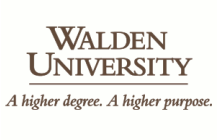

2016

Student Perceptions of Flipped Learning in a High School Math Classroom

Daniel Strohmyer
Walden University

Walden University

College of Education

This is to certify that the doctoral dissertation by

Daniel Strohmyer

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Darci Harland, Committee Chairperson, Education Faculty
Dr. Asoka Jayasena, Committee Member, Education Faculty
Dr. Paula Dawidowicz, University Reviewer, Education Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
2016

Abstract

Student Perceptions of Flipped Learning in a High School Math Classroom

by

Daniel A. Strohmyer

MA, Walden University, 2008

BS, University of Nebraska, 1995

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Education

Specialization: Learning, Instruction, and Innovation

Walden University

July 2016

Abstract

Flipped classrooms are implemented in more schools each year, particularly in courses requiring increased teacher guidance for mastery. While a foundation of research related to pedagogy and academic outcomes exists, research is limited surrounding student perceptions of the social and learning culture during flipped learning. The purpose of this study was to explore high school math students' lived experiences of flipped learning related to content and instruction, critical thinking, and collaboration and interactions. A phenomenological design was employed using a conceptual framework combining cognitive load theory, sociocultural learning theory, and schema theory. Students from two public high schools in the Midwest participated. Seven students participated in interviews, and nine students participated in two focus group discussions. Data analysis involved in vivo coding of transcribed interviews and focus groups. Key results included students' perceptions of increased engagement and interactions, as well as more in-depth learning in flipped environments. Increased critical thinking was related to both instructional strategies employed and students' ability to self-regulate learning. Concepts of peer collaboration shifted as students viewed learning environments and sources of expertise as more extensive in the flipped environment. This study contributes to positive social change by providing educators and researchers with a deeper understanding of the importance of ensuring students are competent in using social technology tools that encourage students to interact both socially and academically in order to help them become more self-directed learners.

Student Perceptions of Flipped Learning in a High School Math Classroom

by

Daniel A. Strohmyer

MA, Walden University, 2008

BS, University of Nebraska, 1995

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Education

Specialization: Learning, Instruction, and Innovation

Walden University

July 2016

Dedication

This academic writing is dedicated to my wife, Karin, and my children. They patiently waited for me to finish this process as I politely excluded myself from gymnastics meets, wrestling meets, and many other family outings. I thank them for their patience and support. Karin, you maintained an unshakable foundation to get this done and always offered support when I needed it.

Acknowledgments

I would like to thank my dissertation committee members, Dr. Darci Harland, Dr. Asoka Jayasena, and Dr. Paula Dawidowicz, for their expertise, guidance, and professionalism in helping forge this dissertation. Without their efforts and mentoring, this dissertation would not have been possible.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

As educators in public school systems continue to seek innovative practices for closing achievement gaps, increasing collaboration and critical thinking, and incorporating 21st century literacies, an influx of technological tools have flooded today's classrooms. With the rising trend of wireless technologies and an increasing focus by school districts to seek one-to-one technology initiatives, teachers search to find the best tools and techniques to employ for increased student achievement. As new technologies emerge, teachers need to think critically about best practices in relation to these technologies.

One instructional strategy that has shown promise for student learning is flipped teaching, a strategy that has evolved into a platform for promoting critical thinking, collaboration, and social interaction with peers on an academic level. Flip teaching (Musallam, 2010) involves student engagement in lower order thinking activities at home prior to class, leaving the class time to engage in meaningