and produced three phases that teachers undergo as they teach in a flipped classroom. Brown states that "the concept of adoption or transition can suggest a contained implementation process that

includes a beginning phase of learning about and committing to a change; a middle phase of undertaking the necessary actions; and an end phase, or final result" (p. 97). This phenomenological study collected extensive qualitative data and provided teachers' experiences in assessing students, setting goals, planning, and implementing classroom activities.

2.4.4 Non-Empirical Claims and Other Considerations

This category describes additional claims made by non-empirical studies as well as findings from studies that explored different constructs associated with Flipped Learning, such as self-efficacy, anxiety, and stress. For instance, a survey from Columbia University in 2012 found that 80% of students going through Flipped Learning argued that they had more positive collaboration with other students and with teachers during instructional class time and that they liked that the concept of Flipped Learning allowed them to work at their own pace (Driscoll, 2012). Likewise, The Flipped Learning Network surveyed 450 teachers who were somehow incorporating Flipped Learning components into their classrooms and found that teachers "associated Flipped Learning with improved student performance and attitudes, and increased job satisfaction" (Pearson & the Flipped Learning Network, 2013 . Another claim made by Johnson and Renner (2012) intended to examine the benefits, shortcoming, perceptions, and academic results of the flipped classroom model. Their results did not support their hypothesis that "students in the computer applications class would benefit from the flipped method due to the transitioning of class time from lower-level activities to collaborative group work" (p. v). However, their study provides with observations that may be worth noting. For example, the authors state "the traditional class had nearly twice as many open-ended or active learning prompts as the Classroom Flip. This may have been the result of the flipped classroom spending less time in full class discussion and more time on student projects" and that "higher instances of off-task behavior were observed in the flipped classroom" (p. 37). For instance, students who were expected to be working individually on the computer were seen listening to music on YouTube or playing video games and had to be often redirected.

Furthermore, Wiginton (2013) stated that "student mathematics self-efficacy in the flipped mastery group increased significantly compared to student mathematics self-efficacy in the traditional

group" (p. 196). Similarly, Larsen (2013) argued "five out of the six cases exhibited initially low mathematical self-efficacy based either on self-reports on surveys or observational evidence" (p. 83). However, he states that the flipped classroom as it was implemented in her research study "positively affected student mathematical self-efficacy, especially for those who invited cognitive autonomy support and experienced the complete flipped classroom" (p. 84). Moreover, Marlowe (2012) investigated the effect of Flipped Learning on students' stress levels and found that students reported lower stress levels in a flipped classroom compared to other classes. Howell (2013) also states that data "indicated that accountability was a problem for ninth grade students as is evidenced by the fact that only 10% of students watched the videos 100% of the time as assigned" (p. 67). She also stated that "no significant difference between males and females in the experimental versus the control class" was found; which was also true for students with free/reduced-price lunch status versus students with full-price lunch status. Larsen (2013) also states "student attendance seems to play a strong role in how students experienced the flipped classroom" (p. 86). She states that students "falling behind seems to be highly associated with absence" and that "absences seemed to be generally related to self-pacing" (p. 87). Lastly, McLaughlin (2013) suggests that flipping a classroom promotes student empowerment, development, and engagement.

We can conclude then, that findings from the extant literature on Flipped Learning vary. Nonetheless, results emphasize on perceptions towards flipped learning, students' academic performance in flipped classrooms, and recommendations to educators as they explore flipping their classrooms. Other constructs are also explored, such as self-efficacy, stress, and students' attendance. Additionally, it was noted that most non-empirical claims concur with empirical studies, and provided further data to make conclusions.

2.5 Critiques of Flipped Learning

Just as school administrators have expressed concerns with Flipped Learning, others have also voiced limitations or delimitations within the extant research on Flipping. For example, Clark (2013) states that his study was "narrowed by the limited time frame of the project" (p. 17) which occurred for only approximately seven weeks. Such limitation, he argues, "allowed for the possibility of the novelty

effect associated with the use of technology within the intervention" (p. 17). In other words, because of the short period of time that this study was conducted, it cannot be determined at what point could the use of technology lose its effects once it ceases to be a novelty piece of the instructional approach. This seemed to have been the case for other studies on Flipped Learning, such as the study conducted by Schwankl (2013). Most studies on Flipped Learning do not address retention of the gains on student achievement or other factors, such as student perceptions towards this approach, over time.

Furthermore, Marlowe (2012) also states that she can see some concerns that can arise when implementing Flipped Learning. In her study, the population of the school was economically stable and she states that "aside from the initial difficulty of setting up the Internet" (p. 22), all students have access to the internet and computers at home, and students have accessibility to a library for additional use of computers. However, she states "in areas where socio-economic factors must be considered, other solutions such as burning the video lectures to DVD for watching at home would need to be explored" (p. 23). Johnson (2013) agrees with this statement and states that for his study, the school where the research was conducted "was located in a middle-to-upper class neighborhood; consequently this social-cultural homogeneity may limit the transfer of any findings to a larger heterogeneous population" (p. 10). This is particularly of importance to this proposed study, as it will be conducted in a borderland region at schools with large numbers of students considered of low-social economic status, which differs from the populations that have been used within the extant research. Marlowe also argues that implementing the use of Flipped Learning with lower grade students may prove to be more challenging as research shows that students in the 9th grade level, for example, are less motivated and less mature than grade 12 students. Thus, she states, "using the flipped classroom model with younger students would need more rules and accountability" (p. 21). Moreover, a critique published by USA Today in December 2013 (Retrieved from http://www.usatoday.com/story/news/nation/2013/10/22/flipped-classrooms) states that there might be bad news for advocates of Flipped Learning. Such publication states that preliminary results from Harvey Mudd College in Claremont, California, from a study sponsored by the National Science Foundation, show that "benefits of flipping a classroom are dubious". The publication also states that others, such as Andrew Miller, an educational consultant who uses

online classes to teach at the university level, believes the approach only works if you flip correctly and that "If you're not a good instructor, flipping the classroom won't really ensure better learning".

The above statement by Miller concurs with other, perhaps tougher, criticisms of Flipped Learning. Stager, for example, considered one of the world's leading experts in digital technologies is a firm critic of this approach. A renowned international speaker and educational consultant, he is better known for his dissertational doctoral work and his collaboration with Papert, who in turn collaborated with Piaget to better understand how children learn mathematics. Stager has expressed three particular concerns regarding Flipped Learning (Pearson & The Flipped Learning Network, 2013). He argued that this type of approach over emphasizes lectures and homework and that this only flips the position of the two. He also argued that today's excessive and loaded curriculum in schools has forced educators to take this route in an attempt to lessen the amount of content included within their yearly curriculum. He states that this is just a need for teachers to teach outside their classrooms since there is too much for them to cover during the year. Finally, he also states that Flipped Learning advocates for standardized learning and privatization of education, which then implies teachers losing their jobs. His argument is that this type of movement will simply replace teachers with videos created for student use. Nonetheless, supporters of the approach state that the main pillars of the model contradict Stager's claims.

2.6 Conceptual Framework

The conceptual framework of this study utilized a lens of Connectivist theory to examine and interpret the results of the participants' connective knowledge of the challenges and possibilitites of the FLM. To better understand such framework, we must first accentuate on the five premises that precede it: 1) it is fundamental to understand historical epistemology developments, 2) prevailing literature suggests connective knowledge is a new form of knowledge, 3) learning networks are a vehicle to create and distribute connective knowledge, 4) connective knowledge can be demonstrated at a personal and at a social level, and 5) Connectivism serves as a new learning theory focused on this type of knowledge.

2.6.1 Historical Epistemological Developments

Understanding the meaning of *knowledge* is not a novel idea. In fact, defining knowledge has been an ongoing debate that has been prolonged throughout time. Epistemology is a part of philosophy

that has continually examined the nature of knowledge and has attempted to provide epistemological beliefs to delineate it. Although many theoretical assumptions have been made regarding learning and the acquisition and distribution of knowledge, there are certainly key learning theories, which have been discoursed about predominantly. I will center this initial transitory discussion on four of them: Behaviorism, Cognitivism, Constructivism, and Constructionism. I will then present literature regarding a new type of knowledge (connective knowledge) and a proposed learning theory that circumscribes it, Connectivism; conceivable connections to these four learning theories will also be offered. It is important to note that this discussion focuses on understanding the major historical developments of studying the nature of knowledge and the processes of learning, and not an attempt to delve, in depth, into specific learning theories; this would constitute a study of its own and certainly goes beyond the scope of this analysis.

Behaviorist Philosophy

Skinner (1972) introduced the idea of behaviorism by emphasizing on the impact that behavior had on the learning process. Behaviorism argues that learning occurs by changing the learner's behavior. Standridge (2010) states "behavior is directed by stimuli" (p. 271) and thus that human behavior is learned, or unlearned, and replaced by new behaviors based on such incitements. Advocates of behaviorism state that learning does not have an association with what occurs in the mind. Instead, it assumes that behavior is not controlled by free will, but rather it is controlled by natural laws (McDonald et al., 2005), and particularly connected to the actions of the learner in a specific learning environment. Skinner's statement that "we cannot assume that behavior has any peculiar properties which require unique methods or special kinds of knowledge"(1953, pp. 35-36), speak to his arguments that behavior is the central force that drives learning.

Parkay & Hass (2000), add to this notion by stating that the learner seeks to select a particular response over another, based on prior conditions and psychological drives that exist, at the moment of the action. Behaviorism refutes the idea that thoughts, beliefs, or emotions play an important role in the learning process; relatively "behavior is learned habits, and attempts to account for how these habits are formed" (Standridge, 2010, p. 271). Skinner also debated that "operant conditioning" directly impacted

behavior and consequently learning experiences. He states, "the things we call pleasant have an energizing or strengthening effect on our behavior" (1972, p. 74). A simple, yet renowned, example would be that of a rat receiving food by pressing a food button. The rat will continue to press the button to receive food. The rat pressing the button represents the "operant", while the button itself represents the stimulus. On the other hand, if the rat was shocked when pressing the button, then it is likely that the rat would not press the button over and over again as it would continue to get shocked. Therefore, a stimulus (the button) can change the learner's behavior and thus learning occurs based on the actions that the learner engages on, creating a specific learning experience; and thus developing knowledge as an outcome of such experience.

Cognitivist Philosophy

While Skinner continued to develop his ideas from a behaviorist viewpoint, other researchers' criticisms to such notions began to gain attractiveness. Chomsky's opposition to Skinner's dispute that the human mind did not play an essential role in the learning process, built on his argument that "the principles underlying the structure of language are biologically determined in the human mind and hence genetically transmitted" (Lyons, 1978, p. 4). Successively, the term Cognitivism focused on how the mind of the learner established, organized, and retrieved information (Ertmer and Newby, 1993). This, along with the claims that information is stored in our memory and that meaningful experiences in turn create knowledge, became more and more appealing to educators and researchers attempting to understand the learning process.

This learning theory emphasized on the idea that the learner develops new knowledge based on their thinking process and promoted the notion to problem-solve by designing meaningful experiences for the learner that could produce motivation and in turn create knowledge. This theory also promoted the role of students in the learning process as active learners, rather than passive learners, as argued by behaviorists. Bandura (1989) extended on this idea to highlight the notion of social responsiveness; he stated that:

> *"within the social cognitive perspective, social factors play an influential role in cognitive development, and there are many motivators of the*

> *pursuit of competence. Maturational factors and the information gained from exploratory experiences contribute to cognitive growth. However, most valuable knowledge is imparted socially"* (p. 12).

This concurs with cognitivists views that the way a learner thinks controls the way they behave and because of that, Cognitivism differs from behaviorist philosophy and their claims about the absence of thinking in the learning process.

Constructivist Philosophy

Although Cognitivism had gained momentum, the attention began to switch to Psychologist Jean Piaget, as he began to pioneer the study of child development based on child cognition through the development of stages of learning readiness. Piagetian philosophy, argued that the learner creates knowledge, instead of it being transferred by or to others, or found (Sinclair, 1988). He argued that a child would go through four stages of developmental readiness: sensorimotor stage (birth-2 years old), pre-operational stage (2-7 years old), followed by concrete operational stage (7-11 years old), and finally through the formal operational stage (12+ years old). As children went through these stages, they would then adapt to new experiences by assimilating- incorporating an idea to existing ideas- or accommodating- creating a new idea to develop new information- (Joyce & Weil, 1996).

Piaget argued that the learner plays an important role in the learning process by being an active agent in the process itself; he claimed, "whatever gets into the mind has to be constructed by the individual through knowledge discovery" (Hung, 2001, p. 282). This thought that learners construct meaning is a key principle of constructivism (Murphy, 1997; Piaget, 1926; Vygotsky, 1978). Similarly, Vygotsky (1978) studied children's learning and concurred with Piaget's idea that individuals construct their own knowledge. However, Vygotsky's ideas argued that learning development is part of a social and cultural context that is embedded in the learning process.

Contrary to Piaget's hierarchical stages of learning development, Vygotsky believed that students did not necessarily have to complete a particular stage in order for them to move to the next. His main contribution to the field of education is believed to be his cognitive learning theory that describes the "Zone of Proximal Development". Vygotsky (1978) argues that this zone is "the distance

between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86).

Both, Piaget and Vygotsky offered great insights into children's learning, particularly influencing the idea of traditional versus non-traditional teaching and learning. This leads us to discuss a deeper way of understanding a latter form of constructivist thinking, social constructivism. Social constructivist pedagogy recognizes the creation of knowledge in the minds of the individuals, through socialization. Although researchers may describe social constructivism in many ways, Anderson and Dron (2011) state that most researchers will agree that in this type of learning incorporates common themes, including emphasizing on new knowledge as building upon the foundation of previous learning, learning as an active rather than passive process, and language and other social tools in constructing knowledge. They also state that social constructivism validates the importance of social activities as part of the process to create new knowledge.

In a traditional classroom, learning tends to be transferred from the teacher to the students, creating a passive environment for the learner. Sandifer (1999) states that in this type of classroom, students "typically attempt to draw out the adult's correct answer rather than try to construct new knowledge" (p. 28). This type of teaching approach is often seen as a teacher-centered method rather than instruction centered on the learner. Contrary to this, a constructivist classroom is thought to be a learner-centered classroom. In this type of environment, the "constructivist teacher helps the students through problem-solving and inquiry-based learning activities with which students formulate and test their ideas, draw conclusions and inferences, and pool and convey their knowledge in a collaborative learning environment" (Khalid and Azeem, 2012, p. 171).

Advocates of the constructivist approach also argue that using this type of approach, where the learners have the opportunity to collaborate with each other, influences students to think critically and reflect on their own learning as well as allowing them to play an active role in making their own conclusions. This, we will see, overlaps with some of the ideas behind Connectivist philosophy, as presented later during this chapter.

Constructionist Philosophy

Constructionist philosophy builds from constructivist thinking. In fact, it is well known that many of the views of Constructionism build from those of Contructivism. A well known advocate of this learning theory, Papert (1991), states that:

> *"constructionism- the N word as opposed to the V word- shares constructivism's view of learning as 'building structures' through progressive internalization of actions…it then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe" (p. 1).*

Constructionist view also adds a "connectedness" notion to this type of learning. Ackerman (2001) argues that "Papert research focuses on how knowledge is formed and transformed within specific contexts, shaped and expressed through different media and processed in different people's minds" (p. 8). She continues by stating that "Papert draws our attention to the fact that 'diving into' situations rather than looking at them from a distance, that connectedness rather than separation, are powerful means of gaining understanding" (p. 8).

Stager (2005) also adds that "while constructivism defines learning as the building of knowledge structures inside of one's head, constructionism suggests that the best way to ensure that such intellectual structures form is through the active construction of something outside of one's head, that is something tangible, something shareable" (p. 2). According to Union (2011), this construction of something is meaningful and can be better built with the aid of technology tools. He states that "students learn more effectively when they construct personally meaningful artifacts that can be created by using various forms of technology. These artifacts or conscious tools are developed from the meaningful experiences of a twenty-first century digital native" (p. 8). Papert (1993b) argues that the advancements in technology are an opportunity to improve learning environments due to the many benefits that can be drawn from the use of digital information technologies. This particular learning theory is noteworthy to mention as some of the views and ideas embraced by it overlap with those in Connectivism.

2.6.2 Connective Knowledge

To extend on the historical epistemological developments already discussed, we must seek to understand a most recent arguable learning theory, Connectivism. Nonetheless, it would be imprudent to endeavor ourselves into understanding Connectivist Philosophy, without delving into some of the key ideas that lead it. Consequently, we have arrived at an integral part of this study, the understanding of what is being known as Connective Knowledge. Connective Knowledge draws from the idea that interactions are a central piece in learning and that knowledge can be described as distributed. Essentially, Downes (2010) defines it as knowledge that "consists of the network of connections formed from experience and interactions with a knowing community" (p. 1). But, what does this imply for the learning process? How does one develop connective knowledge? And how is this type of knowledge different from knowledge that one could acquire otherwise? In order to attempt to formulate answers to such abstract questions, we must first understand the vehicle that drives Connective Knowledge, namely Learning Networks, as well as the arguments that caused the emersion of this construct.

As described in chapter one, technology advancements have transformed the way we interact with each other. Ultimately, according to Kop & Hill (2008), there is a paradigm shift that is moving the learner to a position of autonomous learning. Cook (2012) supplements this notion arguing that "there is a movement beyond the idea of learning anytime and anywhere to the concept of learning all the time and everywhere" (p. 48). This has began a debate about a new theory in which not only is knowledge acquired differently, but it is also shared at an exponential rate and even more importantly, it becomes obsolete faster than it has in the past. In his book "The Half Life of Facts: Why Everything we Know has an Expiration Date", Arbesman (2012) states that knowledge is constantly changing and that even the most informed people are struggling to keep up with those rapid changes. Siemens (2005) describes some recent trends in learning that better explain these changes:

- Informal learning is a significant aspect of our learning experience. Formal education no longer comprises the majority of our learning. Learning now occurs in a variety of ways – through communities of practice, personal networks, and through completion of work-related tasks.

- Many learners will move into a variety of different, possibly unrelated fields over the course of their lifetime.
- Learning is a continual process, lasting for a lifetime. Learning and work related activities are no longer separate. In many situations, they are the same.
- Technology is altering (rewiring) our brains. The tools we use define and shape our thinking.
- The organization and the individual are both learning organisms. Increased attention to knowledge management highlights the need for a theory that attempts to explain the link between individual and organizational learning.
- Many of the processes previously handled by learning theories (especially in cognitive information processing) can now be off-loaded to, or supported by, technology.
- Know-how and know-what is being supplemented with know-where (the understanding of where to find knowledge needed).

In his book "The Wisdom of Crowds", Suroweicki (2005) illustrates the idea that as a "crowd" we can accomplish much more than we could ever individually. He states that "the wisdom of crowds has a far more important and beneficial impact on our everyday lives than we recognize, and its implications for the future are immense" (p. xix). Moreover, he also argues that we need to stop chasing the "expert" and forget about the idea that there is one person who knows the answers.

Siemens (2004) states that existing learning theories do not adequately explain this process of learning in a digital age that is rapidly changing, where the learner displays a higher level of independent learning than in the past. Yet, advancements in technology have also created possibilities for interactions that can further help a learner manage those changes caused by technology itself. According to Hogg & Lomicky (2012), "advances in technologies and tools allow learners to collect, produce, share, and use new knowledge and information to communicate and learn" (pp. 96-97). This can be done through various approaches, including one that centers the design of this study, Learning Networks.

Following, I will describe how learning networks became the vehicle of interactivity amongst the teachers participating in this study and will provide an argument for the networks as the medium for participants to create and distribute connective knowledge of the challenges and possibilities of the FLM. These learning networks became an important part of the research design in order to offer opportunities for teachers participating in the study to interact with each other.

Learning Networks

The notion of a network is far from modern. However, there are unique components of Learning Networks, as they relate to Connective Knowledge, which can be considered contemporary. According to Downes (2012), "a social network is a collection of individuals linked together by a set of relations"; he continues by adding, "entities in a network are called *nodes* and the connections between them are called *ties*" (pp. 55-56). Siemens (2005) states that "a network can simply be defined as connections between entities. Computer networks, power grids, and social networks all function on the simple principle that people, groups, systems, nodes, entities can be connected to create an integrated whole". Nevertheless, he adds that learning networks are defined in terms of the interactions amongst its members. In his publication "Connectivism and Connective Knowledge", Downes (2012) presents four specific principles of a learning network:

- Autonomy- each entity in a network governs itself
- Diversity- entities in a network can have distinct, unique states
- Openness- membership in the network is fluid; the network receives external input
- Interactivity- 'knowledge' in the network is derived through a process of interactivity, rather than through a process of propagating the properties of one entity to other entities

This study adhered to these four principles as described later in chapter three. These four principles are significant to understand as they outline the central ideas of the learning networks that were studied in this research. First, autonomy implies independence from the learner. In other words, the learner has agency to "filter" information and acquire certain knowledge based on his or her own aspirations as a learner. Thus, the learner decides which information is important and pertinent to keep and which is not. Second, the learning networks seek diversity as to maximize the different perspectives

offered by its members. Thus, a variety of viewpoints are embraced as a way to have a wide range of connective knowledge distributed within the network. Third, the network is open, which means that there is flexibility during the learning process. This implies an adaptable directionality caused by interactions among the members of the network. Thus, there is no fixed route as that needs to be followed. Lastly, and most importantly, the learning network has to promote interactivity amongst its members. Opportunities shall be presented to them consistently in order to promote and incite interactions among the nodes in the network. This last component of a network align to what Hogg and Lociky (2012) refer to a sense of community that helps them be comfortable in sharing their ideas. Hogg & Lomicky (2012) argue that a sense of community and high engagement of the learner are closely related to each other. For now, we transition into the type of knowledge that such learning networks developed through the interactions of participants.

Personal Knowledge

According to Siemens (2004), "the starting point of connectivism is the individual. Personal knowledge is comprised of a network, which feeds into organizations and institutions, which in turn feeds back into the network, and then continues to provide learning to the individual" (para. 5). This, he claims "allows the learners to remain current in their field through the connections they have formed". Downes (2012) states that the individual person "senses, discerns, and recognizes using the human brain" to develop such personal knowledge. To better illustrate this idea of personal connective knowledge, I will refer to the work of Pettenati and Cigognini (2007), and their four stages of developing personal knowledge in a connectivist era:

- Stage One: Awareness and Receptivity. During this first stage, the learner is exposed to resources and tools of the "new learning habitat" and begins to get used to "handling knowledge abundance".
- Stage Two: Making Connections, Selecting, and Filtering. During the second stage, the learner begins to make connections, as well as select and filter information. This second stage gets the learner to use the understanding and tools to which he/she was exposed to during stage one, in order to start forming a "personal network" of resources, which may

include people and contents. This is a very important stage as the learner begins to depict agency and become an active learner.

- Stage Three: Contribution and Involvement. During this stage the learner becomes a "visible node" and allows other nodes on the network to accept the resources, contributions, and ideas that he/she has to share. This in turn, creates reciprocal relationships and a shared understanding amongst the nodes.
- Stage Four: Reflection and Metacognition. This last stage as presented by Pettenati and Cigognini, intends to be a stage of self-reflexivity for the learner to reflect on the knowledge processes and products. During this stage, the learner modifies and rebuilds his or her own learning network, in which Siemens (2006) refers to a "network-aware and competent" individual. At this point, the learner acts as both a provider of valuable support to other networked learners, and as an individual capable of accessing "just-in-time" and "personalized" knowledge for him or herself.

Downes (2012) also recognizes knowledge as a cyclical process where knowledge informs the learning, learning informs the community, and the community in turn creates knowledge. This is best portrayed in his publication of Connectivism and Connective Knowledge, as he states:

> *"As a particular organization, a particular set of connections, between neural structures is strengthened, as this structure becomes embedded in more and more of our other concepts and other knowledge, it changes its nature, changing from something that needs to be triggered by cue or association (or mental effort) into something that is natural as other things we 'know' deeply, like how to breathe, and how to walk, structures entrenched through years, decades, or successful practice. Contrast this to a cognitivist model of knowledge, where once justification is presented, something is known, and cannot in later life be more known" (p. 315).*

Siemens (2005), just as Downes (2012), argues that personal knowledge is not only continuously changing, but is also reshaped by the learner based on connections that occur within a learning network. Thus, the learner produces new knowledge by filtering information and transforming it into new knowledge.

Social Knowledge

Similar to personal knowledge, Downes (2012) states that "social knowledge is to a society what personal knowledge is to a person" (p. 312) and that social knowledge consists of how a human society "senses, discerns, and recognizes using its constituent humans" (p. 68). He adds that this "is a result of the connections between the individual members of society, resident in no single one of them, but rather a property of the society working as a whole" (p. 312). Downes (2010) states that "educators play the same sort of role in society as journalists. They become aggregators, assimilators, analysts, and advisors" (p. 21). It is important to note that Downes (2012) emphasizes on the idea that social knowledge "is not merely the aggregation and averaging of individual knowledge" (p. 312). Instead, he states that it is the distributed knowledge that is disseminated by the nodes within the network.

This process, according to Dobozy et al. (2012), comprises a "multi-faceted exchange of ideas", and "rigorous debate", which "enables the construction" of distributed knowledge (p. 15). This is possible, they claim, only through rigorous and focused debate and discussion. As such, students control their learning experiences (Milligan, 2006) through learning activities. A "learning activity, is, in essence, a conversation undertaken between the learner and other members of the community" (Downes, 2010, pp. 19-20). This conversation, he argues, can varied and may consist of exchange of words, but also of images, videos, and multimedia technology tools, as well as other resources. All members of the learning network, create the conversation, and in turn distribute the knowledge amongst them. Siemens and Matheos (2010) suggest that this type of knowledge allows the learner to access, create, and recreate their learning content, as well as interact outside of a learning system.

Connective Knowledge vs. Other Knowledge

Let's examine the questions that were posed earlier: what does connective knowledge imply for the learning process? How does one develop connective knowledge? And how is this type of knowledge different from knowledge that one could acquire otherwise? To address the first question, we shall refer back to reaffirming that knowledge is "an ocean of competing and conflicting possible organizations, each ebbing and subsiding with any new input….and in such a diverse and demanding environment only patterns of organization genuinely successful in some important manner achieve salience, and even

fewer become so important we cannot let them go" (Downes, 2012, p. 319). This brings us to another important concept in trying to understand connective knowledge, that of salience. According to Downes (2012), our knowledge comprises interpretations of perceptions to make inferences; and by using inferences we manipulate bits of knowledge to produce new bits of knowledge. These inferences are the result of a "complex process" in which we select the most "salient" data. In other words, the abundance of knowledge that we currently have access to can become so widely that we have to make decisions to select only what we consider to be the most important information. Everything else becomes ancillary and not as significantly pertinent for what the learner needs to know at that point in time. Thus, the learning process is the connections between nodes and in this manner, the learner acquires and distributes knowledge based on what is utmost relevant and important for the learner at that specific moment in time.

The second question "how does one develop connective knowledge" has already been answered in the previous sections. However, to summarize the answer to this question, connective knowledge is developed and distributed through interactivity among nodes that are part of a learning network. Finally, the answer to the question about how connective knowledge is different from other type of knowledge is perhaps much more convoluted and a straightforward answer may be difficult to be offered. There is certainly an obvious need to continue to explore this type of knowledge so that we can delve profoundly on this construct in comparison to other types of knowledge. However, Downes (2012) states that "this new knowledge is not inherently any more reliable than the old" (p. 323). It is simply knowledge that is acquired and distributed differently. However, he claims, this knowledge can also be more subjective due to its nature.

2.6.3 Connective Knowledge of Challenges and Possibilities of the FLM

For the purpose of this study, it is important to distinguish between the literature presented and the key concepts that were at the forefront of this study. This analysis intended to examine connective knowledge as the main construct, selecting high school mathematics teachers as participants, while they partook in learning networks. However, the focus was given to two specific areas of examination: connective knowledge of the challenges and connective knowledge of the possibilities of the FLM. The

analysis embraced both an analysis of the personal connective knowledge of participants (especially as narrated by three key informants) as well as the social connective knowledge and emergent themes that surfaced through the inquiry and interpretation of the data. Thus, the emergent themes are presented, but also the stories of the informants are offered as to better understand the personal and connective knowledge that emerged during the study.

The learning networks of teachers were structured to entail the four principles stated by Downes (2012): diversity, autonomy, interactivity, and openness. As stated earlier, these principals were important in the development of the networks of high school mathematics teachers as they explored the FLM. First, the networks advocated for teachers to have their own agency and take ownership of their learning. This was made possible by providing them with self-directed structures throughout the period of the study. For example, although teachers had a structure for inciting conversations and fostering interactions amongst them, teachers made their own decisions about what they needed to focus on, what they were going to do as a group in the future, and how they would organize themselves during meetings. Further elaboration of "autonomy" is also provided on chapter three. Second, the learning networks sought diversity and embraced different perspectives offered by its members.

The study attempted to maintain such diversity by selecting participants from nine different high school campuses with distinct student needs, and who taught a variety of mathematics subject areas, ranging from algebra to advanced quantitative reasoning. Third, the network encompassed openness. For this study, openness was portrayed in the flexibility that was presented throughout the length of the study. For instance, although all participants of the study were exploring Flipped Learning, they had flexibility as to which technology tools that they could use to do so. Some decided to use "Schoology" as their learning management system to host the video lessons given to the students. Others decided to use their own website along with Educreations. Some others used You-Tube as their hosting platform for the videos. Lastly, and certainly vital to the study, the learning networks facilitated interactivity amongst its members. Thus, for the 26 teachers participating on the study, interactions among them were crucial to examine the emergent themes that appeared as they created and distributed knowledge about the FLM through those interactions. Opportunities were offered to them consistently in order to

promote and incite interactions among them. To allow for teacher collaboration, systems of support were provided to maximize their opportunities for interaction, such as task sheets (further examined in chapter three). Although there are only four principles, this study included a fifth component of the networks: staff development. This last component provided teachers with opportunities to learn about the different technology tools that they could utilize in their flipped classrooms (e.g., Educreations).

Moreover, although the four stages presented by Pettanati and Cigognini (2007) for developing personal connective knowledge were taken into account, the study focused primarily on the last two stages (contribution and involvement; reflection and metacognition) as it was often difficult to construe meaning for the first two stages (awareness and receptivity; making connections, selecting, and filtering) based on the instruments that were used to collect the data. Nevertheless, all four stages were somehow evident, as further discussed in chapter four.

2.6.4 Connectivism

Since we have now examined connective knowledge, it is prudent to discuss the emergent learning theory that embraces its examination, Connectivism. Connectivism was introduced at the beginning of the twenty first century by Siemens in 2004 and then followed upon by Downes in 2005. Consequently, it has become an intense topic of discussion among researchers, especially those interested in epistemological developments. The ideas that Connectivism offers can certainly be controversial and have since then gained both supporters and opponents.

This developing learning theory emphasizes on the interactions and connections that learners embrace as they exchange ideas in order to acquire and distribute knowledge. Siemens (2005) states that "Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital". This brings us back to the idea of Salience, where the learner makes decisions to filter information and keep the most relevant and significant information He adds that there are eight principles of Connectivism:

- Principle 1: Learning and knowledge rests in diversity of opinions
- Principle 2: Learning is a process of connecting specialized nodes or information sources

- Principle 3: Learning may reside in non-human appliances
- Principle 4: Capacity to know more is more critical than what is currently known
- Principle 5: Nurturing and maintaining connections is needed to facilitate continual learning
- Principle 6: Ability to see connections between fields, ideas, and concepts is a core skill
- Principle 7: Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities
- Principle 8: Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Furthermore, as Connectivism is an emergent learning theory, it may be wise to find any similarities and or differences with more familiar (and established) learning theories. For instance, "while connectivism views knowledge creation as emergent and iterative, constructivism views learning as being based on prior experiences and is largely concerned with how those experiences are brought into current reality" (Strong & Hutchins, 2009, p. 57). Baggaley (2014), also adds that "the current view of Connectivism emulates social learning theories and constructivist approaches to education, while going further, according to Siemens (2008) in discussing the role of network principles at multiple levels of the learning process, including neural, conceptual, and social, and in relation to digital technologies" (p. 120).

Connectivism has been compared to Constructivism because of its' focus on constructing knowledge and to Social Learning Theory as it proposes that people learn through interactions with each other. However, Connectivism highlights on the idea of a Learning Network that creates knowledge, develops communication, and promotes learning. Hence, that and many other features that will be discussed below, make Connectivism fitting for this study. One of the key ideas of Connectivism is that learning is the process of making connections and that such connections can be different. For instance,

some connections may be more complex than others, and may include different ways of connecting (e.g., blogs).

Connectivism then can be defined as "the thesis that knowledge is distributed across a network of connections, and therefore that learning consists of the ability to construct and traverse those networks" (Downes, 2012, p. 85). It is important to note that Connectivism does not recognize knowledge as being rooted in "cognitive" interpretations; that is, that knowledge is constructed under the assumption that humans make choices that are grounded in language and logic. Instead, Connectivism argues that knowledge is constructed by connections formed by actions and experience.

Table 2.2 below adapted by Ireland (2007) offers a comparison of Connectivism to the prevalent theories of Behaviorism, Cognitivism, and Constructivism, as depicted by Strong and Hutchins (2009), in their publication of "Connectivism: a theory for learning in a world of growing complexity".

Table 2.2: Comparison of Learning Theories

	Issue/question	Behaviourism	Cognitivism	Constructivism	Connectivism
1	How does learning occur?	Black-box, ie observable behaviour is the main focus	In a structured, computational manner	Socially and experientially, with personal meaning created by each learner	Distributed within a network, social, technologically enhanced, through recognising and interpreting patterns
2	What factors influence learning?	Nature of reward, punishment, stimuli	Existing schema, previous experiences	Engagement, participation, social and cultural factors	Diversity of network
3	What is the role of memory?	Memory is the hard-wiring of repeated experiences – where reward and punishment are most influential	Encoding, storage, retrieval	Prior knowledge remixed to current context	Adaptive patterns, representative of current state, existing in networks
4	How does transfer occur?	Stimulus-response	Duplicating knowledge constructs of the 'knower'	Socialisation	Connecting to (adding) nodes
5	What types of or approaches to learning are best explained by this theory?	Task-based learning	Reasoning, clear objectives, problem solving	Social, vague (ill-defined)	Complex learning, rapid changing core, diverse knowledge sources

As shown on the table, Connectivism does not consider knowledge to be transferrable, but rather states that learning occurs as a distributed process in a network. Learning communities that constitute specialized nodes or information sources creates a network. Each network can be of different size, and different "strength" based on the people forming the nodes. Siemens (2004) states that these communities have similar interests that allow them to interact, share, and reflect together as they create knowledge within their node. Dron and Anderson (2007) also add that learning happens best in network contexts, as opposed to individual or group contexts.

Downes (2012) argues, once a network is established within a community, "only individuals in a community have agency" (p. 374). He further explains, "the community begins to establish which knowledge is important" and, he states "what this means is that few members of the community undertake this action and are then in some way able to impose this as a directive on the community as a whole" (p. 374). Therefore, knowledge becomes part of a cyclical process, where knowledge informs learning, what is being learned informs the community, and the community in turn creates the knowledge. Thus, high school mathematics teachers who participated in this study created connective knowledge as they take partook in learning networks.

Connectivism incorporates learning distributed across a network. Furthermore, while Constructivism is rooted in social-reforms, Connectivism is rooted in rapid-change and diversity in informational tools. Nonetheless, meaning-making is certainly part of both Connectivism and Constructivism, more so than in Cognitivism and definitely not in Behaviorism. And as we continue to learn more about Connectivism, this study aims at contributing to how it can be used to interpret the results of how high school mathematics teachers create and distribute connective knowledge of the FLM through learning networks.

Nevertheless, as we explore connective knowledge and the emergent theory of Connectivism, it is important to acknowledge criticisms of Connectivism that question many of the elements embraced by this theory. Kop and Hill (2008), for example, argue that connectivism is simply a pedagogical approach, rather than a learning theory. Although they recognize the valuable perspective that Connectivism brings to the table, they refute the idea that such perspective can truly constitute that of a

new learning theory. They state, instead, that Connectivism draws from the already existent theories of learning and only bring a perhaps slightly different lens to what we know already about the learning process and the development of knowledge.

Moreover, Tu et al. (2012) argue that there are critical issues that have to be considered about the use of a Connectivist approach to learning, such as the students' and the instructors' experiences which impact their "self-regulation, competency, perception, supports, and privacy issues" (p. 18). They argue that some students lack skills to self-regulate their learning and organizational skills needed to learn in a personal learning environment like the one described in Connectivism. As such they state that this type of learning process would require students to "shift mental models". Moreover, they also argue that the confusion between formal and informal learning can create a negative perception of learning through the learning networks, as learners are traditionally used to a more directed type of learning environment in a more formal setting and see informal learning as adverse. Furthermore, they add that the lack of understanding for social learning paradigms can cause ineffective integration of technology tools, where the lack of support systems are evident, including teacher evaluations by the current educational organizations. Finally, they also argue that the integration of technology and social interactions through social media can rapidly create security and privacy issues, including that of protecting intellectual property.

2.7 Conclusions

Chapter two provided an overview of the extant literature on the construct of Flipped Learning as to provide a better understanding of the key theoretical foundations that embrace this investigation. The literature presented seven sections, including a synopsis of research in technology integration overall as well as a deeper look at how such research connects to Flipped Learning. Moreover, a historical background of Flipped Learning and the notions behind it were presented, and findings of empirical studies related to flipped classrooms were given. Additionally, critiques of the model were included and a theoretical framework for interpreting the results of the study, using Connectivist philosophy, was described. Non-empirical findings were also used to complement the literature and to enrich arguments made by the author.

Chapter 3: Methodology

"An Investment in Knowledge Always Pays the Best Interest."[2]

3.1 Introduction

This chapter will focus on the methodology that was used to conduct the study. The chapter will be divided in eight sections: (a) Research Design, (b) Setting, (c) Participant Selection, (d) Data Collection, (e) Data Analysis, (f) Trustworthiness and Credibility, (g) Research Procedures, and (h) Conclusions.

3.2 Research Design

This study follows a *fixed mixed-methods approach*, which centers on the idea of seeking multiple perspectives for understanding how high school mathematics teachers develop and distribute connective knowledge of the challenges and possibilities of the FLM as they part of learning networks.. As such, the use of quantitative and qualitative methods were predetermined and planned prior to the start of the research process. The rational for utilizing this approach was for *completeness*. Completeness refers to the notion that the researcher can bring together a more comprehensive account of the area of inquiry in which he or she is interested if both quantitative and qualitative research are employed (Bryman, 2006). Moreover, there was a direct level of interaction between the quantitative and qualitative strands, when appropriate. As stated by Creswell and Plano Clark (2011), this may imply certain interrelations between the quantitative and qualitative data, which can help answer the posed research questions in a more thorough manner.

The fixed mixed-methods approach employed an *Embedded* design intended to place a greater emphasis on the qualitative strand, with the quantitative data taking a supportive secondary role (Morse, 2003). Therefore, the supplemental quantitative strand was used to enhance the overall design by providing a baseline of information about the participants, such as their demographics, their prior formal or informal training on Flipped Learning, and their self-reported background of Flipped Learning. The main goal of the study was to narrate the story of high school mathematics teachers' experiences in

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creating new knowledge about Flipped Learning while interacting with each other in Learning Networks.

In narrative research, "the inquirer focuses on the stories told from the individual and arranges these stories in chronological order" (Creswell, 2006, p. 76). Narrative research differs from ethnography in that the focus of the participants' stories is not on their culture, but rather in how the events of their experiences evolve over a given period of time. Similarly, narrative research differs from a case study as it does not focus on an individual issue or set of issues, but rather intends to discover the occurrences that emerge through the investigation. When conducting a narrative research, the need is to tell a story (or stories) of individuals based on collection of their accounts through the use of documents, field notes, and interviews. Riessman (1993) states that this type of inquiry helps the researcher as well as the reader "make sense of event and actions" (p. 2) in the participants' lives. Moreover, Green and Thorogood (2009) call this approach the "practice of story-telling", which adds authenticity to the data collected.

It is important to note that the methodological precedents from the extant literature on flipped learning influenced the decisions of the researcher to select a research design that can contribute to the field of education, particularly in understanding teachers' experiences with the construct of flipped learning, within the context of high school mathematics teaching and learning. For example, it was noted that only about one-sixth of the studies that currently exist on the FLM utilized a qualitative approach. Thus, qualitative data had a great emphasis on this study. Furthermore, about two-thirds of the studies were conducted at the higher education level. Therefore, this study focused on the secondary level, specifically high school, grades 9 through 12. Appendix A offers an overview of the various research designs used on the forty publications mentioned on the literature as discussed on chapter one.

Figure 3.1 below illustrates the research design, which will be discussed throughout this chapter and thereafter.

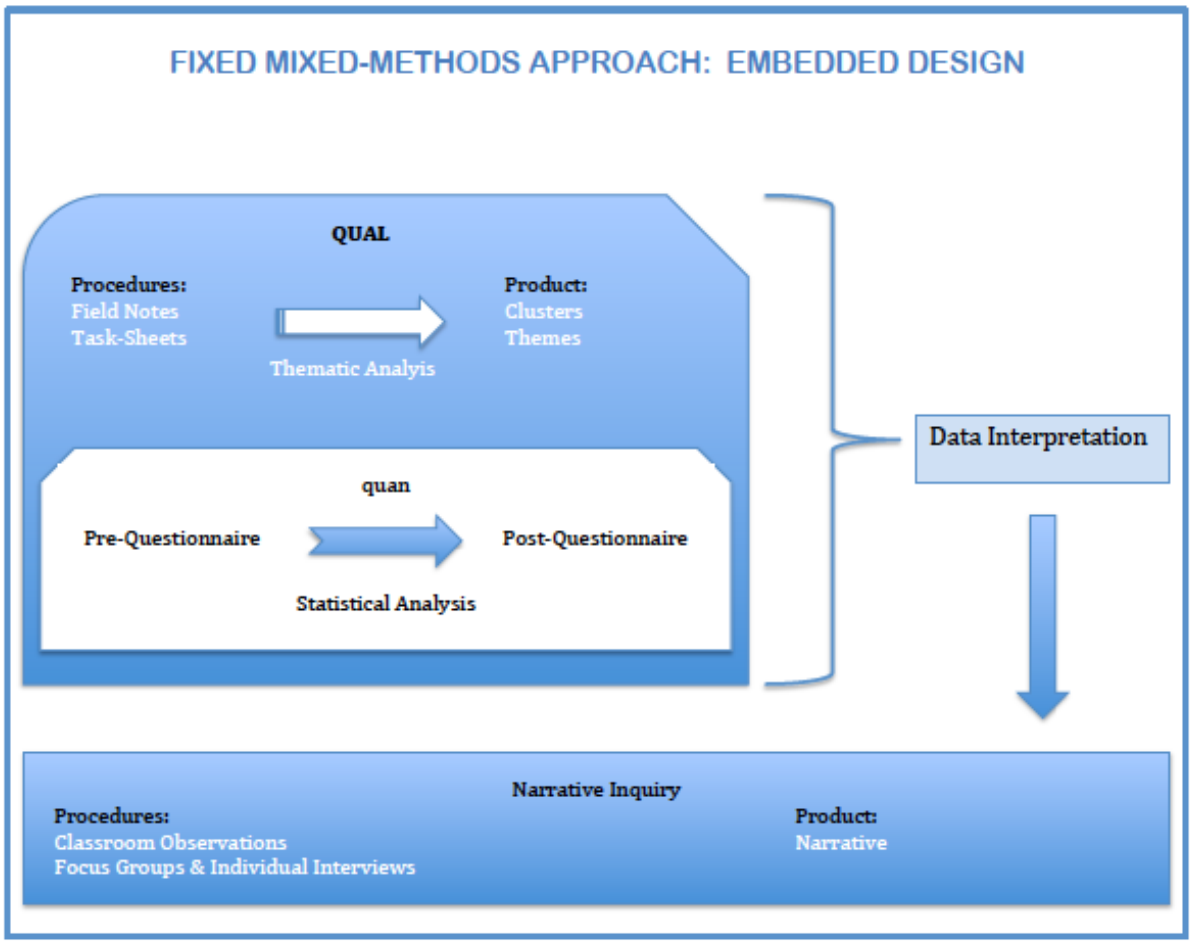


Figure 3.1: Research Design

3.3 Setting

The research was conducted in a natural setting to allow for deep understanding of Flipped Learning. Teachers participating in the study were selected from District Bravo in a Mexico-U.S. borderland region. District Bravo is one of the largest districts in its' state and it is the largest district in its region, with 94 school campuses serving over 63,000 students. As mentioned in chapter one, approximately 81% of those students are Hispanic, 5% African American, 12% White, less than 1% Native American, and about 1% Asian. It is also the largest employer in its city with nearly 9,000 employees and has an annual operating budget of approximately $461 million. Participants were from nine traditional high school campuses within district Bravo. Eight of the nine campuses are considered

to be Title I schools, which implies that they enroll at least 40% of their students from low-income families and utilize state funding to provide additional assistance to students through school-wide programs designed to improve student achievement, particularly for the lowest-achieving students.

Furthermore, approximately 71% of students in this district are economically disadvantaged and about 55% of them are considered at risk of not graduating high school. At-risk students are defined by meeting at least one of thirteen different criteria, as shown below (Retrieved from http://ritter.tea.state.tx.us/perfreport/aeis/2011/glossary.html):

1. Was not advanced from one grade level to the next for one or more school years;
2. Is in grades 7, 8, 9, 10, 11, or 12 and did not maintain an average equivalent to 70 on a scale of 100 in two or more subjects in the foundation curriculum during a semester in the preceding or current school year or is not maintaining such an average in two or more subjects in the foundation curriculum in the current semester;
3. Did not perform satisfactorily on an assessment instrument administered to the student under TEC Subchapter B, Chapter 39, and who has not in the previous or current school year subsequently performed on that instrument or another appropriate instrument at a level equal to at least 110 percent of the level of satisfactory performance on that instrument;
4. Is in prekindergarten, kindergarten or grades 1, 2, or 3 and did not perform satisfactorily on a readiness test or assessment instrument administered during the current school year;
5. Is pregnant or is a parent;
6. Has been placed in an alternative education program in accordance with §TEC 37.006 during the preceding or current school year;
7. Has been expelled in accordance with §TEC 37.007 during the preceding or current school year;
8. Is currently on parole, probation, deferred prosecution, or other conditional release;
9. Was previously reported through the PEIMS to have dropped out of school;
10. Is a student of limited English proficiency, as defined by §TEC 29.052;

11. Is in the custody or care of the Department of Protective and Regulatory Services or has, during the current school year, been referred to the department by a school official, officer of the juvenile court, or law enforcement official;
12. Is homeless, as defined by 42 U.S.C. Section 11302 and its subsequent amendments; or
13. Resided in the preceding school year or resides in the current school year in a residential placement facility in the district, including a detention facility, substance abuse treatment facility, emergency shelter, psychiatric hospital, halfway house, or foster group home.

3.4 Participant's Selection

Criterion-sampling was used to select participants. Criterion-sampling involves selecting participants that meet some predetermined criterion of importance (Patton, 2001). In this study, participants were selected based on three criteria, as shown below:

1) Participants held a high school mathematics position.
2) Participants had to be willing to partake in a learning network of teachers focused on the exploration of Flipped Learning.
3) Participants had to be teachers from District Bravo in order to try to minimize differences in district initiatives and/or practices as well as curriculum implementation in the classroom.

Subsequently, six participants were chosen using the key-informant approach (Spradley, 1979) as a way to identify individuals who were able to inform the investigator about Flipped Learning from different perspectives in a deeper way. Specifically, in terms of this study, the researcher sought to select participants with the following characteristics:

1) Teachers who had at least an 80% participation rate within the connective network of teachers,
2) Teachers who had at least an 80% participation rate within the connective network of teachers, as measured by their attendance.
3) Teachers who had "Flipped" at least one of their mathematics courses.
4) Teachers who responded to the questionnaire.

5) Teachers who were willing to be interviewed.

Data from three of those participants was examined further to understand their experiences more in depth and a narrative of their individual stories was offered.

3.5 Data Collection

Data collection incorporated various instruments as a way to obtain multiple perspectives of teachers' experiences with Flipped Learning. Both quantitative and qualitative data was collected. Nonetheless, as explained earlier in this chapter, quantitative data constituted a smaller portion of the data collection process, as presented in the research design. Each data collection tool is described below and the actual instruments that were used are either included in this section of chapter 3 or as part of the appendix.

3.5.1 Quantitative Strand

Quantitative data was collected at the beginning of the study, in October 2013, and again towards the end of the study, in May 2014. The selected participants were asked to respond to a base-line questionnaire intended to offer a greater awareness about the participants' background in Flipped Learning as well as their demographics. For instance, participants were asked if they had received any formal or informal training about Flipped Learning. They were also asked about their prior exposure to technology tools, such as creating video lessons, developing a website, or using Internet based programs, such as Khan Academy. Another item asked participants to self-report which components they thought were likely to be found in a "Flipped Classroom". This list of components varied and encompassed various ideas behind the Flipped Learning Model, as found in the literature review.

It is important to note that being that Flipped Learning is a fairly new construct, no instrument was found that could be used in this study. Therefore, a new instrument had to be developed. The instrument was created with a foundation on the existent literature review. Although this literature review was also limited, main patterns found on the existent studies were examined and items were developed based on that. Furthermore, since the research questions are focused on how high school mathematics teachers conceptualize and operationalize Flipped Learning, the items that were developed were intended to support the process to answer the posed research questions. Identifying the content to

be included on this newly developed instrument was not an easy task. Besides the fact that there were limitations on the literature, it was hard to find experts who knew about Flipped Learning, and who could contribute to the development of the instrument. Nonetheless, the researcher was able to collaborate with a panel of mathematics experts from District Bravo, as well as with technology specialists from the same district. In fact, one of those individuals was also a trainer for the Flipped Learning Model at District Bravo. Their expertise helped support the content and construct validity of the instrument. Further discussion of this will be presented later during this chapter in the credibility and trustworthiness section.

3.5.2 Qualitative Strand

Qualitative data was gathered for over one year, from October 2013 to November 2014. Various tools were used to gather the data, which included 1) field notes, 2) interview transcripts, and 3) teachers' written reflections. In order to better understand the process of collecting field notes for this study, we shall first examine the context that was used for this collection. Field notes were taken by the researcher and were an essential part of the collected data for this study. According to Atkinson (2002), field notes are "writings produced in or in close proximity to the field" (p. 353). He also states that field notes "are intended to provide descriptive accounts of people, scenes, and dialogue, as well as personal experiences and reactions, that is, accounts that minimize explicit theorizing and interpretations" (p. 353). The vehicles to collect field notes included classroom observations, interviews, and meetings of teachers coming together periodically as a connective network. So that the reader better understands the journey that teachers experienced, a clear and detailed description of each one of those vehicles will follow.

Field Notes from the Learning Networks

According to Downes (2006) a learning network is a learning community with similar interests aimed at interacting, sharing ideas, and reflecting to create Connective knowledge. Entities within a network are called nodes and connections between those nodes are called ties. Moreover, a learning network is characterized by four components (Downes, 2005):

- Decentralized- foster connections between entities

- Distributed- emphasis is on sharing
- Democratized- entities within the network are autonomous
- Dynamic- the creation of connections is a core function

Therefore, the connective networks that were formed by the high school mathematics teachers (nodes) embraced those four components. Teachers fostered connections amongst each other, shared ideas, and had the autonomy to make choices based on their own learning. Teachers participating in the study met periodically throughout the period of the study, a total of five times. They made ties at every one of those five meetings by sharing information, feelings, ideas, and thinking with others. Two of those meetings were during the fall semester and three during the spring semester. Each meeting consisted of eight hours, where the participants had the opportunity to meet at a centralized location to collaborate and discuss their progress. The meetings were fairly unstructured with freedom for them to guide themselves, but also with opportunities to receive training about technology tools, flipping a classroom, mathematics instruction, and combinations of those three.

The field notes taken during these meetings included the components suggested by Chiseri-Strater and Sunstein (1997):

- Date, time, and place of observation
- Specific words, phrases, and summaries of conversations
- Specific facts, numbers, and details of what happens at the site
- Sensory impressions: sights, sounds, textures, smells, taste, when appropriate
- Questions or notes that may need further investigation
- Page numbers to organize notes and keep information in order

Field Notes from Interviews

Interviews were conducted with two focus groups of six total participants at the end of the school year in May 2014 and individual interviews were conducted with them after they began a second school year, in November 2014. The process for developing the interviews were guided by Kvale's (1996)-stages of an interview investigation:

1) Thematizing- identifying the themes that the interview questions will be addressing.

2) Designing- planning the interview questions based on themes.

3) Interviewing- conducting interviews with the selected participants.

4) Transcribing- recording the participants' responses in detail.

5) Analyzing- examining the interview transcriptions based on data analysis process.

6) Verifying- accounting for credibility and trustworthiness of the gathered data.

7) Reporting- writing and sharing the findings of the conducted interviews.

The first stage was used to reflect about the research questions and how the interview questions could help in answering them. The second stage was used to design the interview questions based on the main goals of the study, which were to examine how connective networks helped them create new knowledge. Below are the questions that were used during the interviews of the focus groups and again during the individual interviews with all six participants.

1) How are learning communities within your campus or district impacting your understanding of Flipped Learning in mathematics?
2) What role is the networking with other teachers who are flipping their classrooms playing in the implementation of Flipped Learning in your mathematics classroom?
3) How has the transition to the Flipped Learning Model impacted the way in which you approach teaching and learning in your mathematics classroom?
4) Which challenges are you facing as you are implementing the Flipped Learning Model in your classroom?
5) What kind of tools are you using for the implementation of the Flipped Learning Model?
6) Describe the type of support that you are receiving or needing as you continue to explore the Flipped Learning Model
7) Additional Questions/Comments

Field Notes from Classroom Observations

Observations "involves not only gaining access to and immersing oneself in new social worlds, but also producing written accounts and descriptions that bring versions of these worlds to others" (Atkinson et al., 2003). For this study, classroom observations were conducted with the six key

informants. The observations were intended to provide a more in-depth collection of information about their mathematics classroom instruction as related to how they acquired knowledge about Flipped Learning. Three key elements were considered to conduct the classroom observations, as specified by Mitchell et al. (2013):

- Building rapport with the participants
- Spending enough time interacting to get the needed data
- Getting into the location of whatever aspect of the human experience that will be studied

The participant observations were conducted with the intent of having the key informants share their stories of "flipping" their classrooms not only with the researcher, but also with the rest of the participants. The observations were conducted approximately after one semester of the informants implementing Flipped Learning. Appendix B shows the observation form that was used to take notes and reflect on the notes. Moreover, other relevant information was collected during the observation, to include school name, classroom teacher, subject area being taught, and number of students that are participating in the flipped classroom. District Bravo videotaped the flipped lesson and the videos of the teachers' flipped classrooms to be shared with the connective network. The key informants shared their stories and were able to receive feedback from other fellow mathematics teachers on their flipped classroom, using a rubric (see Appendix D). An additional discussion to extend on the classroom observations will be presented on chapter four.

Teachers' Written Reflections: Task-Sheets

Documents used during the connective network meetings were collected in order to gather additional information and provide supporting evidence regarding teachers' connective knowledge of the Flipped Learning Model. Teachers in district Bravo know these documents, as "task-sheets". Thus, we will refer to them with such name. A task-sheet can constitute any type of document that is used during activities that are implemented as teachers participate in meetings, staff development sessions, or any other type of gathering at their campus or district.

For instance, participants of the learning network were given a task-sheet in the form of an open-ended questionnaire with questions like "how can you support each other to better implement Flipped

Mathematics Learning in your classroom?" They were asked to share their responses with other participants and they discussed their responses as a whole group. Other examples of task-sheets may be a checklist, a journal, or any document used during trainings or meetings, particularly to incite reflection. Nonetheless, task-sheets are typically a 'worksheet'-like document or documents where teachers share their thinking. Thus, it is important to note that teachers participating in this study were very familiar with task-sheets as they are regularly used in their school district.

3.6 Data Analysis

Data analysis took a multifaceted approach. Both quantitative data and qualitative data were analyzed and a point of interface was used to integrate both sets of data as a way to have interactions between the two strands.

3.6.1 Quantitative Strand

For the quantitative strand, statistical procedures were conducted using Statistical Program for Social Sciences (SPSS). Variables were identified and defined based on the questionnaire that was given to participants at the beginning and end of the study. After the variables were identified and defined, their nature was identified as nominal, ordinal, or interval scale. To analyze this data, a descriptive analysis of data was completed to find general trends based on participants' responses.

3.6.2 Qualitative Strand

For the qualitative data, a thematic analysis was conducted to help the researcher develop types of knowledge that emerge as members of the Learning Network interacted with each other. Moreover, qualitative data was also examined to assist in developing a narrative of the major events that occurred throughout the study and how such events impacted the individuals constructing the narrative, especially for two key informants. During this process, data was inputted into a qualitative data analysis computer software program, namely NVivo. Once the data was inputted and organized in the program, it was coded. The coding process used phrases, rather than specific words through line-by-line coding, followed by focused coding (Glaser, 1978). Line-by-line coding means naming each line of your written data (Glaser, 1978). These codes were then examined to see which ones fit together in specific

categories by using focused coding. These codes were more precise and conceptual than line-by-line coding (Glaser, 1978). These codes helped the researcher generate "strong analytic directions" to begin to produce considerable pieces of data. Thus, this type of coding used key codes to begin to take a broad view of the data. Once the data was coded, themes were created and organized into clusters. The analysis aimed at creating a story with an explanation, organization, and presentation of the qualitative data (Charmaz, 1990) from the beginning of teachers' participation, throughout their experiences, and to the end of the study.

3.6.3 Point of Interface

The mixed-methods approach to this study guided the data analysis process during a point of interface by using triangulation and crystallization (Richardson, 2000), which examines all perspectives of the study as a way to experience data through self-reflexivity and self-critique. Karp and Kendall (1982), state that reflexivity helps researchers avoid making unexamined assumptions. Thus, this strategy was intended to reflect on the collected data and to verify findings. After recording all gathered information, the data was converted into themes and subsequently grouped into types of knowledge acquired by participants through their interactions. Additionally, the researcher coded the interview transcripts and "task-sheets" responses as well as all field notes. Both the quantitative and the qualitative data were used to triangulate the emergent themes, as well as to better understand the stories to be narrated about the three key informants.

Figure 3.1 summarizes the procedures and products that were used and obtained during the study for the quantitative and qualitative strands, as well as for the integration of both sets of data. Keep in mind that as the study employed an embedded research design, a major emphasis was given to the qualitative data. The quantitative data, although important, constituted a less substantial piece of information, constituting only a base-line questionnaire intended to gather information about the participants' use of technology tools and classroom practices as it applied to the FLM. Numeric data from this questionnaire was obtained and analyzed, using descriptive statistics. The qualitative data comprised the major part of the data collection and data analysis process. For this type of data, several instruments were used. The study collected field notes, interview transcripts, and task-sheets were

obtained. They were then analyzed using focus and line-by-line coding and thematic analysis to find the emergent themes within such data. Finally, an integration of both sets of data was produced in order to interpret the results.

Table 3.1: Products and Procedures for Data Collection and Analysis

Quantitative Strand		
Data Collection	**Procedure:** • Pre & Post Questionnaire → Supportive Data	**Product(s):** • Numeric Data from Questionnaire
Data Analysis	**Procedure:** • Data Screening	**Product(s):** • Descriptive Statistics
Qualitative Strand		
Data Collection	**Procedure:** • Classroom Observations → Stages 1, 2, 3 & 4 • Meeting Observations → Stages 1, 2, 3, & 4 • Focus-Group Interviews → Stages 2 & 4 • Individual Interviews → Stage 4 • Teacher Reflections → Stage 4	**Product(s):** • Field Notes • Interview Transcripts • Task-Sheets

Data Analysis	**Procedure:**
	• Thematic Analysis
	  • Line-by-Line Coding
	  • Focused Coding
		Product(s):
		• Emergent Themes
		• Narrative

Point of Interface		
Integration of Quantitative and Qualitative Data	**Procedure:** • Triangulation	**Product(s):** • Interpretations of results • Implications • Reflections & Discussions

3.7 Credibility and Trustworthiness

Credibility and trustworthiness were an essential part of this study. Various approaches were followed in order to provide credible and trustworthy results of the data collection and data analysis process. Yin (1994) emphasizes on the importance of ensuring credibility in a research study by

incorporating "correct operational measures for the concepts being studied". In the case of this study, such measures were taken into account to ensure that the main construct being examined, connective knowledge, as well as the new notion of the FLM, was carefully present in the instruments that were used to collect both the quantitative and qualitative data.

3.7.1 Quantitative Strand

As stated earlier in this chapter, Flipped Learning is fairly a new construct and no instrument was found that could be used in this study. Therefore, the questionnaire used in this study had to be developed. Several steps were taken into account to ensure validity and reliability of the questionnaire as explained below.

Content Validity

In order to ensure content validity of the items being used in the questionnaire, an extensive analysis of the literature was done as a foundation to understanding major themes and ideas presented on the already existent studies. Furthermore, the researcher sought the help of several individuals to create the instrument including technology specialists, a panel of experts in mathematics instruction at the high school level, and an instructional technology manager who had provided trainings on Flipped Learning for teachers at District Bravo. However, it is important to note that although their input was valuable, their limited knowledge of Flipped Learning in mathematics classrooms made it challenging for them to provide ample feedback regarding the addition/modification/deletion of items. Nonetheless, changes were made based on their input. For example, originally, there was one question that asked about teachers' prior training on Flipped Learning: "Have you received any training about the flipped learning model?" The panel of experts suggested that such question be divided into two areas, formal and informal training. Thus, two questions were asked instead: "Have you received any formal training about the flipped learning model?" and "Have you received any informal training about the flipped learning model? (e.g., reading books, articles, online blogs)". They also suggested to provide examples of "informal training" such as articles and online blogs, which the researcher did, as shown above in parenthesis. Developing content for items to be used in the questionnaire turned to be very challenging for the researcher. Besides the fact that there were limitations on the literature, it was hard to find

experts who knew enough about Flipped Learning to contribute in a substantial way. Content validity was intended to measure the degree to which the items in the Flipped Learning questionnaire incorporated the content that is being researched; in this case how teachers conceptualize and operationalize Flipped Learning in mathematics classrooms at the high school level. Therefore, three pieces of information were taken into account: 1) Content (mathematics), 2) Pedagogy, and 3) Technology; all of these pieces were then examined to develop items that addressed the intended constructs.

Construct Validity and Reliability

Cronbach and Meehl (1995) state that "Construct validity must be investigated whenever no criterion or universe of content is accepted as entirely adequate to define the quality to be measured". In other words, construct validity will help to ensure the questionnaire measures what it is intended to measure. For this particular process of validation, it is important to take into account the theoretical framework and theories underlying Flipped Learning. Thus, the adequacy of the questionnaire was based on the intent of the study to measure high school mathematics teachers' knowledge of Flipped Learning. The main constructs being examined were defined prior to the development of the instrument to ensure a concise focus of the items measuring them. Additionally, a Cronbach alpha reliability measure was calculated, which resulted of 0.580. Although the measure can be consider low, the number of people considered for the measure (N=26) would imply a low, yet, acceptable reliability measure; particularly as the items that were included in the measure were examined individually, totaling only eight items, and an overall scale score was not calculated. Thus, this measure of reliability intended to provide particular information about the consistency of all items measuring the same thing.

3.7.2 Qualitative Strand

To ensure credibility and trustworthiness of the qualitative data collected, member checks were used to check interpretations with the teachers participating in the study as well as peer debriefing with the primary investigator's committee chair to discuss the emergent findings and ensure the analyses were grounded on the data. The main purpose of this study was "to describe accurately the lived experiences of people, and not to generate theories or models of the phenomenon being studied" (Van

Manen, 1990). Therefore, data was used to describe the experiences that teachers had while exploring the use of the Flip Learning Model in their mathematics classroom. Part of the efforts by the researcher to ensure trustworthiness was to continuously correspond with the participants to share summarization of the data collected and make sure such data reflected their experiences. For example, when the learning network met in October 2013, participants were asked to reflect about their experiences with Flipped Learning, if any. After their reflections were collected, they were summarized and presented in December, once the Learning Network members met again. Therefore, continual engagement with the participants was critical, to include member checks, triangulation of collected data, and understanding of their teacher perspectives as it related to their conceptualization and operationalization of Flipped Learning. Moreover, during the interview process the researcher summarized and clarified statements, as needed, when collecting sets of data to make sure that the participants' narrative retained accuracy. Additionally, the qualitative data was shared with the dissertation chair to ensure the researcher's perspective of the data was not biased.

3.8 Research Procedures and Protocol

The participants of the study began to partake in the activities of the investigation in October 2013 and continued through May 2014. Moreover, the subgroup of participants (key informants) who were selected to participate in the focus-groups and individual interviews continued to be part of the study for an extended period of time, through the fall of 2014. During this period of time, participants' rights were protected from unauthorized release of any kind of information that they disclosed during the length of the study and under a relationship of trust. Thus, the information collected was used only as stated in the description of the study as it was submitted to the Internal Review Board (IRB) and was not disclosed to others in ways that are not consistent with the main purpose of the study. Pseudonyms were used to protect identification of individuals, school sites, etc. Data was only shared during "peer debriefing" with the chair of the investigator for the purpose of analyzing and reflecting on the information collected. Moreover, confidentiality issues were considered at every stage of the research process. Participants' information and any collected data remained confidential at all times, including during the initial recruitment, the duration of the study, the analysis of data, and during any submissions

of publications or dissemination of results. Data collected was coded to ensure confidentiality and only the Principal Investigator had access to the code. Ethical conflicts did not emerge during the period of the study. Guidelines and procedures were followed as stated by the Institutional Review Board (IRB). An application was submitted with the IRB from the Institution of Higher Education for which the investigator conducted the research as well as with the school district that served as the institution to conduct the study. An Informed Consent Form was described and expounded upon the participants and included a description of the study, an agreement to participate in the study, an explanation of the confidentiality of the information that was gathered, and an acknowledgement that their rights as participants of the study were protected.

3.9 Conclusions

This chapter presented the methods that were used in order to conduct this study, including the instruments that were administered to participants during the data collection process, both quantitatively and qualitatively. Furthermore, a description of participants and the setting of the study were provided as a way for the reader to better understand the background of the study.

Chapter 4: Findings

"There is nothing like looking, if you want to find something. You certainly usually find something, if you look, but it is not always quite the something you were after"[3]

4.1 Introduction

Chapter 4 focuses on the results of the data collection and data analysis conducted by this study. The chapter will be divided in five sections: (a) Response Rate and Demographics, (b) Data Collection, (c) Data Analysis, (d) Results to Research Question #1, and (e) Results to Research Question #2. It is important to note that the data used during the length of the study was purposefully collected and analyzed to answer the research questions posed on chapter one and aligned to the theoretical framework, particularly to the theory of Connectivism. Thus, the findings are presented based on each of the two research questions posed by the study.

4.2 Response Rate and Demographics

As mentioned on Chapter 3, criterion sampling was used to select participants using a predetermined criterion of importance. As part of the recruitment effort, an informational meeting was held on August 8, 2013 as a way to invite district math leaders to learn more about the study. High school campuses from district Bravo were invited to send at least one representative to participate in this meeting so that he/she could take the information back to the campus to share with the whole math department. Representatives from all campuses attended this meeting. Twenty-one individuals were present, including instructional math coaches and teachers. They were given the information to share with the math teachers at their campus. Additionally, information related to the study was also sent to all campuses via e-mail. This information included an invitation to attend a recruitment meeting and first network meeting for math teachers participating on October 8, 2013.

Thirty-nine participants attended the first meeting on October 8, 2013. Of those participants, two were instructional coaches with no teaching assignment and three were teachers who were not allowed to participate in the study due to guidelines from the district. Therefore, of the 39 individuals who attended the meeting, only 34 had potential to participate on the study. Nonetheless, two of those 34

[3] John Ronald Raul Tolkien

teachers decided not to sign the inform consent form to participate in the study. Hence, 32 out of 34 teachers (or 94%) decided to participate on the study. Moreover, one teacher left the district in the middle of the study, and consequently her data was not included in the results bringing the group down to 31 participants. Of those 31 participants, five did not complete the post-survey and had minimal participation on the connective networks. Therefore, they were also not included in the data analysis of the investigation. Of these five participants, four had a 20% participation rate, while the 5th participant had a 40% participation rate. The final group of participants included in the data analysis and results of the study is a total of 26 high school mathematics teachers out of the 31 feasible participants (approximately 84%).

To provide a clearer picture of the participants, their demographics and some of their background information related to Flipped Learning is being presented. Figures 4.1 and 4.2 portray the age and gender for the final 26 participants of the study. Fifty percent of the participants were between ages 31 through 40, while only 11.5% were between 51-60, and no participants exceeded the age of 60 years old. Moreover, it was interesting to note that approximately half (n=12) of the participants were female compared to males (n=14)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<31	4	15.4	15.4	15.4
	31-40	13	50.0	50.0	65.4
	41-50	6	23.1	23.1	88.5
	51-60	3	11.5	11.5	100.0
	Total	26	100.0	100.0	

Figure 4.1: Participants' Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	12	46.2	46.2	46.2
	Male	14	53.8	53.8	100.0
	Total	26	100.0	100.0	

Figure 4.2: Participants' Gender

When asked about their teaching experience, most participants (n=15) had five to nine years of teaching experience. Only two participants, constituting 7.7%, had more than 20 years of teaching experience. Figure 4.3 offers the participants' teaching experience in more detail.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	5	19.2	19.2	19.2
	5-9 years	15	57.7	57.7	76.9
	10-14 years	4	15.4	15.4	92.3
	>20 years	2	7.7	7.7	100.0
	Total	26	100.0	100.0	

Figure 4.3: Participants' Teaching Experience

When participants were asked to select the subject area concentration that they were teaching during the school year in which they were participating in the study, most of them (n=21) selected Algebra 1, Geometry, or a combination of courses. Only 3.8% of the participants (n=1) taught

Mathematical Models with Applications, and three participants taught Algebra 2 only. Figure 4.4 below presents the information related to the subject area that participants taught as they were participating in the study.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Algebra 1	7	26.9	26.9	26.9
	Geometry	7	26.9	26.9	53.8
	Math Models	1	3.8	3.8	57.7
	Algebra 2	3	11.5	11.5	69.2
	Other or Various	8	30.8	30.8	100.0
	Total	26	100.0	100.0	

Figure 4.4: Participants' Subject Area Concentration for 2013-2014 School Year

Moreover, participants' ethnicity and race was also collected. For the 26 participants, 61.5% of them were Hispanic or Latino (n=16). Twenty-two of the participants self-reported to be white, which equivalents to approximately 85%. Figures 4.5 and 4.6 offer more detailed information on these two items.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Hispanic or Latino	16	61.5	61.5	61.5
	Not Hispanic or Latino	10	38.5	38.5	100.0
	Total	26	100.0	100.0	

Figure 4.5: Participants' Ethnicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	White	22	84.6	84.6	84.6
	American Indian or Alaska Native	1	3.8	3.8	88.5
	Asian	2	7.7	7.7	96.2
	Native Hawaiian or Other Pacific Islander	1	3.8	3.8	100.0
	Total	26	100.0	100.0	

Figure 4.6: Participants' Race

Participants were asked to provide their highest level of educational background, which included bachelor's degree, master's degree, or doctorate degree. Only 15.4% of participants (n=4) self-reported

to have a master's degree, while no participant had a doctoral degree and the majority of them, 84.6% (n=22) had a bachelor's degree. Figure 4.7 below presents those results.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor's Degree	22	84.6	84.6	84.6
	Master's Degree	4	15.4	15.4	100.0
	Total	26	100.0	100.0	

Figure 4.7: Participants' Highest Level of Educational Background

4.3 Data Collection

Data collection began on October 2013 and continued until May 2014 for the larger group of participants. However, six key-informants were interviewed at the end of the school year in May 2014 and again at the beginning of the following school year in fall 2014.

4.3.1 Quantitative Strand

Participants were asked to respond to a base-line questionnaire during the first time they met as a learning network, at the beginning of the study, in October 2013. Participants were also asked to respond to this same base-line questionnaire at the end of the school year, in May 2014. The questionnaire had items intended to provide additional and supportive information related to the participants' exposure to flipped learning. Figures 4.8 and 4.9 present the participants' responses for the first two items of the questionnaire, which focus on obtaining their background about any formal or informal exposure that they had received related to flipped learning, prior to the beginning of the study.

Item Description: Have you received any formal training(s) about the Flipped Learning Model?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	5	19.2	19.2	19.2
	Yes. One Time.	14	53.8	53.8	73.1
	Yes. 2-3 Times	7	26.9	26.9	100.0
	Yes. > 3 Times	0	0.0	0.0	
	Total	26	100.0	100.0	

Figure 4.8: Participants' Formal Training on FLM Prior to Study

Please note that most participants (53.8%) stated that they had received formal training, once prior to the beginning of the study. Only 5 participants (19.2%) stated that they had not received any type of formal training, while 7 of them (26.9%) had participated in formal training two to three times. It is also important to note that none of the participants self-reported to have had participated in more than three formal trainings prior to the beginning of the study. Similarly, about half of the participants stated to have received some type of informal training prior to the study.

Item Description: Have you received any informal training about the flipped learning model? (e.g., reading books, articles, online blogs)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	11	42.3	42.3	42.3
	No	15	57.7	57.7	100.0
	Total	26	100.0	100.0	

Figure 4.9: Participants' Informal Training on FLM Prior to Study

Moreover, the questionnaire also asked participants to read thirteen statements that were developed based on the literature related to flipped learning, as presented on chapter three, and state whether they considered such statements to be a component of the FLM or not. For example, one of the statements was: "Class assignments are completed outside the classroom, and homework is completed

during the instructional time in the classroom". Appendix B illustrates the rest of the components, as they were presented on the questionnaire. Figures 4.10-22 offer a summary of the participants' responses to such statements.

Item Description: An online course used to teach the concepts that would otherwise be traditionally taught in the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	18	69.2	78.3	78.3
	Yes	5	19.2	21.7	100.0
	Total	23	88.5	100.0	
Missing	99	3	11.5		
Total		26	100.0		

Figure 4.10: FLM- Component #1

Although three of the participants did not respond to this item, a preponderance number of participants (69.2%) self-reported that they thought FLM was not an online course used to teach mathematical concepts that would otherwise be traditionally taught in the classroom and only five of the participants (19.2%) stated otherwise. It is interesting to note that by the end of the study, the percentage of teachers that reported to think that this item was not a component of the FLM increased to 73.1%, while the percentage of teachers who reported this item as a component of the FLM also increased to 2i6.9%. Furthermore, another item given to participants was an item that asked participants to examine if a constructivist approach to learning along with the integration of direct instruction was a component of the FLM. Remarkably, half of the participants (50%) self-reported that they did think this item was representative of embracing the notions of the FLM. Figure 4.11 illustrates the participants' responses in more detail.

Item Description: The integration of constructivist learning and direct instruction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	8	30.8	36.4	36.4
	Yes	13	50.0	59.1	95.5
	Y/N	1	3.8	4.5	100.0
	Total	22	84.6	100.0	
Missing	99	4	15.4		
Total		26	100.0		

Figure 4.11: FLM- Component #2

When participants were asked to state if they believed that students working independently to learn new concepts was an element of the FLM, 12 of them (46.2%) stated that they did, compared to 9 (34.6%) who stated that they did not. As portrayed by Figure 4.12, five of the participants (19.2%) did not respond either way.

Item Description: Students working independently to learn new concepts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	9	34.6	42.9	42.9
	Yes	12	46.2	57.1	100.0
	Total	21	80.8	100.0	
Missing	99	5	19.2		
Total		26	100.0		

Figure 4.12: FLM- Component #3

An item that seemed to have a remarkable number of teachers agreeing on, was an item that asked teachers to state if they believed that increasing student-teacher interactions during instructional time was a component of the FLM. As shown by Figure 4.13, Twenty-three of the teachers (88.5%) stated that they did, while the remaining three teachers (11.5%) did not provide a response.

Item Description: Increasing student-teacher interactions during instructional time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	23	88.5	100.0	100.0
Missing	99	3	11.5		
Total		26	100.0		

Figure 4.13: FLM- Component #4

Similarly, when teachers were given a statement about the flipping of class assignments to be completed outside the classroom and homework, to be completed during the instructional time in the classroom. Half of the teachers (50%) reported that they did think this was a component of the FLM. Interestingly, 24 teachers (92.3%) stated that they did think that "students working freely without structure" was an element of the FLM. Figures 4.14 and 4.15 provide a more detailed account of the participants' responses on these two items.

Item Description: Class assignments are completed outside the classroom and homework is completed during the instructional time in the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	7	26.9	33.3	33.3
	Yes	13	50.0	61.9	95.2
	Y/N	1	3.8	4.8	100.0
	Total	21	80.8	100.0	
Missing	99	5	19.2		
Total		26	100.0		

Figure 4.14: FLM- Component #5

Item Description: Students working freely without structure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	24	92.3	100.0	100.0
Missing	99	2	7.7		
Total		26	100.0		

Figure 4.15: FLM- Component #6

It is also noteworthy to mention that although 18 teachers (69.2%) reported that they thought the FLM was an online course (component #1), all but one teacher (96.2%) self-reported that they thought flipped learning was a synonym of online videos, a fact that was evident throughout the fall semester of 2013, as teachers began to explore the FLM in their classrooms. A similar percentage (92.3%) reported that they thought the FLM allowed teachers to find deeper connections with students in order to improve learning (see Figures 4.15 and 4.16).

Item Description: Flipped Learning is a synonym of online videos

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	25	96.2	96.2	96.2
	Yes	1	3.8	3.8	100.0
	Total	26	100.0	100.0	

Figure 4.16: FLM- Component #7

Item Description: Allowing teachers to find deeper connections with their students in order to improve learning.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	3.8	3.8	3.8
	Yes	24	92.3	92.3	96.2
	Y/N	1	3.8	3.8	100.0
	Total	26	100.0	100.0	

Figure 4.17: FLM- Component #8

Moreover, all teachers stated that they thought "providing students with meaningful resources to differentiate instruction" was a component of the FLM. This was the only item in which 100% of teachers self-reported that they thought this item was embraced by the FLM. Similarly, 24 teachers (92.3%) thought that "connecting curriculum standards and technology to facilitate teaching and learning" was certainly a component of the FLM (see Figures 4.18 and 4.19).

Item Description: Providing students with meaningful resources to differentiate instruction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	26	100.0	100.0	100.0

Figure 4.18: FLM- Component #9

Item Description: Connecting curriculum standards and technology to facilitate teaching and learning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	3.8	4.0	4.0
	Yes	24	92.3	96.0	100.0
	Total	25	96.2	100.0	
Missing	99	1	3.8		
Total		26	100.0		

Figure 4.19: FLM- Component #10

Furthermore, when teachers were given the statement "Flipped learning allows the teacher to evaluate less and interrelate more with students", fifteen of them (57.7%) stated that they did not think this was an element of the FLM. On the other hand, eight teachers (30.8%) reported the opposite, while one teacher (3.8%) wrote both Yes and No as her response and two others (7.7%) did not provide a response for this item, as shown on Figure 4.20.

Item Description: Flipped learning allows the teacher to evaluate less and interrelate more with students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	15	57.7	62.5	62.5
	Yes	8	30.8	33.3	95.8
	Y/N	1	3.8	4.2	100.0
	Total	24	92.3	100.0	
Missing	99	2	7.7		
Total		26	100.0		

Figure 4.20: FLM- Component #11

One of the interesting responses from participants was when they given the statement that declaimed, "replacing lecture with videos". Twenty of the participants (76.9%) stated that they did not think that was a component of the FLM (see Figure 4.21). However, 25 of them (96.2%) stated that they thought flipped learning was a synonym of online videos.

Item Description: Replacing lecture with videos

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	20	76.9	76.9	76.9
	Yes	5	19.2	19.2	96.2
	Y/N	1	3.8	3.8	100.0
	Total	26	100.0	100.0	

Figure 4.21: FLM- Component #12

The last item asked participants to respond about "classroom instruction primarily spent in groups". Seventeen of them (65.4%) stated that they did think this was a component of the FLM, while seven of them (26.9%) said the contrary and two participants (7.7%) did not provide a response for this item (see Figure 4.22).

Item Description: Classroom instruction is primarily spent in group environments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	7	26.9	29.2	29.2
	Yes	17	65.4	70.8	100.0
	Total	24	92.3	100.0	
Missing	99	2	7.7		
Total		26	100.0		

Figure 4.22: FLM- Component #13

Moreover, when participants were asked if they had tried to implement the FLM in their classrooms, prior to the study, sixteen of them (61.5%) stated that they had not, nine of them (34.6%)

that they had but only to some extent and one of them (3.8%) stated that he had implemented the FLM fully prior to the study. Figure 4.23 offers the details for the participants' responses on this item

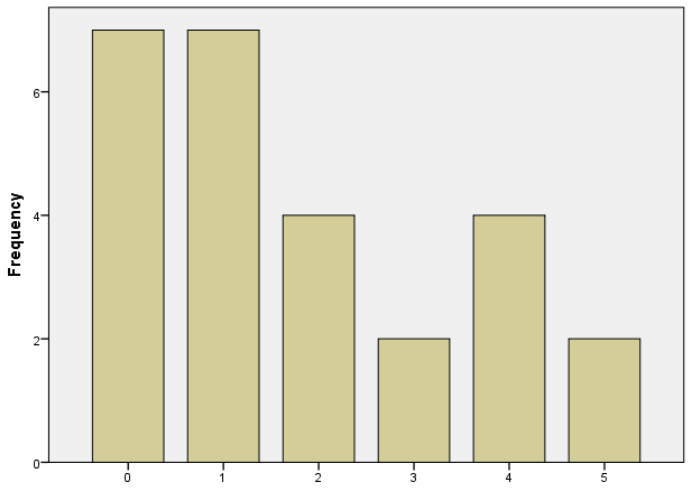
Item Description: Have you tried to implement the FLM in your classroom before?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, I haven't	16	61.5	61.5	61.5
	Yes, to some extent	9	34.6	34.6	96.2
	Yes, fully	1	3.8	3.8	100.0
	Total	26	100.0	100.0	

Figure 4.23: Participants' Implementation of the FLM prior to the Study

Participants were also given a set of sixteen technology tools to circle the ones that they had used in the past to enhance instruction for students in their classroom. They also had the opportunity to make any notes or comment on other technology tools that were perhaps not included in the list of sixteen. The tools included within those sixteen tools were chosen based on the literature, focusing on tools, including learning management systems and tools to develop and/or edit/upload videos. The highest number of tools selected by two of the participants was five, while seven of the participants stated that they had not used any of those technology tools in their classrooms, nor did they note any other tools either. Illustration 4.1 portrays the number of tools stated as being used by participants.

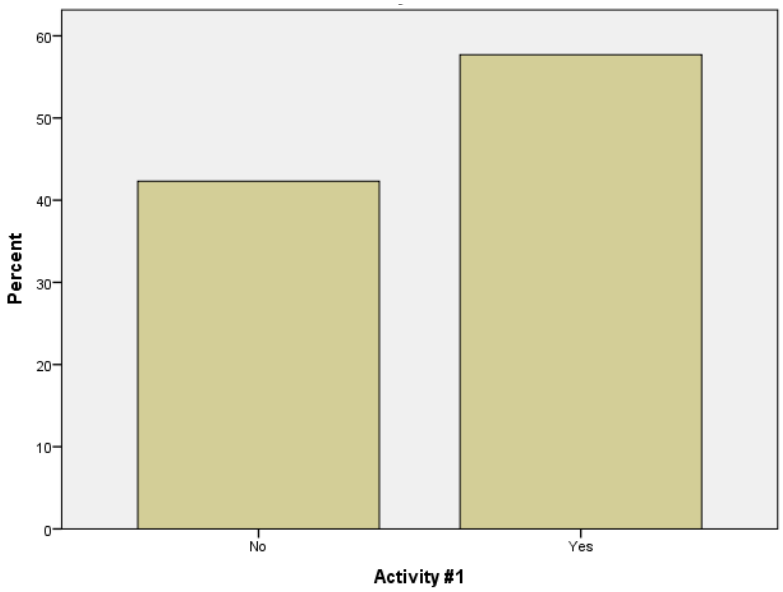
Illustration 4.1: Technology Tools Used Prior to Study



Participants were also asked to examine six classroom activities that were developed from the literature on the FLM, and state whether they had implemented those activities in their classroom, prior to the study. For example, participants were asked if they had created videos of their lessons for students to use outside the classroom, or if they had found videos online in the past to use with students. They were also asked if they had used videos during their classroom instruction and if they had their own website where students could access their mathematics content and/or tools to support them during their learning process.

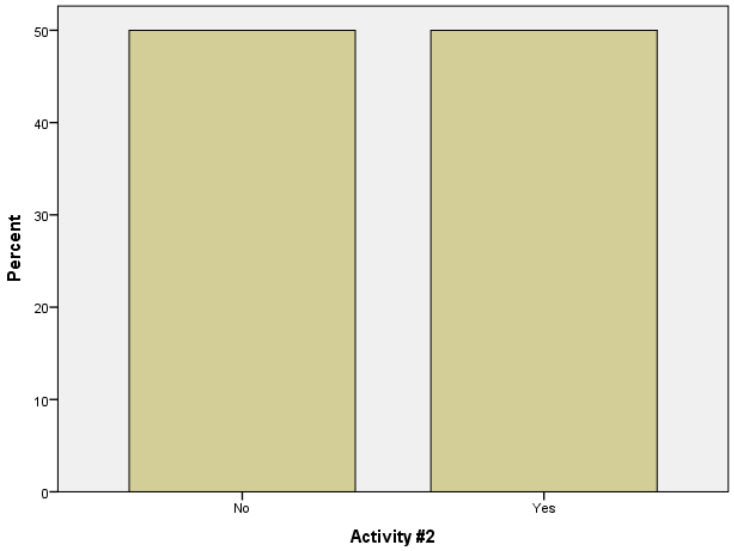
Illustrations 4.2-4.7 provide the responses of teachers, represented as pie charts to better visualize the percentages of teachers who were (or were not) implementing those mentioned activities prior to the study.

Illustration 4.2: Prior Use of Video Lessons Outside the Classroom



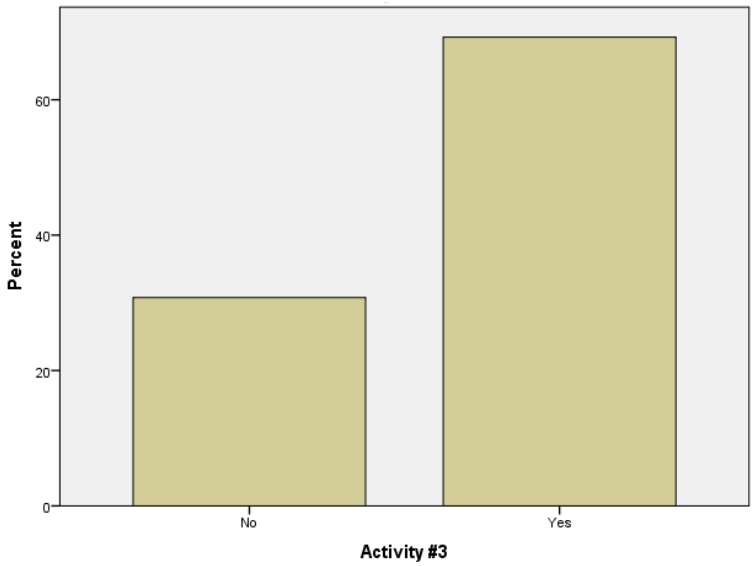
Item Description: I have created videos of my lessons for students to use outside the classroom

Illustration 4.3: Prior Regard for Online Videos



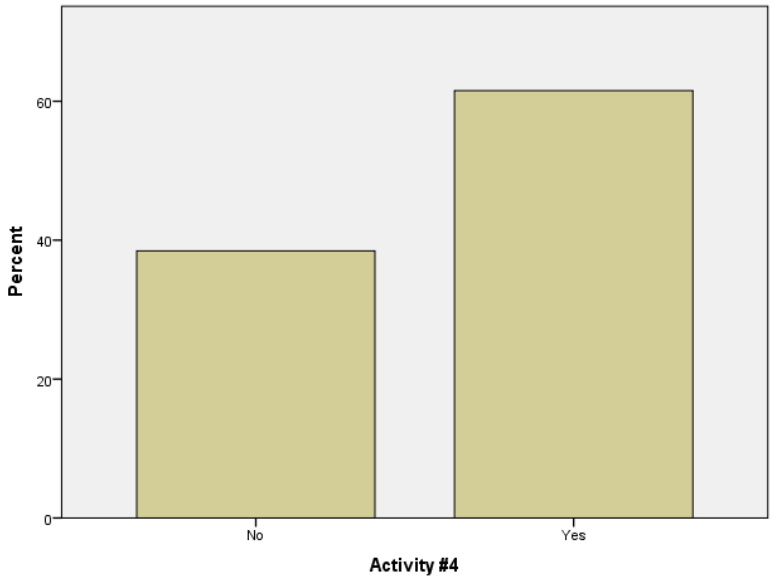
Item Description: I have found videos online to provide students to use outside the classroom

Illustration 4.4: Prior Use of Video Lessons During Classroom Instruction



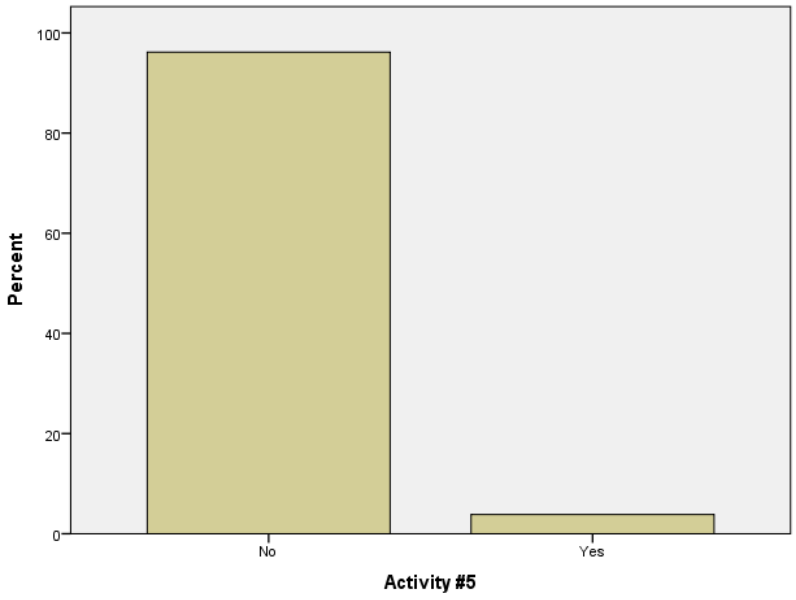
Item Description: I have used videos during classroom instruction

Illustration 4.5: Prior Use of Teacher Website



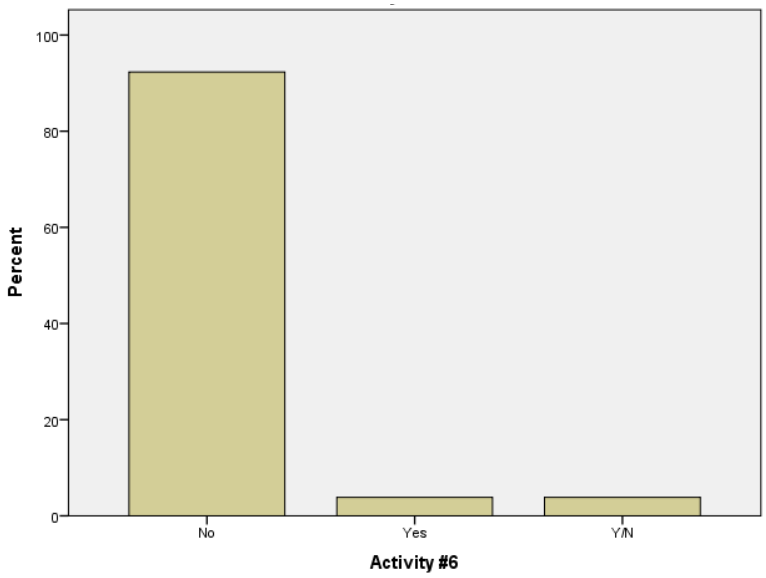
Item Description: I have my own teacher website where students can access content and tools to use for learning

Illustration 4.6: Video Conferencing Across Campuses



Item Description: I have done video conferencing with teachers from other campuses

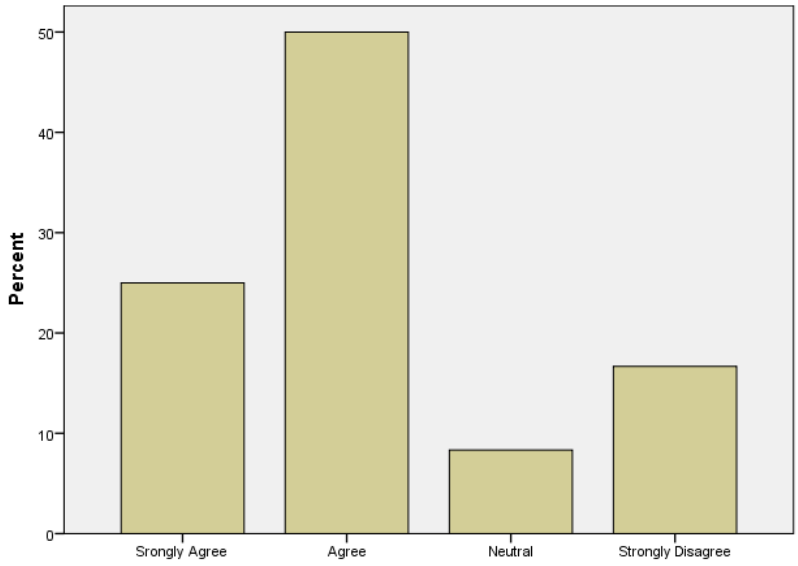
Illustration 4.7: Prior Podcast Presentations to Students Inside/Outside the Classroom



Item Description: I have presented podcasts to students inside or outside the classroom

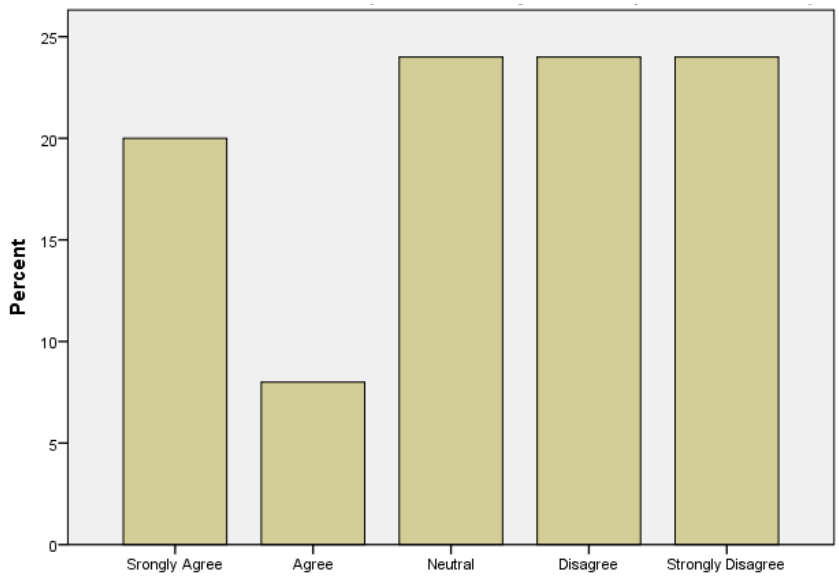
Finally, participants were asked to examine eight different items related to their classroom structures, as related to findings found in the literature of the FLM. The participants' responses are shown on Illustrations 4.8-4.15 below.

Illustration 4.8: Students Lead Discussions in My Classroom



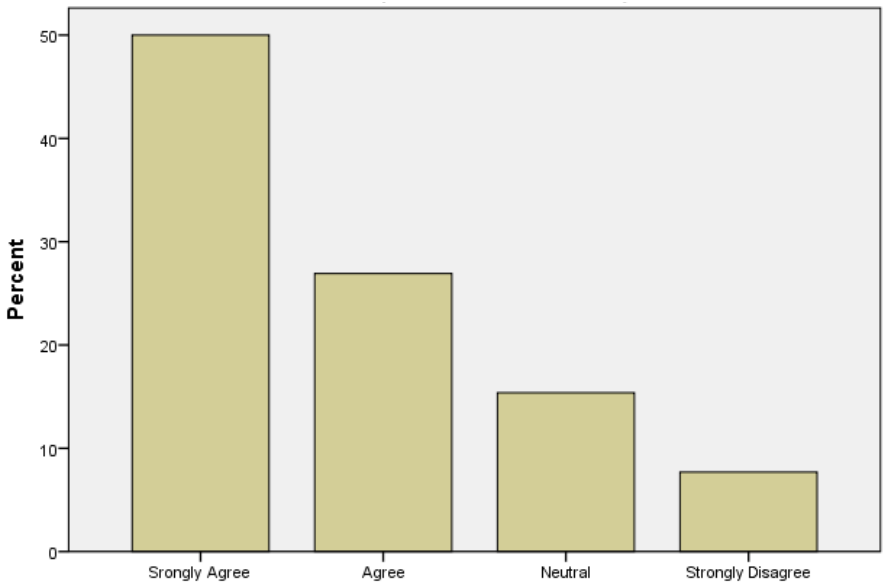
Item Description: I let students lead discussions within groups or for the whole class

Illustration 4.9: Passive Listeners-Students



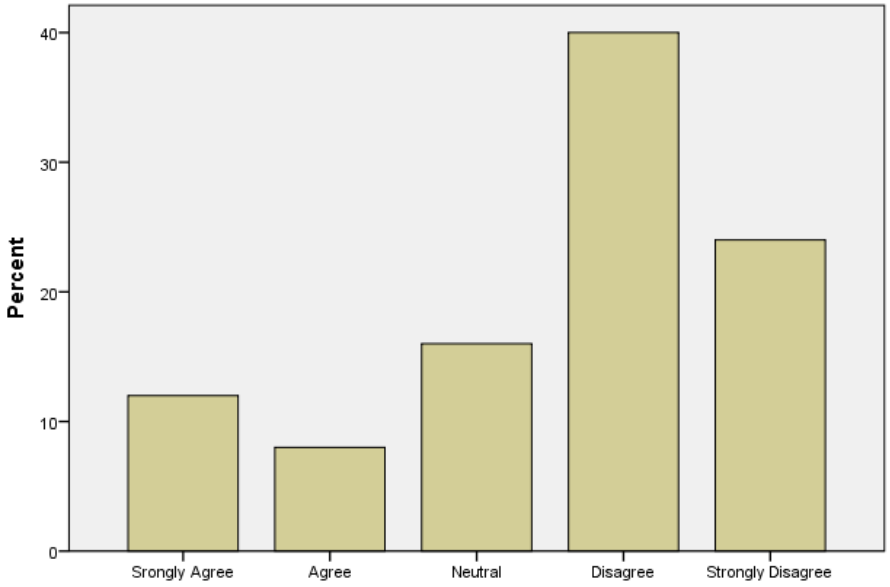
Item Description: Students in my class are passive listeners

Illustration 4.10: Promote Collaboration Among Students



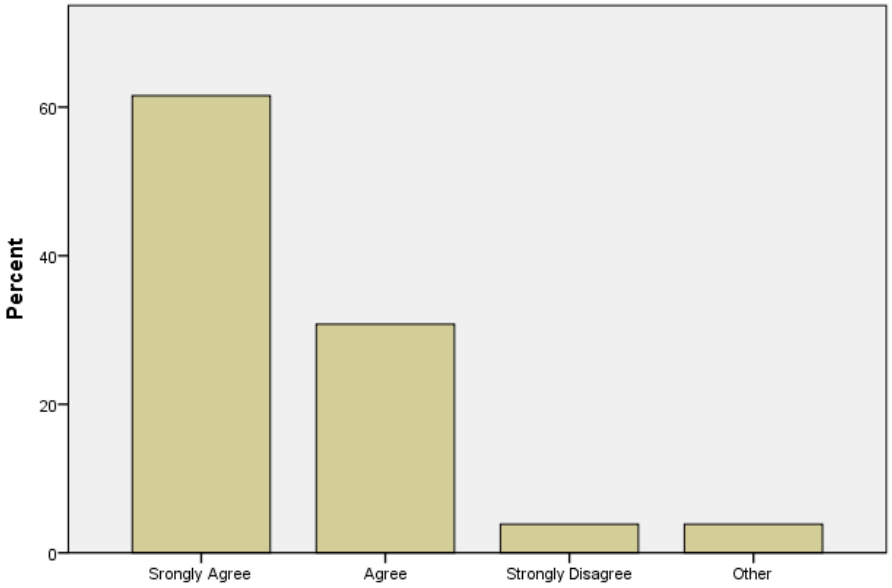
Item Description: I promote collaboration among students more so than independent student work

Illustration 4.11: In-Class Instruction vs. Homework



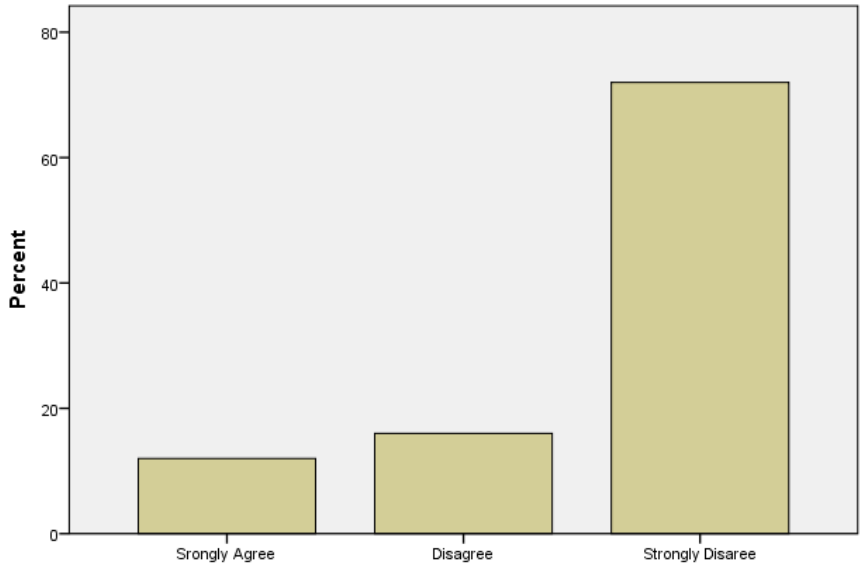
Item Description: I prefer for students to receive instruction in class because I'm afraid they will not do their homework

Illustration 4.12: Students' Ownership of their Learning



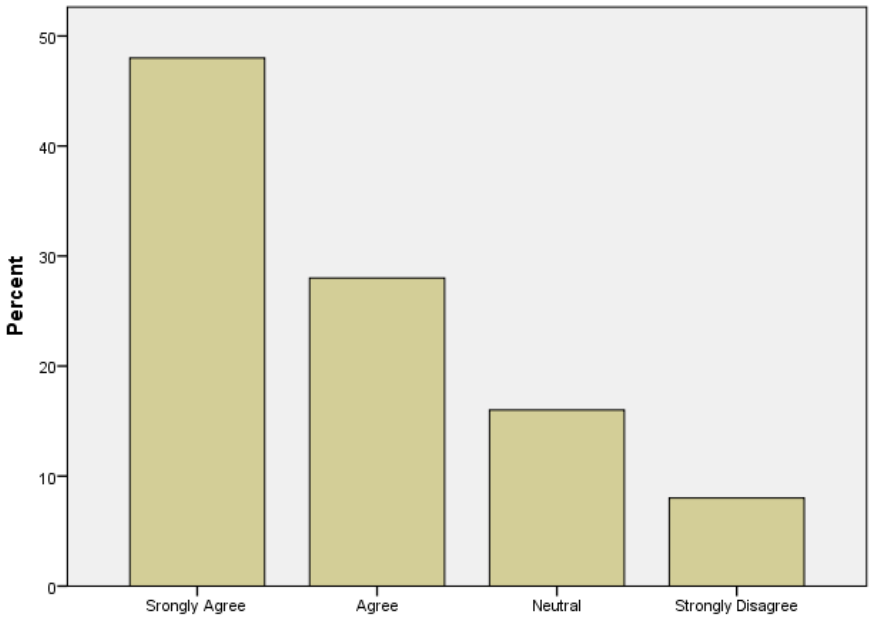
Item Description: I encourage students to take ownership of their learning, yet provide them with proper guidance

Illustration 4.13: Technology Integration- Access



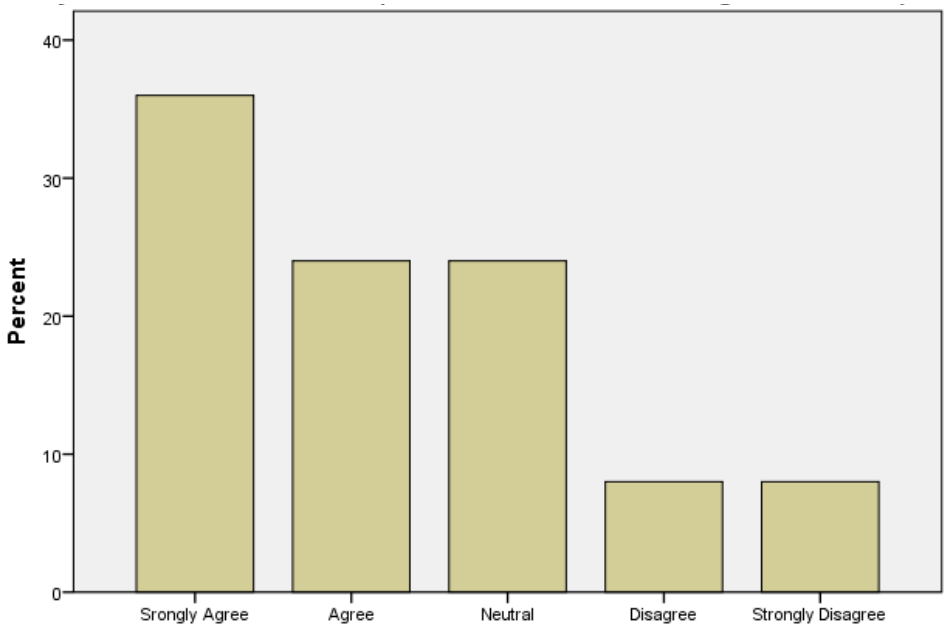
Item Description: I do not like to incorporate technology in my class because students do not have access to it

Illustration 4.14: Active Learners- Students



Item Description: Students in my class are active learners

Illustration 4.15: Student Exploration in the Classroom



Item Description: In my class, students are allowed to go beyond the curriculum and explore their interests according to their needs

4.3.2 Qualitative Strand

Qualitative data was gathered in various ways, including field notes from the learning networks, interviews (both from the focus groups and individual interviews), and classroom observations from the six key informants. Moreover, documents (task-sheets) used by teachers primarily for reflection during the network meetings were also collected. Further discussion of the data collected is presented below.

Field Notes from the Learning Networks

The researcher took Field notes at various stages of the research. One of those stages was during the meetings that were held during the 2013-2014 school year at District Bravo, to bring the learning network of teachers together. There were a total of five meetings held at various locations within the district. Two of those meetings were held during the fall 2013 semester and the other three meetings were held during the spring 2014 semester. The meetings from the fall semester were held on October 2013 and December 2013. The October meeting was the first one that was held with the participants. The December meeting was held as an end-of-semester meeting for participants to reflect on their

journey and share with their colleagues their Flipped Learning experience since the beginning of the school year. The three meetings that were held during the spring semester occurred at the beginning, in the middle, and at the end of the semester. The first one was held on January 30, 2014; the second one was held on March 04, 2014; the third one was held on May 09, 2014.

Field Notes from Interviews

Interviews were conducted with two focus groups of six total participants at the end of the school year (May 2014) and individual interviews were conducted with them after they began a second school year in the fall of 2014. The focus interviews lasted approximately thirty minutes with each of the two focus groups, while individual interviews lasted approximately ten minutes each. The focus groups interviews were held at two locations; two high school campuses from District Bravo. The lead researcher conducted these focus groups interviews. Moreover, the individual interviews were conducted at each of the six participants' high school campuses. The lead researcher, as an effort to avoid any bias from the participants in responding to the researcher, who conducted the initial focus group interviews, did not conduct these individual interviews. Instead, the researcher asked a mathematics specialist to conduct the interviews. An audio-recorder was used to record the participants' responses during the interviews. The person conducting the interviews also took notes. Appendix B illustrates the form that was used to take notes during the interviews.

Field Notes from Classroom Observations

The researcher conducted classroom observations of the six key informants. These observations were conducted approximately after one semester of teachers implementing Flipped Learning and were expected to provide additional information to further develop the story of participants' experiences with Flipped Learning. The observations were conducted dependent upon the participant's schedule of courses at his or her campus. The informants provided the researcher with a given date and time to go observe one of their classes. The researcher made sure to keep the administrators from the campuses informed regarding her classroom observations. Field notes were taken during the observations using a specific form (see Appendix C). The researcher gathered any information that could help in understanding the informant's conceptualization and implementation of Flipped Learning in her or his

classroom. Moreover, District Bravo decided to videotape the six teachers during their flipped lessons. These videos were later used during two of the meetings with the connective network to share their stories with the other participants. The field notes were also shared with them. During these two meetings, participants were asked to use the videos and notes to provide feedback to the key informants. The participants used a form with a list of components to examine their colleagues' flipped classroom. All key informants shared their videos of the lessons they presented to their students as well as the videos that they gave to their students to flip their lessons. Three of the key informants shared their stories on January 2014 and the other three informants shared their stories on March 2014. They all received feedback related to their "flipping" from the rest of the participants. The discussions included questions from the participants to the key informants, such as *"Why are you choosing to flip that class?"* or *"What platform are you using to upload the videos and share them with students"*. They also provided the informants with suggestions, ideas, and concerns about their flipped classrooms.

Teacher Reflections: Task-Sheets

Participants completed various task-sheets throughout the study. On October 8, 2014, they filled out a reflective document that presented them with questions about their experiences with the Flipped Learning Model, if any, up to that point. For instance, teachers responded to the following inquiry: *"Think about the struggles and successes that you are having in your Flipped Mathematics Classroom. Use the space provided below to write down your thoughts."* Participants were told to write about their assumptions as well, in the case that they were not "Flipping" their classroom. Additionally, during this network meetings, teachers collaborated with each other in understanding Flipped Learning, as it related to the content of mathematics and created a network of support through their participation as a community of learners. For example, teachers were asked to work together with their "subject area teams" (e.g., Algebra I, Geometry) to answer the following questions: *"How can you support each other to better implement Flipped Mathematics Learning in your classroom?"* and *"Think about our conversations about Flipped Mathematics Learning. With your subject area team, develop goals and/or objectives for the rest of the semester."*

Moreover, on December 5, 2014, participants were asked to complete a task sheet intended for them to reflect on their experiences thus far of Flipped Learning. For example, participants were asked to answer, in written form, questions like: *"What has improved from the beginning of your exploration of the Flipped Learning Model, to now?" "What has stayed the same in your exploration of the model that you wish could have changed?" "What has not gone as well as you had hoped in your journey of understanding and implementing the Flipped Learning Model?"* and *"What else would you like to share with us that can help us support you in the future?"*

On January 30, 2014, participants were asked to complete a task sheet intended to help them reflect about their personal understanding of "Flipping" their classroom. They were asked two main questions: "How do you know that your classroom has flipped?" and "To what extent have you flipped your classroom?" After analyzing data for this particular meeting, the researcher found that this became an important meeting for participants, since they were able to examine three of their colleagues' video lessons and had the opportunity to look at examples of how a "flipped classroom" could look like. During this meeting, participants also used a list of components of a flipped classroom to examine the video lessons and provide feedback to their colleagues. Further discussion of this is presented on the findings section of this chapter.

The fourth meeting that was held on March 9, 2014 asked participants to continue examining video lessons of three more of their colleagues' video lessons. During this day, participants were asked to reflect on their ideas on how to support instruction in their flipped classrooms. They used a task sheet that inquired about this through "thinking log-stems". Participants were given the option to choose from the following stems to write about their reflections: *"I didn't expect…." "I need to re-think…." "I think next week I would like to try…." "I would like to understand better if…."* They were then asked to share their written reflections with the network.

During the last meeting, on May 9, 2014 participants were asked to reflect on their overall experiences with Flipped Learning, based on how they understood it and how they implemented it in their classroom. They were asked to complete a task-sheet in which they worked together to narrate their thinking using chart tablets. This was a very significant meeting for participants as they came

together to celebrate their accomplishments as a learning network of high school mathematics teachers exploring Flipped Learning in their classrooms. They also reflected on the challenges that the FLM brought to them throughout the school year and the possibilities that such exploration created based on their experiences. Illustration 4.1 summarizes the chronological order of the events that occurred throughout the study.

Illustration 4.16: Chronological Events of the Learning Networks

Time Frame	Face-to-Face Activities	Online Activities
August 2013	• Recruitment Efforts • Training on Overview of the FLM	Continuous interactions and discussions through online resources: • Via Schoology • Teachers' Websites • Discussions through e-mails
October 2013	• Initial Meeting & Pre-Questionnaire • Training on the FLM and on Technology Tools	
December 2013	• Exploration of Classroom Activities • Training on Technology Tools	
January 2014	• Samples of Flipped Classrooms- Part I • Training on Technology Tools and Tips for FLM	
March 2014	• Samples of Flipped Classrooms- Part II	
May 2014	• Post-Questionnaire • Final Group Reflections	
June 2014	• Focus Groups Interviews	
November 2014	• Individual Interviews	

4.4 Data Analysis

Data analysis took a multifaceted approach. The researcher emphasized data analysis on the qualitative strand, using supporting evidence from the quantitative data. For the quantitative strand, the researcher first identified the variables to be analyzed and defined them. Descriptive statistics was completed to find general trends, including means, standard deviations, frequencies, and variances in the

participants' responses, when appropriate. Based on the participants' responses, the researcher examined distribution of values.

For the qualitative data, a thematic analysis was conducted by the researcher to help in understanding the different types of knowledge that teachers created as they navigated through their learning networks. Different themes, within each type of knowledge, were developed for specificity and to better narrate the story of the participants. Data was inputted into NVivo to be organized. Folders were created to separate field notes, task sheets, and interviews. Once the data was organized it was coded and converted into themes, and subsequently grouped into the different types of knowledge found based on common patterns that were being observed across the data. Careful analysis of the data yielded 13 themes that were then categorized into three main types of Connective Knowledge. These themes reflected the participants' interactions and actions during their process of working with their Learning Network to explore the Flipped Learning Model.

Initial coding created a grounded description of the data to fit together in specific themes. For example, some of the codes included teachers knowing there would be no computer access outside of school for some student, knowing that there was a lack of computers in classrooms, and knowing that there was a shortage of software programs needed. Thus, these three codes 1) No computer access outside of school, 2) Lack of computers in the classroom, and 3) Shortage of software programs needed were clustered together to form one theme: "Knowing the types of technology tools lacking inside and outside the classroom".

Focused coding was essential in the coding process when analyzing data. The theme of "Knowing the types of technology tools lacking inside and outside the classroom" became part of a type of Knowledge, which was then labeled "Knowledge to Understand Challenges Presented when Flipping a Classroom". This type of knowledge accounted for other similar themes, such as "Knowing the Time it takes to Create Videos and Plan Lessons". Further details will be provided on the findings sections of this chapter. The findings section will also incorporate data triangulation results, which were conducted as a way to integrate the quantitative and qualitative results.

It is important to note that the four stages by Pettenati and Cigognini (ADD) of acquiring and distributing connective knowledge were taken into account when examining the emergent themes, as shown below. These four stages were carefully examined throughout the process and specifically during the activities offered to teachers through their learning networks.

- Stage One: Awareness and Receptivity. During this first stage, the teachers were exposed to resources and tools about the FLM, including:
    - Book- "Flip your Classroom: Reach Every Student in Every Class Every Day" (Bergmann and Sams, 2012).
    - Three half-day sessions of staff development.
    - Five articles on FLM.
    - Six samples of flipped classrooms.
    - Six samples of video lessons.
    - Networking with other participants.
- Stage Two: Making Connections, Selecting, and Filtering. During this second stage, the teachers began to make connections and selected information based on their individual needs. This included teachers making a decision about which technology tools to use for flipping and creating a specific "personal network" with other teachers.
- Stage Three: Contribution and Involvement. During this stage the teachers allowed other teachers on their network to share with them and vice versa. During this stage, teachers began to create relationships with other teachers and began to exchange resources with each other. They were able to do this because of the opportunities that were offered to them through:
    - Five face-to-face meetings to share experiences.
    - Online interactions via Schoology.
    - Compilation of teacher websites.
    - Discussions (e.g., e-mail, staff development).

- Stage Four: Reflection and Metacognition. During this last stage, teachers were provided with opportunities to reflect about their connective knowledge. For example, teachers were given various "task-sheets" that provided them with guidance on reflecting about their network of people and resources.

4.5 Results- Research Question #1

This section of Chapter four will present the findings of the study, organized based on the research questions. The first research question that was posed by the research was:

What are the emergent themes of the high school mathematics teachers' connective knowledge of the challenges and possibilities of the FLM as they partook in Learning Networks?

After the analysis of data, it was clear that the emergent themes embraced specific clusters of meaning that characterized them. For example, the connective knowledge of the challenges of the FLM was created and distributed as teachers interacted in their learning networks and shared their struggles with flipping the classroom. However, those struggles varied. Examples of those struggles included, lack of technology tools inside and outside the classroom, students' apathy to watch the video lessons, and access to websites and videos.

Similarly, the connective knowledge of the possibilities of the FLM referred to the knowledge that teachers created as they discussed the challenges they were facing, but found alternatives to overcome them and in turn, recognized possibilities that the model offered to them within their learning networks. An example of the connective knowledge of the possibilities that the FLM brought to teachers during their exploration was knowing the benefits of partaking in a learning network to share ideas and distribute knowledge, as well as the possibility of the FLM to change the culture of their classrooms and in turn the school culture overall. For instance, the teachers came to a realization that implementing the FLM in their classrooms implied their awareness in a pedagogical approach that advocates for a student-centered environment. Table 4.1 illustrates the emergent themes within the connective knowledge of the participants of the challenges and possibilities of the FLM. There were a

total of six emergent themes of the challenges of the FLM compared to four emergent themes of the possibilities of the FLM.

Table 4.1: Emergent Themes of High School Mathematics Teachers' Connective Knowledge of the Challenges and Possibilities of the FLM

	Emergent Themes
Connective Knowledge of the Challenges in Implementing the FLM	• Knowing the types of technology tools lacking inside and outside the classroom. • Knowing the barriers to accessing websites and videos. • Knowing the needs of diverse students in a flipped classroom (e.g., English Language Learners, Deaf-Education students). • Knowing the apathy students could depict to watch videos. • Knowing the time it takes to create videos and plan lessons. • Knowing the support needed from administration and parents when flipping a classroom.
Connective Knowledge of the Possibilities in Implementing the FLM	• Knowing the possibility of changing a school culture. • Knowing the benefits of collaboration (e.g., student collaboration, teacher collaboration, partnerships across district; ties between nodes). • Knowing how to identify and use technology tools to integrate in a flipped classroom. • Knowing how to identify and use instructional practices in a flipped classroom.

4.5.1 Connective Knowledge of the Challenges of the FLM

During the interactions of participants in the Learning Network, the community created knowledge about the types of challenges that can be present when a teacher decides to flip his or her classroom. Within that knowledge, several themes emerged, including 1) lack of technology tools inside and outside the classroom, 2) barriers to accessing to websites and videos, 3) needs of diverse student populations, 4) students' apathy to watch videos, 5) time to create videos and plan lessons, and 6) support needed from administrators and parents when flipping a classroom.

Knowing the Lack of Technology Tools Inside and Outside the Classroom

From very early on, teachers' discussions and interactions led them to learn about the various gaps in technology tools that existed both inside and outside their classrooms. The absence of technology tools such as laptops, iPads, in-focus machines, document cameras, or desktop computers

that teachers and students had available inside or outside the classroom to use in the implementation of flipped learning was limited. For instance, some teachers shared their frustration of having old computers at some of the campuses that did not allow students to download some videos even when they were willing to do so and had the time to try to watch them before school, after school, or even during lunchtime. One teacher stated, *"It is very difficult to use Flipped Learning when we don't have the technology we need to do it"*. She continued by saying that *"having an extra computer or a couple of them could help students watch videos"*. Another teacher said *"I need two or three computers of laptops or notebooks for students….I can't expect the students to watch videos if they don't have a computer to watch them on"*. This, along with lack of iPads and other technology tools such as a document camera became challenges in the implementation of the model. One teacher said *"I would also sill need a document camera, iPad stand, and iPad to be able to create videos regularly"*. Another one said, *"The old laptops that we have are so old that they are useless"*.

Moreover, many of the students did not seem to have access to computers and/or Internet at home to watch the videos, which created a great gap in the implementation process. A teacher questioned, for example, *"how do we help the kids that do not have the Internet at home?"* This coincides with research that states that about two-thirds of White and Asian/Pacific Islander children have the ability to access the internet at home, compared to only half of Hispanic and African American kids (Child Trend, 2012). Teachers expressed their frustrations to those challenges through written reflections, conversations with other teachers, and interviews.

Knowing the Barriers in Accessing Websites and Videos

This theme describes the knowledge teachers created about the challenges that they faced, as well as their students when trying to access videos from different resources, such as Khan Academy, YouTube, or TED-Ed even though they might have had access to the Internet. It was discovered that the school district's network filtered many of the websites that teachers and students needed to access, due to safety policies in place. Thus, limiting their access to outside resources needed for the implementation of the model. Moreover, students also struggled to access videos from certain computers, as there are specific access restrictions for students on some school computers. Teachers'

dissatisfaction with the school district blocking certain Internet channels contributed to their struggles in implementing the Flipped Learning Model. These types of challenges limited them to use websites that they thought could have been useful in learning more about the model and in its implementation. For instance, a teacher stated that there are teacher blogs online that could aid her in exploring the struggles that other teachers have gone through or ideas that can help in planning better lessons that address the needs of the model.

Nonetheless, those blogs were out of the reach for teachers at school and could only be accessed at home. Additionally, students struggled to use some of the technology tools that their teachers were incorporating into instruction. For example, a teacher stated that *"Schoology does not allow students to login on certain cell phones. They want to do the work, but can't login. They have to use a computer"*. Another teacher who had a classroom set of laptops available for her to use, stated that students couldn't access the Internet with those laptops. She said, *"In my classroom, I have a COW (Computer on wheels) that doesn't have access to Internet and other problems"*. Thus, even when the technology tools were available, teachers had challenges accessing the websites, videos, and other tools that they wanted to have available to facilitate learning for students. A teacher also stated *"I can't access any of my videos though the District Wi-Fi. So this means that all my students can't access these videos while on campus. Which defeats the purpose of Flipped instruction…this includes streaming websites such as Vimeo and YouTube"*.

This coincides with the information obtained from the pre-questionnaire. When teachers were asked about incorporating technology in their class, eighteen out of twenty-six participants stated that they do not like to incorporate technology in their classrooms because students do not have access to it. However, after the period of the study, twenty-four of the twenty-six participants stated in the post-questionnaire that they either "disagreed" or "strongly disagreed" about they not liking to incorporate technology in their class because students do not have access to it.

Knowing the Needs of Diverse Student Populations in a Flipped Classroom

Teachers encountered challenges that surfaced due to the diverse needs of their student populations. Some classrooms had students with various needs, which included English Language

Learners, special education students, gifted and talented students, advanced students, and students identified as deaf or hard of hearing. For instance, teachers at a campus with a high percentage of limited English proficient students coming from Mexico struggled to find the time to create videos both in English and Spanish to accommodate to the needs of their students. Teachers asked questions like *"how to help LEP students?"* and *"enough differentiation for all?"* Some other teachers, at other campuses, also wanted to know how to provide *"Spanish support"* and how to address *"Bilingual needs"*. One teacher stated *"I feel that I need to make videos for the standard student and the super advanced student"*. Another teacher explained how his students identified as hard-of hearing, or deaf, needed videos with captions embedded in them in order to understand them. As such, he requested the help of the district's technology department to be able to add captions for this group of students.

The technology department guided him to use a You-Tube caption tool with such capability. However, as he provided the videos (with captions) to his students, he realized that they the content had lost some of its meaning as it was embedded in the captions. The interpreter helping the students made the teacher aware of this misalignment of information and he had to stop using videos with this group of students. He continued to search other ways to help this group of special education students, but was unable to find a solution that did not impact the delivery of content in a misconstrued way. Although this particular teacher had a strong background in computer science based on his education, he struggled to find ways that were practical to use with his students.

Knowing the Challenge to Confront Students' Apathy to Watch Videos

This theme describes one of the key issues that teachers encountered when implementing flip learning, which is the unwillingness of students to watch videos at home as part of their class work. This limited teachers' ability to conduct the activities that they had planned to do in class as a follow up to the video. Teachers felt frustrated that they could not implement the model as they would have liked, because a great number of students were not watching the videos and they did not have the technology available at school to make them watch them during class and move on with the students who did watch them. Thus, they spent instructional time encouraging students to watch the videos and explaining to them the new expectations of the classroom. A teacher asked *"how to motivate students to watch the*

videos?" Another teacher inquired *"how can I make my classroom more engaging in order for students to want to watch the videos, thus being able to participate in class"*. Other teachers stated that some students did not want to work in groups or participate in the activities that they planned for them in groups or in a less structured manner, and therefore, students would purposely not watch the videos so that they wouldn't have to participate in those activities. A teacher, for instance, stated that *"students do not want to interact with others, so they do not watch videos; thus having to watch video in class"*. Other participants also wrote about their frustrations with *"engagement with students"* and *"low participation"*.

Knowing the Time it takes to Create Videos and Plan Lessons

This theme describes the challenge that teachers faced as classroom activities had to be adjusted dependent upon how many students watched the videos; thus, creating more complex instructional sessions for teachers. Their lesson plans had to be adjusted and readjusted almost every time they tried to flip a lesson. Additionally, one of the most consistent themes across data was the lack of time for teachers to create their own videos. Therefore, teachers had to be very selective in choosing which lessons to flip as they felt they had only a limited amount of time to create the videos and plan the activities for instructional time in their classrooms. Teachers expressed their exasperation in not being able to find the time to create the videos and in some instances even having to work at home, during the evenings or weekends, in order to be able to accomplish the development of a video or lesson for their flip classroom. Additionally, their in-school and out-of school activities besides teaching also made it challenging for them to have the time to create videos of plan their lessons. Teachers stated that *"finding time to make videos; with family and a lot of meetings at school, time is limited"* and "I spend a lot of time tutoring and attending meetings, so making videos is hard". Other stated that *"finding the time to record the videos"* and *"time to create lessons in advance"* was difficult.

Knowing the Challenge to Obtain Administrative and Parental Support in Flipping

One of the key findings of the study was for participants of the study to know their current status in their implementation of the Flipped Learning Model, but yet, understand the needs that they had for the future as they continued to explore the model. This type of knowledge embraced three different

themes: 1) knowing the support needed from administration at the campuses, 2) knowing the support needed from parents, and 3) knowing the kind of school culture needed to integrate Flipped Learning into their mathematics classrooms.

This theme describes participants knowing the type of support that they needed, in order to have a successful Flipped Classroom. During the progress of the study, some of the participants shared their concerns about administrators at their campus not understanding or supporting the use of the Flipped Learning Model in their classroom. In fact, for some of the participants, they were told by their administrators to not deviate from the State of Texas Assessment of Academic Readiness (STAAR) by using the model. According to some of the participants, their administrators did not think that the model could work with struggling students that needed additional support in understanding mathematical concepts needed to be master in order to be successful in the state assessment.

This theme describes participants' knowing the type of parental support needed for implementing the Flipped Learning Model, with their children. Some teachers stated that parents were worried about their children being able to pace themselves and learn independently as they watched the videos at home. Many parents did not support the use of the model in the mathematics classroom as they argued that such use of the model limited their children's learning and hindered their true understanding of the mathematical concepts that should be taught by a teacher in the classroom, instead of them having to learn them on their own by a video.

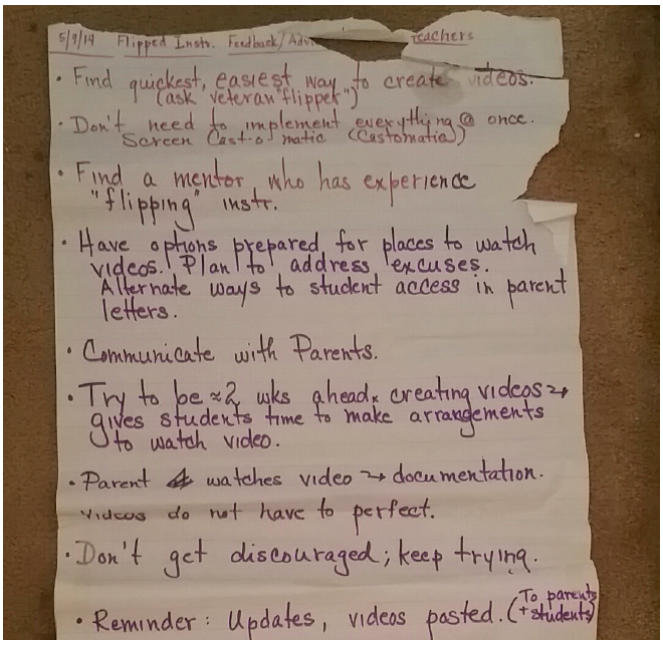
4.5.2 Connective Knowledge of the Possibilities of the FLM

Another type of Connective Knowledge developed by participants was the knowledge to overcome challenges and achieve successes. In other words, as teachers continued to learn about the challenges that were created by their exploration of the Flipped Learning Model, they interacted with each other to find ways to overcome those challenges and thus creating new knowledge within the community to resolve issues they were facing. Several themes were clearly defined within this type of knowledge: 1) knowing the possibility to improve a school culture, 2) knowing the benefits of a connective network, 3) knowing how to use new or existent technology tools to integrate in a flipped classroom, and 4) knowing how to use new or existent instructional practices in a flipped classroom.

Knowing the Possibility to Improve a School Culture

This theme describes the participants knowing the type of school culture that is needed to implement the Flipped Learning Model effectively. For instance, students did not like the idea that if they did not watch the video at home, they needed to watch it in isolation in the classroom while the rest of the students worked on the planned activities intended to promote discussions about the concepts learned from the video; this cause students' apathy towards the model and resistance to participate in class. In turn, students at some campuses complained to parents, which in turn complain to the administrators. This provoked unnecessary tension amongst students, teachers, administrators, and parents. The participants of the learning networks developed a list of things to know regarding flipping a classroom, which may contribute to a more positive school culture for flipping. They worked as a network of varied groups of teachers, from Algebra 1, to Geometry, to Precalculus. They came up with ideas that any teacher thinking about flipping should know and how such ideas needed to be developed in conjunction with the appropriate stakeholders at school in order to understand the model and support it from the diverse perspectives of the community. They worked in groups to write their ideas on a chart tablet and then shared that as a whole group. The illustration below is an example of what one of the groups came up with.

Illustration 4.17: Teachers' Sample Suggestions on Improving a School Culture using the FLM



Once each group shared with the whole group, they developed the following list of things to know about flipping that could help with having a more positive school culture towards the model:

- When possible, find a mentor who has previously used the Flipped Learning Model to support you throughout the process
- Videos provided to students should be short, concise, and engaging.
    - When developing videos, remember that they don't have to be perfect. If you make a mistake, while creating the video, it is fine. Just continue recording rather than starting from scratch.
    - Videos for homework that are boring are the same as worksheets for homework that are boring.
    - Understand the time it takes to create videos and discuss alternatives with administrators to use your teacher prep-time effectively.
    - Students prefer watching a video of their own teacher, rather than watching a video from a website, like Khan Academy. They still want to build relationships.
- Communication with parents is critical.
    - Use videos or other methods of communication to update parents and keep them informed about Flipped Learning and its impact to their children.
    - Invite parents to come to your campus to learn more about the Flipped Learning Model in action to decrease anxiety related to students not being taught.
- Plan to address limitations for students' access to technology by having alternatives.
    - Can the school provide a schedule for computer labs to be open for students to watch videos?
    - Will the students have other ways to access the video without access to Internet, such as thumb drives, CDs?
    - Can the district "unblock" websites that are intended to support the model?

- Stay ahead of schedule. Try to be 2 weeks ahead so that in case there are campus activities or other events that prevent you from creating and uploading the videos, you will still be ready.
- Encourage and support teachers at your campus or your district who choose to flip their classroom, even if you choose not to flip. This will avoid students hearing bad comments from teachers who are not flipping and will promote a culture of support not only among students, but also among teachers.
- Obtain feedback from students, teachers, parents, and campus staff as often as possible to make adjustments to your implementation of the model, when needed.
- Be ready to have alternate assignments for students who do not watch the video and encourage them to participate next time, rather than punishing them for not participating.
- Share resources with other teachers, even if they are not flipping their classroom, so that you can create a toolbox of ideas that can help you both.

Knowing the Benefits of Partaking in a Learning Network

Within the Connective Knowledge of overcoming challenges and achieving success, teachers created knowledge about benefits that came as they worked together in their learning networks. Teachers began to work together to support each other during their process of exploration of the Flipped Learning Model and as a result, created new knowledge about the benefits of doing that. That knowledge led teachers to begin to meet during their conference periods to discuss issues that they were having and brainstorm ideas together as well as communicate with each other, not only at the campus level, but also across campuses. Teachers began to create networks of their own within the larger network, and ask each other for support as well as share campus initiatives that may not have been implemented at their campus. The new networks that were being created then led different forms of interactions, such as teachers exchanging information, e-mailing each other, and attending staff development sessions together. For example, a group of Geometry teachers created accounts in a learning management system (Schoology) to share mathematics content, videos, lessons, and activities. Furthermore, this Geometry team of teachers from seven high school campuses worked together to share

their ideas and instructional practices and came up with an "action plan" to incorporate 1) support, 2) sharing, 3) accountability, 4) exploration, and 5) resources with students enrolled in Geometry courses. This became the network with the highest "strength". Further development of a network's strength will be discussed on Chapter 5.

Moreover, other teachers also visited teachers in other campuses implementing the Flipped Learning Model in order to see the structures that they were using for their classrooms. Teachers' collaboration during their process of exploration of the Flip Learning Model led to their inclination to find alternatives to barriers that were emerging as they used the model in their classrooms. Teachers began to come up with solutions together for the challenges that they were facing. For example, teachers discussed the idea that summarizing the video as part of the homework would help them in knowing which students watched the video and which ones did not. One teacher also recommended to the group using a "code" embedded within the videos to give students "bonus" points for watching the video and finding the code. Another teacher also suggested to have a cap for the number of points offered to students and share that amount of points only with students who had watched the video, thus avoiding the issue of students sharing the "code" with other students who had not watch the video and perhaps encourage more students to actively participate in watching the videos.

Knowing How to Use New or Existent Technology Tools to Integrate in a Flipped Classroom

This theme describes teachers participating in the study creating a connection between mathematics instruction and technology, which allowed them to incorporate different tools as part of the teaching and learning occurring in their classrooms. Thus, mathematics teachers began to collaborate with the technology department to combine the use of technology with their mathematics lessons. The technology staff offered their assistance in the learning of technological tools, such as Edmodo, Schoology, and Educreations; therefore, helping teachers enhance their skills in using technology devices and tools. From creating videos using different methods (e.g., Screencast-O'matic) to learning about Internet teacher websites (e.g., teacher Tube), blogging, and online student resources (e.g., Khan Academy), the technology department became a big part of the learning process of the model for teachers exploring it. A teacher, for instance, stated that he is *"using a website to communicate with*

students" and *"interacting with them through a learning management system (Schoology)"*. Another teacher wrote about *"learning how to do videos using ScreenCastomatic"* and also *"uploading the lessons to Schoology….for the preparation of a clear lesson"*.

Knowing How to Use New or Existent Instructional Practices in a Flipped Classroom

This theme describes the professional growth sought by and provided to teachers in order to learn more about the tools needed to implement the Flip Learning Model as well as the notion behind the representation and understanding of what the model really is. Throughout their exploration, teachers were staff developed on various research-based practices to help them in their planning of the lessons after students watched the videos. For instance, teachers were trained on Formative Assessment Classroom Techniques, which incorporated various instructional practices that assessed student learning at various points throughout the lesson and which embedded the use of tools, such as the Frayer Model and graphic organizers. Teachers stated that the trainings helped them to plan better lessons and engaged their students more during instructional time. A teacher stated *"I spend more time planning to make sure students can learn better"*. Another teacher stated *"I have organized better"*. Other wrote about how their *"student engagement"* had improved as well as their *"classroom management"*. Another participant stated that she is using *"classroom differentiation"* more. One of the participants stated that now her *"students may practice with the help of teachers and peers"* and that *"there is more time to have activities in class that could reinforce previous content"*.

4.6 Results- Research Question #2

The second research question that was posed by the research was:

What can we learn from the experiences of three high school mathematics teachers as they explore Flipped Learning and develop connective knowledge at a personal level through their participation in learning networks?

Teachers participating in this study created learning networks as they explored the FLM. The selected participants initially came together, in October 2013 to form a learning network of high school mathematics teachers with a similar interest, exploring an innovative instructional approach.

Throughout the study, learning networks within this group of teachers were formed by sub-groups of teachers. For example, some teachers developed a learning network based on their interest of exploring flipped learning within a specific mathematics discipline, such as Algebra 1. Another learning network of teachers developed based on their interest to teach students from the same high school campus.

In some instances, teachers became part of several learning networks, within the main (whole group) learning network. For example, one teacher, who later became a key informant for this study, became part of three different learning networks: (1) A learning network of individuals "flipping" an Algebra 2 course, (2) A learning network of teachers "flipping" at the same campus, and (3) A learning network of teachers using the same type of technology (Schoology). In some cases, some of the sub-groups portrayed levels of interaction with each other in ways that other learning networks did not. For instance, a group of Geometry and Algebra II teachers came together from seven different campuses to form a sub-group within the learning network of high school mathematics teachers. They all decided to learn how to use the same Learning Management System (LMS) to utilize as the main technology tool to incorporate into their flipped classrooms. They all created an account, and shared each other's codes to those accounts so that every member of the network had access to them. Their accounts included links to their personal websites, the video lessons that they were creating for their students, and teaching resources for geometry concepts that aligned to their district curriculum. Furthermore, this learning network decided to develop an "action plan" in order for them to monitor their progress through their exploration of the FLM. Their action plan included ways to incorporate support from each other when needed; as such, they exchanged e-mail addresses and phone numbers to stay in contact, besides being able to stay in contact through their Schoology accounts. Moreover, they made each other accountable by sharing lessons and activities related to geometry, periodically and then discuss them as they met. Downes (2012) would argue that once the network was established within the community of teachers, only they had agency. He states that this community of teachers establishes the knowledge that they consider important. This was certainly true of the participants of the study, as they guided the network as time progressed by voicing their needs, demanding a specific focus for the network, and requesting training based on their emerging challenges that they were facing. An interesting fact is that Downes

(2012) states that few members of the community would typically undertake the action to establish the important and relevant knowledge of the community and distribute this to the community as a whole. As seen particularly during the five network meetings that were held throughout the study, this definitely applied to the teachers participating in the study. There were a few teachers who guided the rest of the group and influenced them in various ways to acquire knowledge and move in specific directions. For example, there was a teacher, Robert, who we will discuss more about in the following section, who seemed to be having a more positive experience with the FLM as compared to other members of the network. This teacher became a person who others looked up to when they faced challenges or had questions. As time progressed, the community of teachers trusted his recommendations and valued his opinion about the FLM. He is one of three key-informants that were selected to further explore, in depth, their experiences with flipped learning and how such experiences embraced or discounted the emergent themes that surfaced from the whole group of 26 participants.

After further exploring the key informants' development of connective knowledge, we can conclude then that although they all underwent the same four stages, those stages appeared to be unique for them. During stage one (Awareness and Receptivity), Robert, Lola, and Audrey were all exposed to the same learning network with the same opportunities and resources offered to them. However, once in stage two (Making Connections, Selection, Filtering), the participants portrayed unique personal networks of resources. For example, Robert's personal network of resources consisted mainly of people (other teachers participating in the study) and a limited number of technology tools.

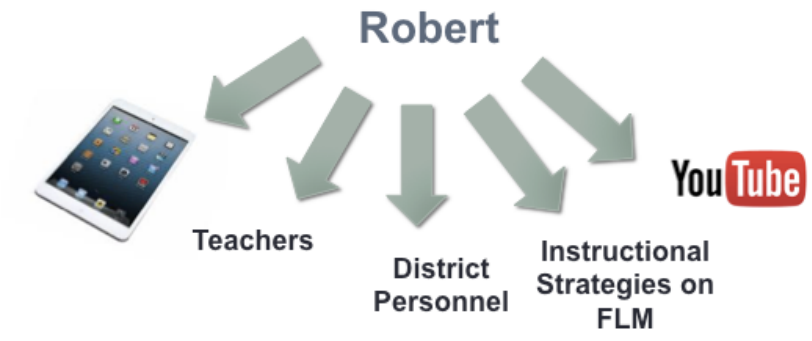


Figure 4.23: Robert's Personal Network of Resources

On the other hand, Lola's personal network of resources consisted mainly of technology tools, such as Camtasia, Schoology, and Educreations. Nonetheless, she also became part of the subgroup of Algebra II teachers who were participating in the study and made a close relationship with Audrey, who was teaching at the same school.

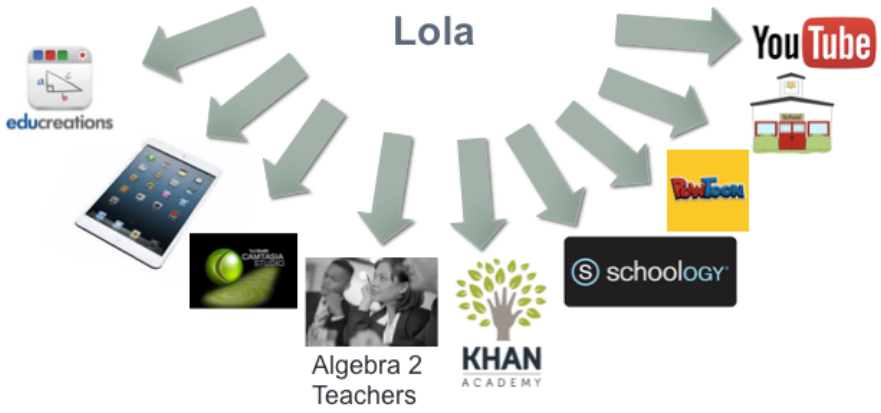


Figure 4.24: Lola's Personal Network of Resources

Finally, Audrey's personal network of resources embraced both people resources and technology tools. For example, she became part of two subgroups of teachers flipping their classrooms, but also used Screencastomatic and Educreations to create her video lessons and upload them into Schoology.

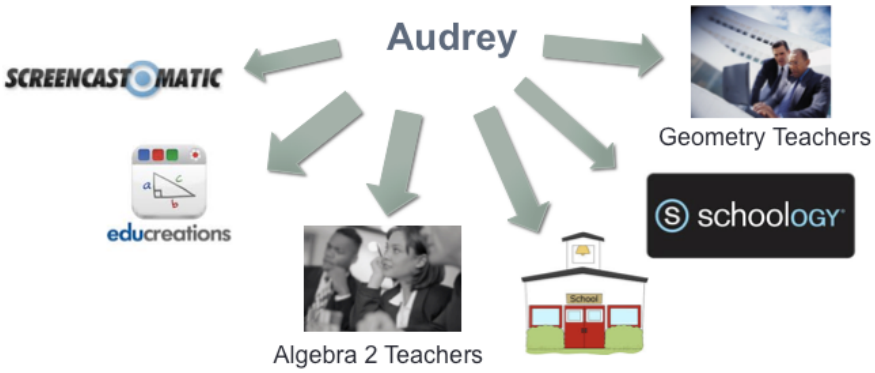


Figure 4.25: Audrey's Personal Network of Resources

During stage three (Contribution and Involvement) Robert, Lola, and Audrey became visible nodes to the learning network and built on relationships with others to acquire and distribute their connective knowledge of the challenges and possibilities in implementing the FLM. Finally, during stage four (Reflection and Metacognition) Robert, Lola, and Audrey "personalized" their knowledge of the challenges and possibilities in implementing the FLM, each focusing on the knowledge that was most important and relevant to them. Below, I will offer a deeper understanding of the three key informants as well as their connective knowledge of the challenges and possibilities in implementing the FLM.

4.6.1 Key Informant #1: Robert

Robert is a high school mathematics teacher with a bachelor's degree in Philosophy. He was one of four participants in the study with a master's degree, also in the Art of Teaching Mathematics. During the period of the study, Robert was starting his 8th year as a high school teacher, of which five were with District Bravo. Robert works at a Title-I school, which opened back in 1962. The campus is well established within its community and has a history of accomplishments in athletics, music, and academic competitions. The school is also the only one within its district that has an International Baccalaureate (IB) program. Robert is one of eighteen mathematics teachers at his school. He was teaching Algebra 2 to 10th and 11th grade students during the period of the study. Fifty-six percent of his students were males and forty-four were females. Twenty-two percent of his students were economically disadvantaged and twelve percent were considered at-risk of not graduating high school. His students were not part of the accountability group of students having to take an End-of-Course (EOC) assessment for the state of Texas. Thus, no standardized data was available for his students. However, by the end of the first semester of the 2013-2014 school year, approximately 76% of his students had passed the district's benchmark assessment in Algebra 2.

Robert was familiar with the term "Flipped Learning" prior to the beginning of this study because he had participated in one training session that was held at District Bravo. Moreover, although Robert had not flipped his classroom by the beginning of the study, he was fully flipping his classroom by the end of the study. Furthermore, Robert self-reported at the beginning of the study that he "strongly disagree" with letting students lead discussions within groups or for the whole class. However, by the end of the study, his self-reported response changed from "strongly disagree" to "agreed". Interestingly, however, throughout the study, he "strongly agreed" that students in his class were active learners.

Robert did not participate in the informational session offered in August 2013 to find out more about the study and the intent to bring teachers together to form a learning network as they explored Flipped Learning. However, he did join the team, once the study began, in October 2013. Robert participated in all five sessions that were offered throughout the period of the study during the fall semester of 2013 and spring semester of 2014. He also participated in the focus group interview and individual interviews. A classroom observation was also conducted with one of Robert's Algebra 2 classes in January 2014.

Robert, as the other participants, went through a cyclical process of acquiring and distributing connective knowledge of the challenges and possibilities of the FLM. During this process, he went through the four stages of acquiring and distributing personal knowledge. He was first exposed to various pieces of information about the FLM as to raise awareness and receptivity of the model. He then made connections and selected information by filtering what was important to him. He then made contributions to the network by interacting with others and involving himself in conversations and situations that aid in the distribution of knowledge. Finally, he reflected about and readjusted his knowledge. The data gathered from Robert's interactions with others, interviews, written reflections, and classroom observations, pointed to Robert portraying mostly knowledge of two of the six challenges that the group of 26 teachers depicted during the study. Those two challenges were students' apathy to watch the videos, and time to create videos and plan lessons. Moreover, data analysis also showed that Robert portrayed personal connective knowledge of all the four possibilities of the FLM that the group

of 26 teachers also depicted. Additionally, Robert's emphasis on improving his instructional practices and changing his classroom culture were evident throughout the findings.

Robert's Personal Knowledge of the Challenges of the FLM

It became apparent very early on during the study, in the fall of 2013, that Robert became a "trusted node" within the learning network. Members of the network sought help from Robert and often asked him to assist them with challenges that they were encountering in their flipped classrooms. For example, one of the teachers expressed her frustrations about students not watching the videos that she was assigning them to watch at home. She expressed that:

> *"The kids complain so much! They don't like the video, it's boring, and it wouldn't load…. However, I do put like a survey question at the end and students can give me feedback…... But also, the time it takes to prepare, having 3 preps it's hard to have enough time in the day to make the videos for each class…"*

She asked Robert:

> *"How do you hold your kids accountable for watching the videos?"*

Robert's response to that question was:

> *"I encourage students to comment on the videos, I facilitate student interactions with the video (feedback) and I pay very close attention to the pacing of the lessons….. sometimes, its just too much for the students to watch a video of math concepts at home that they truly do not understand….so we have to be very clear on how we present the content on the video in very engaging but also clear ways…. more so than we would in class. So, finding the time to that is challenging, but important."*

Robert expressed to the whole group that he really did not pay attention to how "perfect" his videos were. Instead he stated that he wanted to make sure the videos were "real" and that his students were able to pause the videos and understand what he was trying to explain to them, without him being there. He stated that he made mistakes as he was video taping himself and that he did not go back to re-start the taping of the video lesson. Instead, he let the students see any mistakes he would make on the

video, just like he would in class. He stated that time to create the videos and focus on the lessons that he was going to teach was one of his main challenges. He stated:

> *"I'm not gonna worry about my videos being perfect… I want the kids to see the real me in the video….I don't want to spend hours trying to make a video that looks and sounds perfect, instead of worrying about what I need to do next class after students watch the video or what to do with students who do not watch it…..as long as the content is clear, I'm happy"*

Another teacher, Lola, who we will talk about later during the chapter, also expressed the challenges that she was having as students were not watching the videos:

> *"I have let students use their phones in class to watch the videos, but they end up texting or watching other things. I would like to have two or three laptops so students can watch the videos there….. grades in my class have not improved as students are not watching the videos at home"*

Robert then added:

> *"I think what has helped me is to make sure students know my expectations and they understand that if they don't watch the videos is as if they didn't come to class…. I mean, if we are flipping the class, then homework is in class and the class lecture is at home…. so, I told them, if you don't watch the video, then you were absent for my class…that's when they started to understand the idea behind Flipped Learning"*

Besides the fact that Robert was an individual that others sought help from, he was very vocal about requesting help when he needed it, and very open to sharing any of his struggles in his flipped classroom and any of the ideas he had in implementing the FLM. Just as the other participants, he also faced challenges. He stated that:

> *"You know, the major challenges is always getting the kids to watch the videos. So, an example is I just, I was just gone on Thursday and Friday and I had the kids watch a video on Thursday night and do an assignment on Friday, and then watch a video on Friday night, which it's great because I was gone on Thursday and so, they were able to still learn the*

> *material and do some practice in class and then, discuss with each other if there were having difficulty on the problems; they weren't getting the instructor feedback, but they were still getting feedback from other students in the class and they had the answer key so they could check if what they were doing was getting them the right answer. So, you don't have that in a standard classroom. However, the flipped side of that is that no one watched the video on Friday night. So, because I was gone, no one watched the video, and then I come to class today (Monday), expecting to be able to….it was a difficult concept….go into more complex examples and show them the more complex stuff and then give some practice stuff and work with them and kind of, you let them fumble through it a little bit, but push them on their learning and I wasn't able to do that just because no one had watched the video. So, because no one had watched the video, everyone was at square one and I had to try to get across the material in a shorter period of time and more material quite frankly in a shorter period of time and the kids just didn't get enough time to practice and that I mean that was kind of an unusual situation"*

Robert expressed his thinking about how the situation about students not watching a video lesson for homework was similar to students simply not doing anything else for homework, but he also highlighted on how critical the idea of homework was in the FLM as most of the initial exposure to mathematical concepts was done through those video lessons. He stated that:

> *"….the difficulty is always getting all the kids to do their homework and this is the same thing true about the standard classroom. It's not a big surprise, but getting everyone to watch the video so that they are prepared when they get to class is …is a constant struggle. They start thinking like their homework isn't a priority because its just watching a video and somebody can explain it to them in zero seconds and math it's not like that, I mean, you can't explain it in zero seconds, if you could, the whole year would be five minutes long, so, that's the major struggle, it's always trying to get them to actually do the assigned videos….and that is a big difference than the standard classroom because we can't move on without them watching the videos"*

Robert's Personal Knowledge of the Possibilities of the FLM

Just as Robert portrayed personal knowledge of the challenges of the FLM, he also portrayed personal knowledge of the possibilities of the FLM from the very beginning of the study, including the possibility of collaborating with others and networking to improve instruction. When he was asked about the role of Learning Networks in his exploration of the FLM, he responded:

"What's great when working with other teachers in exploring the FLM is they can…get an idea of….well, you both get an idea of what works and what doesn't work for you and how it works for you and what it looks like and what you've done to fix the errors and you can….mmm…when you talk about it with somebody else, you're able to try to prevent those errors and try to prevent those problems from happening….so, talking with other people helps me to….if nothing else just figure out what errors I am making; what difficulties and problems that I'm having, and how to overcome them and a lot of times, we know that kind of stuff but we don't really realize until we are talking with somebody else"

During the first meeting with the members of the network, in October 2013, Robert expressed to the whole group his need to see how a flipped classroom "looks like". He continuously asked questions on "seeing" how instruction differs in a flipped classroom from the instruction he was currently using with his students. Robert took any opportunity that he could to share his experience with others, but also, to ask other teachers questions that he was having so that he could understand the notions of flipping, once they were put in practice. Robert stated:

"when we get together and talk about what distinguishes…mmm…a flipped classroom from a different kind of classroom and what…what parts are needed to really make it a flipped classroom…and…when we did that, it really helped me to understand the concept behind the flipped classroom and what is going on in a flipped classroom. It also really helps to distinguish….like….what….what things are we doing in and what kind of things are we not necessarily doing and …..mmmm…..and the district we also ….mmm…..really were able to talk about like what works and what hasn't worked in what might be more beneficial to try out and what might not….it simply helps you see if you are truly flipping your classroom based on feedback that you get from other teachers"

On this statement above, Robert is referring to the possibility and benefits of teachers getting together to understand what "makes" a flipped classroom. He particularly expressed the benefits of watching other teachers teach in a flipped classroom, in order to better understand the practical side of flipping. This was possible, as he was able to examine video lessons and classroom observations of five of his colleagues. He, in fact, was one of the six participants that were video taped to share their flipped

classrooms in action. He continuously voiced to his colleagues the idea that flipping a classroom is much more complex than simply recording video lessons and providing them to students.

When Robert was asked, "how has the transition to the flipped learning model impacted the way in which you approach teaching and learning in your mathematics classroom?" he stated:

> *"Well, you know the idea behind this whole situation is that we are able to give more hands-on learning with the students, more project-based learning, more discovery learning, more practice in the classroom with somebody there that can help them and so, for me, when I'm doing the flipped model classroom, I'm able to really give a lot, a lot of one-on-one experience or group experience or just act …..actually able to…mmmm….tell the kids, you know, hey you are making these mistakes, this is the way you need to do, as opposed to just the standard classroom would be, I give them an assignment, I see that 70% are doing wrong and I reteach that….and it's, it's alot different in today's society where kids are all over the place and yeah, maybe 70% of them are having difficulty with this one topic, but if you're only covering that one topic and you are re-teaching, then you are leaving out those other kids that were missing something else and we want to give as many kids as possible, the understanding so when you do the flipped learning model, you are able to kind of focus on each kid and what each kid is having difficulties with. So…..ah…..it's kind of changed what I do in the classroom, because I'm able to see if these kids are having difficulties with these thigs, but these kids are having difficulties with these other things, and these other kids are having difficulties with other things and I can address that because I have the time to address it in the classroom".*

Robert throughout the study emphasized on the instructional aspect of the FLM, rather than the technology focus that many of his colleagues had. He stated that he wanted to understand how this model could help him make instruction better for his students. He also tried to find ways to incorporate different ways to encourage the students to watch videos, in a way that would make sense to them, and not simply because "he told them to". He expressed his aspiration to involve the students in the transition to the FLM with him, rather than him transitioning on its own and then imposing that on his students. He stated that:

> *"The students are not used to learning by watching a video. So, I need to help them understand that…. and why it is better than me teaching them in class….. like the benefits…..I think they are used to technology more so than we (teachers) are, but they may not know how to use it (videos) to*

learn math concepts that they would learn from a face-to-face class with me. I mean, it is still me teaching them, but the delivery is now different….and I think they may not understand the benefits until you actually help them with that"

Although during the stage one of the connective knowledge process, Robert was exposed to various technology tools and diverse resources to understand the FLM more in depth, Robert chose to focus on only one technology tool. When participants were asked the technology tools that they were using in their classrooms, such as Schoology, Educreations, or Khan Academy, Robert was amongst the 3% of teachers who stated that they were not using any of the 13 options that were given to them, or any other. During the period of the study, while many of the participants chose to explore many different options for technology tools that could be used in flipping the classroom, Robert instead tried to focus on using what could be considered to be more simplistic technology tools. When asked about the kind of technology tools that he was using for the implementation of the flipped learning model in his classroom, he stated:

"I use an iPad to record my videos and we have an iPad stand that you know helps hold the iPad in place so it's a lot easier to record now. I upload them to YouTube. I just have the kids use YouTube to watch them. I also use the iPads in class. I'll do some group work and stuff and I do through the air server. I have a few different iPads in the class and the kids are sitting in groups and putting their answers or showing their work on the iPads and its displaying on the screen through the air server, so that I can see what they are doing, but also all the other kids can see what they are doing, so they can kind of get an idea, sometimes it just takes a little push in the right direction to see what you are supposed to do, and if someone else is doing it, you can see it, then you get started"

Robert also stated that he tried to use tools that can simply help him with instruction and not just act as a "cool" thing to use in class. For example, he stated that using the iPads helped him to provide immediate feedback to students, but also for students to provide each other feedback and ask questions in class after they have watched the video. He said that this helps him to really help all students more

in-depth, and helps students who may be ahead continue to move forward with their learning. Robert stated that:

> *"Its nice to be able to have multiple displays up there (pointing at the smart board in front of the room) and multiple people doing the same assignments. So, primarily, I use the iPad and I use the iPad with airserver and make videos and upload the videos"*

Robert tried to use technology tools that were simple enough to use, but engaging at the same time to motivate his students. He decided that rather than using other more "fancy" tools, he would use something that he was familiar with and that would help him focus instead on his instruction in the class. He also tried to make strong connections with other teachers to help him develop new ideas. Robert was one of three teachers at his campus who were exploring the use of the Flipped Learning Model. When asked the type of support that he was receiving at his campus, he stated:

> *"On the campus level, we….we did have one training on the campus level but we haven't done alot…mmm…as far as working with the flipped classroom and what it is and what it looks like and how to do it and stuff like that. So, mmmm…we did have one …we did have one training, but it was kind of like a learning curve for the majority…a fast learning curve….and I had already figured it out…what we were talking about; from times that we did trainings at the district level. So, it really wasn't as beneficial. What I think worked for me was the networking with other teachers in the district to see what they were doing and what they were not doing"*

Robert continued by expressing his appreciation for the type of support that he was receiving from the district. He stated that:

> *"…..the district has been very supportive in getting us what we need in the classroom (referring to iPads) in order to be effective and my principal has been great as well"*

Robert also stated that it was important to understand other teachers' perspectives as well as students' perspectives of the FLM. He stated that even though teachers in District Bravo were given

articles to read about the perspectives of teachers and students in other studies related to Flipped Learning, that it was important for them to see how the perspectives of "our" students and teachers in the community differed. In one of his written reflections, he wrote:

> *"We need teachers that have done this to discuss what they are doing and how to overcome problems. Teacher's perspective of the journey. Students' perspective of the journey. Once a month to update everything….. Things that matter in our district and support from on-campus administration (not that they don't, but having them come in and see what we are doing)."*

4.6.2 Key Informant #2: Lola

Lola, just like Robert, also taught Algebra 2 to 10th and 11th graders during the period of the study. Lola was on her 6th year of teaching mathematics and taught at a campus close to Robert's school. She was one of 23 mathematics teachers at her school. Lola's school was the largest one in the district and the only one considered non Title-I. Her campus was relatively new with its first senior class in the 1996-1997 school year. The campus opened its doors in the fall of 1993 and is now housing about 3,500 ninth through twelve grade students. Most of Lola's students were identified as at-risk (68%) and 45% of them as economically disadvantaged. Fifty-four percent of them were male, and 46% were female. Just like Robert's students, Lola's students were not required to take the standardized Texas state assessment in mathematics. However, 23% of her students met the passing standard for the district's benchmark that was administered at the end of the fall semester of 2013. Lola described her students as "struggling" students with many of them lacking foundational knowledge in mathematics concepts needed to be successful in her Algebra 2 course.

Lola has a bachelor's of science degree in mathematics and a master's degree in Educational Technology. This master's degree certainly served her well during the initial exploration of the Flipped Learning Model, as she was already familiar with many of the technology tools that can be used to flip a classroom. Lola described herself as a person who likes to *"spend time researching topics and ideas to implement in an active, student-centered classroom"* and she stated that she likes to use "foldables" to help students. She shared her enjoyment in the idea to flip lessons and have the opportunity to keep students engaged using this instructional approach. Lola also self-reported, similarly as Robert, on the

questionnaire, that she considered her students to be active learners in her class. At the beginning of the study Lola stated to feel "neutral" about letting students collaborate in the classroom. However, by the end of the study her response changed to "strongly agree". Lola participated in all of the sessions held by District Bravo to bring teachers together. She also participated in the initial recruiting session held before the beginning of the study in August 2013.

Lola, just like Robert, also went through the four stages of acquiring personal knowledge and the findings showed that she showed personal connective knowledge of four of the six challenges portrayed by the whole group, including 1) lack of technology tools, 2) barriers to access websites, 3) students' apathy to watch videos, and 4) support to flip a classroom. Moreover, Lola also portrayed personal connective knowledge of two possibilities of the FLM, including 1) the possibility to collaborate with others through learning networks, and 2) the possibility to use new or existent technology tools in a flipped classroom.

Lola's Personal Knowledge of the Challenges of the FLM

Lola expressed the challenges that she was having with the lack of technology tools that were available inside and outside the classroom and the barriers that she faced when students couldn't access the videos or online websites. She stated that:

> *"I'm using…..um…..Educreations. I'm using a tablet that I bought….forgot the name……gosh, I forgot the name of it……I actually googled the software that Khan Academy uses and then that's the software that I'm using and those are the tools that I'm using. So, headsets, that tablet that I forgot the name right now, and two other softwares. One of them is free the other one is on a trial basis. So, that's what I use….but it's difficult when students don't have access to laptops or the Internet. It would be nice to have an extra computer or a couple of them at school to lend to the students and help them with watching the videos in my portable. Even having USB drives that can help when they don't have access to the Internet. I would love to be able to have many flashdrives to save the videos and give them to the students"*

She continued to add that there was mixed support at her campus in understanding the implementation of the FLM and that she continuously had to explain to others what the FLM meant in

terms of the learning process of her students. Her principal seemed to be supportive, but other staff members, including assistant principals, were unfamiliar with the model, and hesitant to employ it at their campus. Lola stated that she tried to do several things to help different stakeholders better understand the model and keep them informed about the things that she was doing while implementing the model as opposed to previous years when she didn't. For example, Lola made a video specifically for parents, to explain to them the role that she expected for them to take in the implementation of the model with their children. She asked parents to watch the video so that they could be aware of the notions behind her new instructional approach to teaching Algebra 2. However, even after doing so, various parents were doubtful of the type of teaching that was occurring in her classroom. She then tried meeting with parents to explain to them the types of activities that she was trying to implement in her classroom and the benefits of the FLM. When asked about the type of support that she was receiving, she stated:

> *"There is only a couple of us who are really invested into the flipped classroom….and….um…..most of the other teachers at this campus don't even like it and they don't think that it works. So, we kinda sorta have to keep it to ourselves because otherwise its not good….so, but the meetings that we've had at the district level, those have been very helpful because we get to meet with other people who are doing the same thing that we are doing so they like it as much as we do."*

Lola expressed that she would have liked to have better support systems to address some of the challenges that she faced as she implemented the FLM in her classroom. One of those challenges, and perhaps the biggest one for Lola, was that students in her class were not watching the videos. When asked why she thought that students were not watching them, she stated that there was a misunderstanding about what Flipped Learning really was and that even parents felt that she was not doing her job as a teacher to teach the students in her class. She elaborated by saying:

> *"Although I have most of the students really, really like it. I always have those who don't watch the videos and they expect to learn anything just by*

coming to class and working with their classmates. And they miss alot of instruction by not watching the videos."

She also stated that students' apathy to watch the videos had been her major struggle in her exploration of the FLM and that perhaps if students were used to "that type of learning" since early on that they would be able to do better in the upper grades. She also stated that she had tried to use various technology tools, such as Camtasia, Educreations, and Schoology, along with her existent tools, like the iPad, in-focus machine, and Smartboard. Contrary to Robert's simplistic way to use technology, Lola embraced various forms of technology integration using diverse tools that could aid in helping her students understand the mathematical concepts that she was presenting to them. Nonetheless, her major struggle, even trying all those tools, was students not watching the videos. She added:

"That's the only struggle that I feel I haven't been able to handle….. Which we know that we always have some who don't do the homework anyway. So…..but for the most part I like it and the students like it too…..but I wish more students would watch the videos so that I could move forward with the activities that I plan on using after they watch them".

During one of the district meetings, Lola expressed her frustration with students rejecting to watch the videos as part of their homework assignments. This matter, she stated that had discouraged her and that she was "*ready to just stop using the model*". She stated that she was spending "*too much energy*" trying to get students to watch the videos and that her failure rate was higher than in the past, due to students not watching the videos at home.

Lola's Personal Knowledge of the Possibilities of the FLM

Lola expressed that she felt she had the tools and technology background to implement the FLM effectively, and that the district had provided the support needed to use technology effectively in the classrooms. She stated:

> *"….we received technology, we received headphones, we received flashdrives to give to the students who don't have internet access at home….. we received um….dvds…blank dvds….um….. CD's or whatever they are called, to record them in case students don't have also a computer, so they can watch them on a tv; we received lots of support from the district; and even within the school, our principal she's very supportive of the model….but the assistant principals don't know exactly how it works….. so, then, there is a few issues there. But for the most part, we have recieved a lot of support. Not only technology, but also, if we require more knowledge, I'm sure that they would give it to us. We were given a book with alot of information about the flipped classroom, what it is, what it isn't, so, we received lots of support…..so, it is nice to see the potentials of working together on this"*

Lola also voiced her enthusiasm for using technology in "*different ways*" and collaborating with others, using technology, and moving towards a more progressive technology phase in her district. Considering Lola's background in technology education, this seemed to be an approach well fit for her classroom instruction. She stated:

> *"I think it is good that we are getting exposed to all these different tools…I mean, I knew many of them already, like Educreations and Khan Academy, but it is good that we are all getting on the same page in using more technology in our classrooms to try to help the students….I like Camtasia a lot because its pretty advanced but the bad thing is that you have to buy the license, which I don't think its cheap, and in the past the district has not being able to have the money to buy it. So, getting staff development on other tools helps so that we can use things that are free instead"*

4.6.3 Key Informant #3: Audrey

During the period of the study, Audrey taught Algebra 2, just like Robert and Lola. Audrey taught 10th and 11th grade students, at the same campus as Lola. She is certified in K-12 instruction and has a background in interdisciplinary studies. She had been a curriculum writer at District Bravo and helped develop the district's scope and sequence for the Geometry course. Audrey also participated in the district's "High School Mathematics Education (HSME) Conference" while still being a participant of this study, where she and Lola presented their experiences with flipping a classroom. Audrey was in her 12th year of teaching mathematics at the time of the study. She was familiar with the term Flipped

Learning, as she had participated in a staff development session held at District Bravo, prior to the beginning of the study and had tried to flipped her classroom as well.

Audrey self-reported to be using three different types of technology tools before she began participating in the study: Schoology, Educreations, and Khan Academy. She also stated that she was already flipping one of her classes, before the study began. Towards the end of the study, she self-reported to still be using three types of technology tools to flip her class: Schoology, Educreations, and Screencast-O-Matic. Audrey participated in all of the sessions held by District Bravo in the fall 2013 and spring 2014. She also participated in the initial recruiting session held before the beginning of the study in August 2013.

During the process of developing connective knowledge at a personal level by going through the four stages mentioned previously, data collected showed that Audrey developed knowledge of the challenges of the FLM in three of the six specific areas that the whole group of teachers portrayed: 1) time to create videos and develop lessons, 2) lack of technology tools inside and outside the classroom, and 3) diverse needs of students who are being exposed to a flipped classroom. Moreover, Audrey also developed knowledge of the possibilities of the FLM in two particular areas: 1) possibilities to collaborate with others through networking, and 2) possibilities to utilize innovative instructional practices.

Audrey's Personal Knowledge of the Challenges of the FLM

One of the challenges that Audrey expressed she was concerned with, was time. She stated that it was difficult to develop video lessons for students to watch outside the classroom and then create other lessons to use inside the classroom. She stated:

> *"Because of the time that we have to plan, it helps to have a 90 minute period. I don't know if I would like it on a traditional 45 minute period. Actually, today and other times, but specifically today, I'm going to get in and do the work with the kids. I facilitate and guide the kids. I help them with their group work. They like it alot. But it's hard to find the time to create the videos and then plan on top of that"*

Audrey had expressed her concern for time-constrains as related to the implementation of the FLM from the first meeting that was held by the district back in October 2013. She stated that it was difficult to find the time to create in-depth lessons that could expand and deepen the knowledge that students brought to class after watching the videos. She also stated that with limitations in the amount of time provided to teachers to prepare for their classes, it was difficult to create videos and that she was having to use videos that she had created in the past or that were already available for use. She added:

> *"Challenges are making the videos and finding the time during the school day to do that. I used to make videos and I used to make them during my conference period…. but now, with the so much of my conference period taken away, I make fewer videos. I kinda use old ones. So, I just tell the students, watch out, there is a mistake here. So, my biggest challenge is time."*

Audrey tried to use technology tools that would facilitate the creation of the videos and utilized her computer and Smartboard to record the videos in school. However, due to the time limitations, she began using the iPad at home, using Educreations as her main tool. She stated:

> *"I now use the iPad more. In Educreations. My kinda "go to" tool is Educreations and the iPad. We do lots of group work and rotating and that kind of stuff. I went from the smartboard to the iPad. I like Educreations. I liked the Smartboard because it was big and easy. In Educreations, I type in word and save all these image files in Educreations, so that part is time-consuming. So, in the smartboard, I could do that all at once….but I can use the Educreations at home."*

Another challenge that Audrey expressed during the exploration of the FLM was the lack of technology tools and access to different online resources that she wanted her students to have available. She stated that the lack of access to computers and to the Internet simply made flipping much more difficult to implement. She stated:

> *"….it would be nice to have at least two computers or laptops in my room. Some students, although not too many, don't have access to the Internet*

and it would be nice to have USB's for those students too. It is just frustrating to have to re-teach a lesson when students don't watch the videos at home because they don't have the technology to do it"

Finally, Audrey also expressed to have faced the challenge of addressing diverse needs of students. She stated that she had a wide range of students in her class, who varied in the foundational knowledge that they brought to her Algebra 2 class. She especially felt that a group of her "smart" (as she called them) students didn't seem to be motivated to watch the videos. She argued:

"I'm not sure how to convince smart and over achieving kids to watch the videos. I feel like they think they are too good to watch the videos. The fact is that no matter how smart they are, they are missing important content because they think they can read the book and understand the concepts we are covering in class, rather than taking the 10 minutes it takes to watch a short video…..so, when they come back to class, they really don't understand the math as well as they think they do. I also have other students who may not know English very well or who may be really struggling with the math and it is hard to differentiate for all using a video"

Audrey's Personal Knowledge of the Possibilities of the FLM

Audrey felt that one of the most significant things of exploring the FLM through learning networks was the learning network itself. When Audrey was asked about the learning networks within her campus and at the district, she stated:

"I don't think there is a very large learning network within my campus. There is only another teacher- Lola- and I who work together and share ideas and bounce things off each other, but other than her, and myself, we don't really have a learning network at our school. I more so get information and ideas out of talking with people at other events; you know, any kind of in-service or professional development sessions. But, whether I learn anything from the professional development sessions or not, I feel like I get much more out of networking with other teachers; especially now that I'm flipping my classroom. That is the case with the district PLCs. We get to network with other teachers and share our ideas."

Mary was referring to the Professional Learning Communities (PLCs) that District Bravo held during the school year to bring teachers together to explore the FLM. When she was asked to expand on what she meant by the networks making a significant difference for her, she stated that she felt the networking with teachers helped her decide to keep exploring the FLM in her mathematics classroom. She added:

> *"If it wasn't for the networking, I don't think I would be doing it. I got this idea…I had done it for I guess three or four years; and I got it from my friend at one of the schools in District Bravo. So, if I hadn't talk to her, I probably wouldn't have started it. Even with a little bit of talk here in the district, because I didn't have a background on it. But I liked that I had started it and that I can help others with it and that the new ones that come on always bring great ideas. So, I use the networking more so than the literature."*

Audrey sought support from the different nodes of the network and found specific teachers within the district that had similar courses than her, similar students than her, and who were using similar technology tools to acquire new knowledge of flipped learning. She also requested additional assistance from district personnel, such as funding to provide substitutes for her so that she could meet with other teachers in the district and to go observe them in class. She became an advocate of the FLM and presented her perspective of the FLM at the district's High School Mathematics Education Conference (HSME). When she was asked about the transition to the FLM and the impact that it had in her teaching, she explained:

> *"Let's see…..as far the teaching….I think it makes me narrow down my ideas so when I put together videos; the first videos I was creating were like 20-25 minutes. They were forever long and now I instead zoom in on the specifics of the content; teach on the specifics and then we get to the needy greedy and do it in class, and I think that the students really like it. It's kinda "this is the goal" and we can expand when they come back to class."*

Audrey expressed her appreciation for the learning networks of teachers who helped her come up with ideas for implementing the FLM in her classroom. She added:

“I wouldn't say…… Now I wouldn't say that I was needing anything…. unless there was no networking of teachers to share ideas with….. the support that I'm receiving from my colleagues that are doing it also and the networking…. If it wasn't for them I probably, I might as well fall off and say "back to the old ways". But it is nice to discuss and meet up with somebody, anyone who may be doing something that you can learn from. It is nice to be able to talk and interact with others and say ‘how is it working for you’..... it makes you feel as if you are part of a community and it helps you keep motivated to keep trying, even when things don’t really work out……it just makes you have less stress about trying to make something work”

Chapter 5: Discussions

5.1 Introduction

Chapter five offers a brief overview of the study and an interpretation of the findings, including a discussion on results in comparison to extant research. Moreover, implications of the findings and recommendations for possible future research are also provided. It is important to note that the findings of the study do not presume to be definitive, nor culminating to the current research; at best, they represent an attempt to expand on the limited examination of emergent instructional approaches (Flipped Learning Model) and promising learning theories (Connectivism).

5.2 Overview of the Study

This study aimed at examining the connective knowledge of the challenges and possibilities in implementing the FLM by high school mathematics teachers as they participated in learning networks. The purpose of this fixed-mixed methods study was to narrate the story of high school mathematics teachers as they explored the FLM in their classrooms. The embedded research design utilized in this study was intended to employ narrative research to tell the stories of the participating teachers, and particularly of three key informants. Data analysis yielded ten themes that were organized within two main areas of connective knowledge: 1) knowledge of challenges in implementing the FLM, and 2) knowledge of the possibilities in implementing the FLM.

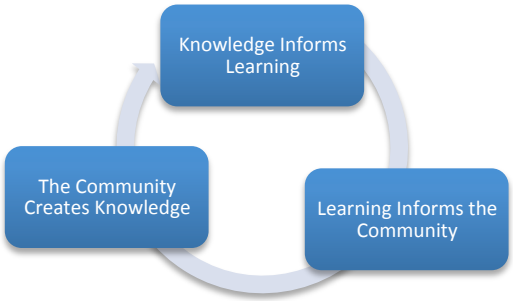
5.3 Interpretation of Findings

The Conceptual Framework followed in this study employs the theory of Connectivism as its main vehicle of interpretation of data. As stated in chapter two, Connectivism highlights on interactions amongst members of a learning network to develop communication and promote learning. As such, the notions behind Connectivism were used to construe meaning of the results. Learning in this case consisted of the ability for teachers to construct and navigate those networks. Connectivism does not recognize knowledge as the "cognitive", or intellectual interpretations of teachers; in the case of this study, knowledge was built by the connections that teachers made through their participation in network. Such connections were made through the teachers' actions and behaviors. Thus, their acquired knowledge was not transferrable, but rather a distributed process within their network.

Researchers refer to this type of knowledge as Connective Knowledge. This type of knowledge was distributed during the network through interactions among teachers. Therefore, knowledge became a cyclical process, where knowledge informed the learning, what was learned informed the community of teachers, and the community in turn created the knowledge. Illustration 5.1 offers a diagram of this process.

Illustration 5.1: Cyclical Process of Knowledge Development and Distribution

(Adapted from Downes, 2010)



We can represent the knowledge acquired by the high school mathematics teachers who participated in this study as follows:

- Knowledge of the challenges presented when "flipping" a classroom
- Knowledge of the possibilities of the FLM

The learning occurred as the teachers used that knowledge to navigate through their connective networks, through different types of actions and/or behaviors. For instance, when teachers realized that there was a lack of technology tools at their campuses, that knowledge informed their actions and behaviors during the network. They began to discuss with each other ideas to overcome that challenge and learn about alternatives. Such learning informed their community, which in turn created knowledge to overcome their challenges, such as saving videos for students on thumb-drives and CDs. Teachers participating in this study created learning communities that supported their professional growth as they explored Flipped Learning in their classrooms, by making connections and creating Connective

Knowledge. Participants underwent on-going reflection on their personal experiences as they conceptualized Flipped Learning and as they implemented it in their classrooms.

5.3.1 Considerations about the Key Informants' Connective Knowledge

When we reexamine the three key informants, we can see patterns that emerge as we study their stories in depth, but also key differences in the development of their personal knowledge through the learning networks. Thus, let's begin by recognizing that all three informants underwent the same four stages of personal knowledge development, as presented by Pettenati and Cigognini (2007). During stage one, all three informants were exposed to the same resources and tools related to the FLM. For example, they were all given the book "Flip Your Classroom: Reach Every Student in Every Class, Every Day" by Bergmann and Sams (2012). They were also exposed to the same written reflections and task-sheets during all of the five meetings held by district Bravo. They all participated in all the meetings and were exposed to the same information. During this first stage, these three participants began to handle the knowledge abundance that they had been provided with.

However, during stage two, the three informants began to select and filter information in different ways. They began to form a "personal network" of resources, which consistent of people (other teachers, district personnel, and technology specialists), content, and technology tools. Nonetheless, that personal network was different for each one of them. Thus, Robert seemed to have a network mostly consisting of people (including district personnel and other members of the network), an iPad and YouTube as his main resources. On the other hand, Lola's personal network had a wide range of technology tools (e.g., Educreations, Camtasia, Schoology, Powtoon, Khan Academy, YouTube), and people that she was close to, like Audrey and other teachers she had previously met. Finally, Audrey's personal network consisted of mostly Algebra 2 and Geometry teachers, as well as a few technology tools, including the Smartboard in her class, Educreations, Schoology, and her iPad. During this second

stage, the informants begin to have agency about their own learning and filtered information based on their own decisions and dependent upon their personal networks.

Stage three became a very critical stage during the development of their personal knowledge, but also a stage where the informants contributed to the social knowledge of the network. During this stage, the informants became visible to the network and became involved in sharing their knowledge about the FLM. However, Robert became a more "visible node" than did Lola and Audrey. During this stage, the informants began to contribute to the knowledge of the network, but also accepted contributions made by the members of the network. This is the stage where the members of the network began to build relationships to continue to share their knowledge of the challenges and possibilities of the FLM as they explored the model.

Finally, during stage four of the knowledge development process, the three key informants rebuilt their knowledge based on the outcomes of stages one, two, and three. They "personalized" their knowledge and accessed information from the network, as they desired. Thus, the personal knowledge of each of this three key informants varied. Robert's personal knowledge, for example, focused mainly on the possibilities of the FLM and only portrayed knowledge of two challenges of the FLM, which were students' apathy to watch videos and the time that it would take to create the videos and plan the lessons needed during class after students watched them. On the other hand, Lola's personal knowledge was primarily of the challenges of the FLM, and only portrayed knowledge of the possibilities of the FLM, in two areas, the possibility of the benefits of networking with other teachers, and the possibility to use technology tools to enhance instruction. Finally, Audrey's personal knowledge included a mixture of both challenges and possibilities of the FLM, with three main challenges portrayed in the evidence, including lack of technology tools inside and outside the classroom, diverse needs of students in a flipped classroom, and time needed to create the videos and plan lessons. The knowledge of the possibilities of the FLM shown by Audrey included networking with others, and improving instructional

practices in a flipped classroom. Table 4.1 illustrates the different areas in which the evidence suggests the key informants developed their personal knowledge of the challenges and possibilities of the FLM.

Table 5.2 Key Informants' Personal Knowledge of the Challenges and Possibilities of the FLM

	Emergent Theme	Robert	Lola	Audrey
Connective Knowledge of the Challenges in Implementing the FLM	Knowing the Lack of Technology Tools Inside and Outside the Classroom		X	X
	Knowing the Barriers to Accessing Websites and Videos		X	
	Knowing the needs of diverse students in a flipped classroom (e.g., English Language Learners, Deaf-Education students)			X
	Knowing the apathy students could depict to watch videos	X	X	X
	Knowing the time it takes to create videos and plan lessons	X		X
	Knowing the support needed from administration and parents when flipping a classroom.		X	
Connective Knowledge of the Possibilities in Implementing the FLM	Knowing the possibility of changing a school culture	X		
	Knowing the benefits of collaboration (e.g., student collaboration, teacher collaboration, partnerships across district; ties between nodes)	X	X	X
	Knowing how to identify and use technology tools to integrate in a flipped classroom	X	X	
	Knowing how to identify and use instructional practices in a flipped classroom.	X		X

5.4 Implications of Findings

Although the Flipped Learning Model seems to be supported by literature as a model that promotes student achievement, its' implementation proved to be problematic for teachers at District Bravo. The understanding of Flipped Learning, as well as the skills and tools needed in order to put it into operation, seemed to be challenging in various ways. Primarily, lack of technology tools and diverse student needs generated initial frustrations among teachers and created barriers that were hard to

overcome, unless there was support from other teachers and/or district personnel. Moreover, one of the pillars of the Flipped Learning Model, "Shift in learning culture" appeared to be complex with misconceptions about the model created both at the campus and district level. As a result, hesitation toward the success of the model became clear among students, parents, and administrators; and in many instances, even among teachers. Nonetheless, teachers remained hopeful to learn more about the model and continued its exploration throughout the length of the study. This led to teachers becoming resourceful and creating partnerships with colleagues at their campus, at other campuses, and with other departments (e.g., technology department). When teachers worked individually, there was a great feeling of overwhelm and disappointment in the lack of accomplishments when implementing the model, particularly in finding the time to create the videos or plan the student-centered classroom activities. Additionally, technology support is essential, as many of the tools needed to implement the model (e.g, creating a video lesson) are technology based.

The rapid technology advancements in today's world continue to impact teaching and learning in diverse ways. One of those ways is the use of instructional approaches that integrate technology tools, such as the Flipped Learning Model. The model incorporates videos, that without technology would be difficult to create and share with students. Technology tools, programs, and learning platforms, have allowed educators to use this model. There is also an overabundance of technology, which provides teachers with tools that perhaps were not available before.

It is important to note, that technology integration in schools encompasses much more than simply availability and/or access to technology. Instead, other factors also play an equally important role, such as the integration of pedagogical practices and technology tools. When it comes to the Flipped Learning Model, it is worth observing that one of the main ideas behind it is to use technology to increase instructional time with students in rich and engaging ways. However, this study, and various other studies have proven that to be challenging for teachers. This study also showed that teachers struggled to find time to prepare instructional activities that aligned to the videos given to students.

The scope of this study provided rich data that advocates for teachers who are exploring or considering the implementation of the flipped learning model to seek support and collaborate with other teachers in

order to have a more positive experience while using the model, especially within their Learning Networks.

5.5 Connections to Extant Research

Although there is limited research on the FLM, the findings of this study show both agreements and disagreements with extant research. Becker (1994) states that technology integration requires support at the campus and district levels in order for it to be implemented successfully. This turned out to be the case for teachers participating in this study. For example, Lola consistently stated that the lack of support at her campus created challenges for her that were hard to overcome. She stated that "*the assistant principals don't know exactly how it (FLM) works…so, then there is a few issues there"*. This, in turn, developed into parental concerns regarding her choices for instruction. She added that *"Parents also don't understand and complain to administration and they don't back me up"*

Likewise, the SpeakUp organization surveyed administrators; many of whom expressed concerns with flipped learning, particularly within three areas: 1) students who have no access to computers or internet at home; 2) staff development for teachers in creating or finding videos; 3) use of additional classroom instructional time (Speak Up Survey, 2012). These three areas were evident on the findings of this study, while from a teachers' perspective. Two of the emergent themes within this study, as shown below, implicitly address those areas:

- Lack of technology tools inside and outside the classroom
- Time to create videos or plan lessons

However, it is worth noting that existent research mainly addresses no access to technology outside the school, and fails to address the lack of technology devices within the school. Additionally, although the literature does refer to creating and finding videos as a challenge for teachers, it fails to address other factors of developing and uploading videos, such as the different platforms that can be used (e.g., Schoology) to give students access to those videos, as well as the limitations within the creation of the videos (e.g., editing).

Moreover, Hone and Moeller (1990) argue that pedagogical beliefs on teaching and learning are essential in order for technology integration to be successful. This requires teachers to examine their

teaching practices and structures in the classroom in an attempt to increase collaboration and active learning. This became part of the process that participants underwent during this study, particularly during stage four (Reflection and Metacognition) of their connective knowledge development. For instance, Robert, reflected on redefining some of his instructional practices based on his new connective knowledge of the FLM. One of his written reflections stated: "*I need to rethink how I am using my formative assessments. It seems to me that I am using most of the information individually and not having the students use the information to self-evaluate. I would like to have them dissect their understanding level*".

Snowden (2012) states that results of her study showed that perceptions of teachers towards flipping their classrooms was positive. This seemed to be partially true for participants of this study. Although most teachers were initially enthusiastic about implementing the FLM, the challenges that emerged throughout the process created hesitance amongst participants about the successful implementation of the model. For example, after repeated challenges with her students watching the videos at home, Lola, seemed to have lost hope in successfully implementing the FLM. She stated "*I wish more students would watch the videos so that I could move forward with the activities that I plan on using after they watch them…..I am really frustrated to the point I just want to quit and go back to doing what I was doing"*. However, Lola's enthusiasm for continuing the implementation of the FLM improved after collaborating and receiving feedback from others. By the end of the study she stated: *"It is nice to see the potentials of working together on this"*. Thus, the collaboration between Lola and other participants turned her challenge into a possibility. This was the case for many of the other participants. They showed enthusiasm as they overcame challenges, but showed lack of interest or concerns, once a new challenge emerged.

Furthermore, Brown (2012) discussed the phenomenon of college instructors using flipped learning and produced three phases that teachers undergo as they teach in a flipped classroom. Brown states that "the concept of adoption or transition can suggest a contained implementation process that includes a beginning phase of learning about and committing to a change; a middle phase of undertaking the necessary actions; and an end phase, or final result" (p. 97). These three phases are similar to the

four stages of connective knowledge development that were examined in this study. Thus, the beginning phase, as stated by Brown, is intended to learn about new information, which in the four stages of connective knowledge development, Pettanati and Cigognini, refer to stage one, awareness and receptivity. During the middle phase, the participants undertook actions, which can be connected to stages two and three of the participants' connective knowledge development. During these two stages, participants made connections, selected and filtered information, and created a personal network of resources. Finally, during the end phase, a product emerges; in the case of the participants of this study, they reflected and redefined their connective knowledge about the challenges and possibilities in implementing the FLM.

Finally, the results of this study concurred with findings about the recommendation when flipping a classroom. For instance, Renner (DATE) provides guidelines to promote a successful experience in implementing the flipped classroom:

- The expectation of spending time doing homework should be clear
- A flipped class implementation does not have to be "all or nothing"
- Students do not automatically prefer cooperative group work, nor do they intuitively know how to work in a group successfully.
- Teachers do not have to create all of their own content for a flipped class
- Lecturing is not bad pedagogy, but it should not be the primary or sole means of instruction.
- Pre-testing in K-12 classes warrants further study
- Students respond to multiple means of representation

These guidelines were evident on the findings of this study, as teachers continued their implementation of the FLM. In fact, the first two guidelines seemed to be two of the most important topics of discussion among teachers participating in this study.

5.6 Discussion on Possible Future Research Direction

This study provided an examination of high school mathematics teachers' connective knowledge focused on two areas, the challenges and possibilities of the FLM. However, findings of the study that

were not anticipated have opened the possibility to explore new avenues, especially within the limited research that exists in mathematics education. First, it is important to further build on existent research about populations with diverse needs in a flipped classroom. Outcomes of this study showed that teachers with special education students and English Language Learners struggled to adapt their instruction in their flipped classroom, which was due primarily to the unique needs of their students. For instance, one teacher had a group of special education students, identified as hard of hearing, for which the video lessons had to be tailored to include captions. Nonetheless, such captions proved to be somehow inaccurate and not completely aligned to the mathematics content that the teacher intended to teach. Similarly, some teachers voiced their concerns for creating video lessons that were not correctly translated for recent immigrant students with limited English proficiency. Thus, some of the teachers decided to translate the video lessons themselves; yet, causing them to feel overwhelmed with the workload that this challenged presented to them.

Second, a focal point of the theoretical framework of this study was the connective knowledge development model presented by Pettenati and Cigognini (2007). Nevertheless, it is important to expand on the examination of the four stages of connective knowledge development presented on this study by exploring it with other populations, including students. For this study, the analysis of the four stages provided valuable data that resulted on the understanding of teachers' selection of information and connections made to their own knowledge when creating their personal network of resources; however, it would be worthy to also analyze students' four stages of connective knowledge development in a flipped classroom in order for us to enrich findings within epistemological developments. Additionally, this study supports a broader exploration of the impacts of Connectivism in today's classrooms. It is essential to recognize that Connectivism is not yet seen as a universally accepted learning theory; thus, further research about the core ideas behind this theory is necessary.

Third, this study suggests further consideration for a new context, location, and perhaps cultural background of participants in a flipped classroom, as well as participants within a learning network. Extant research does not provide a comprehensive account of specific populations and/or regions that could provide important information to continue to improve on our understanding of the FLM.

Although this study attempted to provide a new context (mathematics), location (Mexico-US borderland region), and cultural background (Hispanics), additional research is needed that expands on the diversity of populations being studied.

Finally, it is important to mention that although flipped learning continues to gain interest amongst educators across grade levels, there is a need to continue to expand on research about the construct of "flipping". Continuing quantitative and qualitative research is indispensable, with a major need for qualitative studies that provide rich, in-depth data about Flipped Learning. The literature shows that studies are needed not only across grade level, but across disciplines as well.

5.7 Researcher's Reflection

Due to the limited research on both Flipped Learning and the emergent theory of Connectivism, it was difficult to make connections that could support and/or make comparisons of the findings of this study with existent research. The most challenging aspect of the study was to meticulously focus on the four stages of personal knowledge development stated by Pettenati and Cigognini (2007) as the data was collected. The qualitative data certainly provided with most of the information needed to examine interactions amongst the members of the learning networks and how they underwent the four stages of knowledge development to, in turn, distribute knowledge within the network and create social knowledge about the challenges and possibilities of the FLM. This process was complex to examine, due to the fact that conversations, written reflections, interviews, and observations were multifaceted and an extensive amount of data was gathered. Therefore, the data analysis procedures were intricate, at best, and numerous repetitions of analysis of data through coding, line-by-line coding, and focus coding, were necessary to achieve concise outcomes of the emergent themes, that were trustworthy.

Moreover, a similar challenge was encountered as an examination was conducted of the personal knowledge of the three key informants that were selected to delve, more in depth, into their process of developing knowledge in the two aforementioned areas of challenges and possibilities of the FLM. Thus, videos and field notes, as well as observations were essential in analysis the three cases of the informants to better understand their experiences in the exploration of the FLM. Further discussions (besides the interviews) were necessary to clarify some of their thinking as well as to ensure the

evidence presented in the data was accurate and truly reflective of their personal stories as participants of this study.

References

Abbott, J. (1994). Learning Makes Sense: Recreating Education for a Changing Future. Education 2000. Corporation Offices. Broadway, Hertfordshire.

Ackermann, E.. 2001. Piaget's constructivism, Papert's constructionism: What's the difference? In: Constructivism: uses and perspectives in education, vol. 1, 2, pp. 85–94, Geneva, Research Center in Education.

Anderson, T. & Dron, J. (2011). Three generations of distance education pedagogy. *International Review of Research on Distance and Open Learning, 12(3)*, (pp. 80-97).

Baker, Celia. (2012). Flipped classrooms: Turning learning upside down: Trend of "flipping classrooms" helps teachers to personalize education. Deseret News. Retrieved from http://www.deseretnews.com/article/765616415/Flipped-classrooms-Turning-learning-upside-down.html?pg=all.

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

Baker, J. W., & Mentch, M. W. (2000). IMOWA curriculum materials. Retrieved from http://www.imowa.org/curricula/flip/.

Bakia, M., Jones, K., Means, B., Murphy, R., & Toyama, Y. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. Washington, DC: U.S. Department of Education.

Bandura, A. (1986). Social foundation of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1989). A social cognitive theory of action. In J. P. Forgas & M. J. Innes (Eds.), *Recent advances in social psychology: An international perspective* (pp. 127-138). North Holland: Elsevier.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. Educational Psychologist, 28(2), 117-148.

Bandura, A. (1997). Self-efficacy: The exercise of control. New York: W.H. Freeman and Company.

Baranovic, K. (2013). Flipping the first-year composition classroom: Slouching toward the pedagogically hip. ProQuest Dissertations and Theses,95. Retrieved from http://search.proquest.com/docview/1441087946?accountid=7121.

Becker, H.J. (1994). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education*, *26*(3), 291-321.

Bergmann, J. & Sams, A. (2012). Flip Your Classroom: Reach Every Student in Every Class Every Day. International Society for Technology in Education.

Berrett, D. (2012 . How 'flipping' the classroom can improve the traditional lecture. The Chronicle of Higher Education. Retrieved from http://chronicle.com/article/How-Flipping-the-Classroom/130857/

Bishop, J. L. (2013). A controlled study of the flipped classroom with numerical methods for engineers. ProQuest Dissertations and Theses, , 284. Retrieved from http://search.proquest.com/docview/1492991096?accountid=7121.

Bland, L. (2006), Apply Flip/Inverted Classroom Model in Electrical Engineering to Establish Life-long Learning, in Proceedings of the ASEE Annual Conference 2006. Chicago, IL.

Brooks-Young, S. (2012). Flipped classrooms: What's it all about? Today's Catholic Teacher, 45(6), 22. 60

Brown, J. S., (2002). Growing Up Digital: How the Web Changes Work, Education, and the Ways People Learn. United States Distance Learning Association. Retrieved from: http://www.usdla.org/html/journal/FEB02_Issue/article01.html.

Brown, A. F. (2012). A phenomenological study of undergraduate instructors using the inverted or flipped classroom model. ProQuest Dissertations and Theses, 222. Retrieved from http://search.proquest.com/docview/1238015781?accountid=7121.

Burns, J. (2012). Critical care in the age of the duty hour regulations: Circadian-based scheduling, standardized handoffs, and the flipped classroom? Retrieved from http://dx.doi.org/10.1097/CCM.0b013e31826bf117

Charmaz, K. (2000). Grounded theory: Objectivist and constructivist methods. In N. K. Denzin & Y. S. Lincoln (Eds.), Handbook of qualitative research (2nd ed.). Thousand Oaks: Sage.

Chetcuti, S. E. (2013). Exploring a blended learning seminar in a suburban new york school district. ProQuest Dissertations and Theses, , 228. Retrieved from http://search.proquest.com/docview/1506585525?accountid=7121.

Child Trends. (2012). Home Computer Access and Internet Use. Retrieved from http://www.childtrendsdatabank.org

Clark, K. R. (2013). Examining the effects of the flipped model of instruction on student engagement and performance in the secondary mathematics classroom: An action research study. ProQuest Dissertations and Theses, 130. Retrieved from http://search.proquest.com/docview/1437012328?accountid=7121.

Cline, Z., & Necochea, J. (2006). Teacher Dispositions for Effective Education in the Borderlands. Educational Forum. V. 70 (3). P. 268-282.

Cole, J. E., & Kritzer, J. B. (2009). Strategies for success: Teaching an online course. *Rural Special Education Quarterly, 28*(4), 36-40.

Critz, C. M., & Knight, D. (2013). Using the flipped classroom in graduate nursing education. Nurse Educator, 38(5), 210-213.

Datig, I., & Ruswick, C. (2013). Four quick flips: Activities for the information literacy classroom. College & Research Libraries News, 74(5), 249-251, 257. 61

Daus, K. (2013). Tales from the other side of the podium: How to use a flipped classroom model to increase student learning and engagement in organic chemistry. Retrieved from http://search.proquest.com/docview/1490508511?accountid=7121

Demski, J. (2013). 6 expert tips for flipping the classroom. Campus Technology, 25(5), 32-37.

Downes, S. (2007). Learning networks in practice. Becta Emerging Technologies for Learning, 2, 19-27.

Downes, S. (2012). Connectivism and connective knowledge: Essays on meaning and learning networks. Retrieved from http://www.downes.ca/files/books/Connective_Knowledge.pdf.

Driscoll, M. (2000). Psychology of Learning for Instruction. Needham Heights, MA, Allyn & Bacon.

Driscoll, T. (2012). Flipped Learning and democratic Education: The Complete Report. Retreive from http:// www.flipped-history.com/2012/12/flipped-learning-democratic-education.html

Engelward, A. (2012). Harvard Extension School. Technology in Math Education: The iPad a Game-Changer? Retrieved from http:// www.extension. harvard.edu/hub/blog/math-teaching/technology-math-education-ipad-game-changer.

Ertmer, P.A., & Newby, T.J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 6*(4), 50-72.

Flipped Learning Network (FLN). (2014) The Four Pillars of F-L-I-P™ . Retrieved from: http://flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/46/FLIP_handout_FNL_Web.pdf.

Fonteix, K. A. (2013). Separate, but not equal: A qualitative case study comparing traditional and homebound instruction using technology. ProQuest Dissertations and Theses, 281. Retrieved from http://search.proquest.com/docview/1449375336?accountid=7121.

Frederickson, N., Reed, P., & Clifford, V. (2005). Evaluating web-supported learning versus lecture-based teaching: Quantitative and qualitative perspectives. Kluwer Academic Publishers, 50(4), 645-664.

Fulton, K. (2012). Upside down and inside out: Flip your classroom to improve student learning. Learning & Leading with Technology, 39(8), 12-17.

Gannod, G., Burge, J., Helmick, M., (2008) Using the Inverted Classroom to teach Software Engineering, ICSE, May 2008, Leipzig, Germany, pp 777-786.

Goodwin, B., & Miller, K. (2013). Teaching self-regulation has long-term benefits. *Educational Leadership, 70*(8), 80–8.

Green, D. E., & McNeeley, M. F. (2013). Practice corner: Is radiology education ready for a flipped classroom? Retrieved from http://dx.doi.org/10.1148/rg.332135003

Green, G. (2012). The Flipped Classroom and School Approach: Clintondale High School. Presented at the annual Building Learning Communities Education Conference, Boston, 62

Greene, H., & Crespi, C. (2012). The value of student created videos in the college classroom –An exploratory study in marketing and accounting. International Journal of Arts & Sciences, 5(1), 273-283. MA. Retrieved from http://2012.blcconference.com/documents/flipped-classroom-school-approach.pdf

Green, H., & Hannon, C. (2007). Their Space: Education for a digital generation, online version. Retrieved from http://www.demos.co.uk/files/Their%20space%20-%20web.pdf.

Grimsley, C. (2013). New media and the inverted classroom: Investigating their impact on women in first-year composition. ProQuest Dissertations and Theses, 263. Retrieved from http://search.proquest.com/docview/1496772826?accountid=7121.

Groff, J., & Mouza, C. (2008). A framework for addressing challenges to classroom technology use. Association for the Advancement of Computing in Education (AACE) Journal, 16 (1), 21-46.

Hadley, M., & Sheingold, K. (1993). Commonalties and distinctive patterns in teachers'integration of computers. American Journal of Education, 101, 261-315.

Hantla, B. F. (2014). Flip your classroom: Reach every student in every class every day. Christian Education Journal, 11(1), 183-188.

Healy, J. M. (1998). *Failure to connect: How computers affect our children's minds--for better and worse*. New York: Simon and Schuster.

Herreid, C. F., & Schiller, N. A. (2013). Case study: Case studies and the flipped classroom. Journal of College Science Teaching, 42(5), 62-67.

Honey, M., & Moeller, B. (1990). *Teacher beliefs and technology integration: Different values, different understandings*. CTE Technical Report, Issue 6. Retrieved from http://cct2.edc.org/ccthome/reports/tr6.html.

Howell, D. (2013). Effects of an inverted instructional delivery model on achievement of ninth-grade physical science honors students. ProQuest Dissertations and Theses,176. Retrieved from http://search.proquest.com/docview/1468701492?accountid=7121.

Hung, D. (2001). Theories of Learning and Computer-Mediated Instructional Technologies Educational Media International Volume 38 Issue 4 2001 pp281-287. Retrieved from: http://repository.maestra.net/valutazione/MaterialeSarti/articoli/Hung.pdf.

Hwang, L., Dunn, B., & Khosla, C. (2013). Not your average flipped classroom: An online, multi-media "textbook" for introduction to chemical engineering. Retrieved from http://search.proquest.com/docview/1490503924?accountid=7121

Jaster, R. W. (2013). Inverting the classroom in college algebra: An examination of student perceptions and engagement and their effects on grade outcomes. ProQuest Dissertations and Theses, 254. Retrieved from http://search.proquest.com/docview/1491386309?accountid=7121.

Johnson, G. B. (2013). Student Perceptions of the Flipped Classroom. The University of British Columbia. Retrieved from: https://circle.ubc.ca/bitstream/handle/2429/44070/ubc_2013_spring_johnson_graham.pdf?sequence=1.

Johnson, L.W., & Renner, J. D. (2012). Effect of the flipped classroom model on a secondary computer applications course: Student and teacher perceptions, questions, and student achievement. Unpublished doctoral dissertation. University of Louisville, Kentucky. Available: http://theflippedclassroom.files.wordpress.com/2012/04/johnson-renner-2012.pdf.

Jonassen, D. (2002). Learning as activity. Educational Technology, 42(2), 45-51.

Jones, A.N. (2006, January-April). From the Sage on the Stage to the Guide on the Side: the Challenge for Educators Today. ABAC Journal, vol. 26, no. 1, pp.1 – 18.

Kerr, B. (2007). A challenge to connectivism. Online Connectivism Conference. University of Manitoba. Retrieved from http://ltc.umanitoba.ca/

King, A. (1993). From sage on the stage to guide on the side. College Teaching, 41(1), 30-35. 63

Klopfer, E., Osterweil, S., Groff, J., & Hass, J. (2009). The instructional Power of Digital Games Social Networking Simulations and how Teachers can Leverage Them. The Education Arcade. Massachusetts Institute of Technology.

Kop, R. and Hill, A. (2008) Connectivism: Learning Theory of the Future or Vestige of the Past? The International Review of Research in Open and Distance Learning. Vol 9, No 3.

Kurup, V., & Hersey, D. (2013). The changing landscape of anesthesia education: Is flipped classroom the answer? Current Opinion in Anaesthesiology, 26(6), 726-731.

Lage, M., Platt, G., and Treglia, M. (2000) , Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment. J. of Econ. Educ., 31 (1): p. 30-43.

Larsen, A. J. (2013). Experiencing a flipped mathematics class. ProQuest Dissertations and Theses,135. Retrieved from http://search.proquest.com/docview/1519670617?accountid=7121.

Larsen, K. (2014). Mastery of geologic content by preservice elementary education students in a flipped classroom. Retrieved from http://search.proquest.com/docview/1518617245?accountid=7121

Lyons, J.O. (1978). The Invention of the Self: the Hinge of Consciousness in the Eighteenth Century. Carbondale: University of Southern Illinois Press.

Marlowe, C.A. (2012) The Effect of the Flipped Classroom on Student Achievement and Stress, Master of Science in Science Education (Thesis). Montana State University, Bozeman, MT.

McDonald, Jason K., Yanchar, Stephen C., & Osguthorpe, Russell T. (2005). Learning from programmed instruction: Examining implications for modern instructional technology. Educational Technology: Research and Development, 53 (2), 84-98.

McDonald, K., & Smith, C. M. (2013). The flipped classroom for professional development: Part I. benefits and strategies. Journal of Continuing Education in Nursing, 44(10), 437-438.

McKenzie, J. (2007). "Digital nativism, digital delusions, and digital deprivation," *From Now On: the educational technology journal*, volume 17, number 2. Retrieved from http://www.fno.org/nov07/nativism.html.

McLaughlin, J. E., Griffin, L. M., Esserman, D. A., Davidson, C. A., Glatt, D. M., Roth, M. T., . . . Mumper, R. J. (2013). Pharmacy student engagement, performance, and perception in a flipped satellite classroom. American Journal of Pharmaceutical Education, 77(9), 196.

McLaughlin, J. E., Roth, M. T., Glatt, D. M., Gharkholonarehe, N., Davidson, C. A., Griffin, L. M., . . . Mumper, R. J. (2014). The flipped classroom: A course redesign to foster learning and engagement in a health professions school. Academic Medicine : Journal of the Association of American Medical Colleges, 89(2), 236-243.

Missildine, K., Fountain, R., Summers, L., & Gosselin, K. (2013). Flipping the classroom to improve student performance and satisfaction. The Journal of Nursing Education, 52(10), 597-599. 64.

Murphy, E. (1997). Constructivism from philosophy to practice. Retrieved from: http://www.cdli.ca/~elmurphy/emurphy/cle.html.

National School Board Association (2007). Creating & connecting: Research and guidelines on online social and educational networking. Alexandria, VA.

National Clearinghouse for English language Acquisition (2011). The Growing Numbers of English Learner Students, 1998/99-2008/09. Retrieved from http://www.ncela.gwu.edu/files/uploads/9/growingLEP_0809.pdf

Oni, S. (2012). Revitalizing Nigerian Education in Digital Age. Trafford Publishing. U.S.A.

Papert, S. & Harel, I. (1991). Situating constructionism. In S. Papert & I. Harel (Eds.), *Constructionism*. Wesport, CT, US: Ablex Publishing Corporation.

Parkay, F.W. & Hass, G. (2000). Curriculum Planning (7th Ed.). Needham Heights, MA: Allyn & Bacon.

Parslow, G. R. (2012). Commentary: The khan academy and the day-night flipped classroom. Biochemistry and Molecular Biology Education, 40(5), 337-338.

Pearson & The Flipped Learning Network (2013). Flipped Learning Professional Development. Retrieved from http://www.pearsonschool.com/flippedlearning

Pearson, G. (2012). Biology teacher's flipped classroom: "A simple thing, but it's so powerful". Education Canada, 52(5), 0.

Pearson, G. (2012). Students, parents give thumbs-up to flipped classroom. Education Canada, 52(5), 0.

Periyakoil, V. S., & Basaviah, P. (2013). The flipped classroom paradigm for teaching palliative care skills. The Virtual Mentor : VM, 15(12), 1034-1037.

Perraton, H., and Creed, C. (2000). *Applying new techniques and cost-effective delivery systems in basic education (Education for all 2000 assessment: Thematic study)*. Paris: UNESCO

Pettenati, M.C., Cigognini, M.E., & Sorrentino, F. (2007). Methods and tools for developing personal knowledge management skills in the connectivist era. Paper presented at the European Distance and E-learning Network (EDEN), 2007 Annual Conference. Naple, Italy.

Piaget, J. (1926). *The Language and Thought of the Child*. New York: Harcourt Brace & Company.

Pierce, R., & Fox, J. (2012). Vodcasts and active-learning exercises in a "flipped classroom" model of a renal pharmacotherapy module. American Journal of Pharmaceutical Education, 76(10), 196.

Prensky, M. (2001). Digital Natives, Digital Immigrants: Do they really think different? On the Horizon, 9(6), 1-6. Retrieved from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part2.pdf

President's Council of Advisors on Science and Technology (PCAST), 2010. Report to the President: Prepare and inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future. Washington, D.C. Retrieved from https://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stem-ed-final.pdf

Ross, S. M. et al. (2010). Educational Technology Research Past and Present: Balancing Rigor and Relevance to Impact School Learning. Contemporary Educational Technology, 2010, 1(1), 17-35.

Scheffler F. L., & Logan J. P. (1999). Computer technology in schools: What teachers should know and be able to do. *Journal of Research on Computing in Education*, 31, 305–326

Schwankl, E. R. (2013). Flipped classroom: Effects on achievement and student perception. (Order No. 1523826, Southwest Minnesota State University). ProQuest Dissertations and Theses, 86. Retrieved from http://search.proquest.com/docview/1441947201?accountid=7121. 65

Schwartz, T. A. (2014). Flipping the statistics classroom in nursing education. The Journal of Nursing Education, 53(4), 199-206.

Siemens, G. (2005a). Connectivism: Learning as network-creation. *ElearnSpace*.

Siemens, G. (2005b). A Learning Theory for the Digital Age. *Instructional Technology and Distance Education, 2(1)*, (pp. 3-10).

Siemens, G. (2007). Connectivism: Creating a Learning Ecology in Distributed Environments. In T. Hug (Ed.), *Didactics of Microlearning: Concepts, Discourses and Examples* (pp. 53). Munster: Waxmann Verlag.

Sinclair, R. C. (1988). Mood, categorization breadth, and performance appraisal: The effects of order of information acquisition and affective state on halo, accuracy, information retrieval, and evaluations. Organizational Behavior and Human Decision Processes, 42, 22-46.

Skinner, B. F. (1972). Cumulative record. A selection of papers. New York: Appleton-Century- Crofts.

Smith, C. (1954, Aug 01). Nation will get dr. baxter's now and then program today. Los Angeles Times (1923-Current File) Retrieved from http://search.proquest.com/docview/166678745?accountid=7121

Smith, C. M., & McDonald, K. (2013). The flipped classroom for professional development: Part II. making podcasts and videos. Journal of Continuing Education in Nursing, 44(11), 486-487.

Snowden, K. E. (2012). Teacher perceptions of the flipped classroom: Using video lectures online to replace traditional in-class lectures. ProQuest Dissertations and Theses, 71. Retrieved from http://search.proquest.com/docview/1334925547?accountid=7121.

Speak Up Survey (2012). Learning In The 21st Century Mobile Devices + Social Media = Personalized Learning. Retrieved from: http://www.tomorrow.org/speakup/MobileLearningReport2012.html.

Standridge, M. (2002). Behaviorism. In M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technolog*. Retrieved from http://projects.coe.uga.edu/epltt/.

Standridge, M. (2010). Behaviorism. Department of Educational Psychology and Instructional Technology, University of Georgia. Retrieved from http://epltt.coe.uga.edu/index.php?title=Behaviorism.

Strayer, J. F. (2007). The effects of the classroom flip on the learning environment: A comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system (Doctoral Dissertation). Retrieved from: http://faculty.washington.edu/rvanderp/DLData/FlippingClassDis.pdf

Texas Education Agency. (2001). Texas Education Code. Chapter 29. Retrieved from http://www.statutes.legis.state.tx.us/Docs/ED/htm/ED.29.htm#29.003.

Texas Education Agency. (2012). Texas Education Code. Chapter 29. Retrieved from http://www.statutes.legis.state.tx.us/Docs/ED/htm/ED.29.htm#29.052.

Torkelson, V. (2012). The flipped classroom, putting learning back into the hands of students. ProQuest Dissertations and Theses, 127. Retrieved from http://search.proquest.com/docview/1439941102?accountid=7121.

Tosun, N., & Baris, M. F. (2011). Using information and communication technologies in School improvement. The Turkish Online Journal of Educational Technology, 10(1), 223-231

Tune, J. D., Sturek, M., & Basile, D. P. (2013). Flipped classroom model improves graduate student performance in cardiovascular, respiratory, and renal physiology. Advances in Physiology Education, 37(4), 316-320.

U.S. Department of Education, National Center for Education Statistics. (2010). Teachers' Use of Educational Technology in U.S. Public Schools: 2009 (NCES 2010-040) 6.

U.S. Department of Education (2013). Expanding Evidence Approaches for Learning in a Digital World. Washington, D.C. Retrieved from http://tech.ed.gov/files/2013/02/Expanding-Evidence-Approaches.pdf.

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

Wiley, D. A and Edwards, E. K. (2002). *Online self-organizing social systems: The decentralized future of online learning*. Retrieved December 10, 2004 from http://wiley.ed.usu.edu/docs/ososs.pdf.

Wiginton, B. L. (2013). Flipped Instruction: An investigation into the effect of learning environment on student self-efficacy, learning style, and academic achievement in an Algebra I classroom. Tuscaloosa, Alabama. Retrieved from: http://acumen.lib.ua.edu/content/u0015/0000001/0001416/u0015_0000001_0001416.pdf.

APPENDIX A: OBSERVATION PROTOCOL

School Name:_____ Date:_____

Classroom Number:_____ Time:_____

Teacher Name:_____

Number of Students in Class_____ Subject Area_____

Key Notes	Expanded Thinking
Classroom Arrangement	Questions
Flipped Learning Components Observed	

APPENDIX B: QUESTIONNAIRE

FLIPPED MATHEMATICS LEARNING QUESTIONNAIRE

Demographics	Circle the response that best represents you				
Age	<31	31-40	41-50	51-60	>61
Gender	Female		Male		
Teaching experience	0-4 years	5-9 years	10-14 years	15-19 years	>20 years
Subject area concentration for 2013-2014 school year	Algebra 1	Geometry	Math Models	Algebra 2	Other
Ethnicity	Hispanic or Latino		Not Hispanic or Latino		
Race	White	Black or African American	American Indian or Alaska Native	Asian	Native Hawaiian or Other Pacific Islander
Highest Level of Educational Background	Bachelor's Degree		Master's Degree		Doctorate Degree
Flipped Learning Model- Conceptualization Component					
Have you received any formal training(s) about the flipped learning model?	Yes, One Time	Yes, 2-3 Times	Yes, >3 Times	No	
Have you received any informal training about the flipped learning model? (e.g., reading books, articles, online blogs)	Yes		No		
What do you think are the key components of the flipped learning model? Please write a Y for those statements that you believe describe key components of flipped learning and an N for those statements that you believe do not.	An online course used to teach the concepts that would otherwise be traditionally taught in the classroom.				
	The integration of constructivist learning and direct instruction.				
	Students working independently to learn new concepts.				
	Increasing student-teacher interactions during instructional time.				
	Class assignments are completed outside the classroom and homework is completed during the instructional time in the classroom				
	Students working freely without structure				
	Flipped learning is a synonym of online videos				
	Allowing teachers to find deeper connections with their students in order to improve learning				
	Providing students with meaningful resources to differentiate instruction				
	Connecting curriculum standards and technology to facilitate teaching and learning				
	Flipped learning allows the teacher to evaluate less and interrelate more with students				
	Replacing lecture with videos				
	Classroom instruction is primarily spent in group environments				

Flipped Learning Model- Operationalization Component				
Have you tried to implement the flipped learning model in your classroom before?	Yes, to some extent	Yes, fully	No, I haven't	
Please circle any of the tools that you have used in the past to enhance instruction for students:	Khan Academy	Edmoto	TeacherTube	Educreations
	Jing	Camtasia	Screencast-O-Matic	YouTube- EDU
	Google+	Toontastic	Schoology	PowToon
	iTunes	TED	Watch/Know/ Learn	PBS Teachers
Which of the following activities have you implemented before? Please write a Y for Yes and an N for No in the space provided to the right of the activity	I have created videos of my lessons for students to use outside the classroom			
	I have found videos online to provide students to use outside the classroom			
	I have used videos during classroom instruction			
	I have my own teacher website where students can access content and tools to use for learning			
	I have done video conferencing with teachers from other campuses			
	I have presented podcasts to students inside or outside the classroom			
Classroom Environment- Please rate the following statements with a: 1- Strongly agree 2- Agree 3- Neutral 4- Disagree 5- Strongly disagree Place the number to the right of the statement	I let students lead discussions within groups or for the whole class			
	Students in my class are passive listeners			
	I promote collaboration among students more so than independent student work			
	I prefer for students to receive instruction in class because I'm afraid they will not do their homework			
	I encourage students to take ownership of their learning, yet provide them with proper guidance			
	I do not like to incorporate technology in my class because students do not have access to it			
	Students in my class are active learners			
	In my class, students are allowed to go beyond the curriculum and explore their interests according to their needs			
Additional Comments:				

APPENDIX C: FIELD NOTES

Date_____Time_____

Place of Observation_____Number of Participants_____

Words & Phrases	Summaries of Conversations
Facts, Numbers & Site Details	Sights, Sounds, Textures

Questions	Additional Notes

APPENDIX D: INTERVIEW QUESTIONS

Teacher Name:_____ Date:_____

School Name:_____

Start time:_____ End Time:_____

How are learning communities within your campus or district impacting your understanding of Flipped Learning in mathematics?
What role is the networking with other teachers who are flipping their classrooms playing in the implementation of Flipped Learning in your mathematics classroom?
How has the transition to the Flipped Learning Model impacted the way in which you approach teaching and learning in your mathematics classroom?

Which challenges are you facing as you are implementing the Flipped Learning Model in your classroom?
What kind of tools are you using for the implementation of the Flipped Learning Model?
Describe the type of support that you are receiving or needing as you continue to explore the Flipped Learning Model?

Vita

As an immigrant Hispanic female who studied in U.S. schools, I have learned to love diversity and appreciate the field of education in a deeper way. Migrating from my native country, Mexico, to the United States at age 13 has helped me develop a unique perspective of teaching and learning. Education has in fact, become my passion and inspiration. Being able to experience the structures, pedagogical practices, culture, and content that embrace each system of education in different countries, is truly a venture into a world of both differences and similarities that make us who we are. My primary interest lies in the conceptualization and operationalization of technology integration in the mathematics classrooms, as well as the diverse needs of students at the secondary level. As such, I am eager for the possibility to continue working on projects that support the investigation of these constructs.

I believe my background has prepared me for the challenges and different opportunities that may emerge in the future. I have a Bachelor's of Science Degree in Mathematics with a minor in Physics. I also have a Master's Degree as an Instructional Specialist in Mathematics and have now taken the endeavor to partake in the program of Teaching, Learning, and Culture to conclude a Doctor of Philosophy (Ph.D.). Furthermore, my study abroad in Russia, Spain, and Mexico have given me the opportunity to learn about other educational systems as well as to see different perspectives of Mathematics teaching and learning for students of diverse backgrounds. In fact, the knowledge that I have acquired through such experiences has become a catalyst to my future goals as an educator.

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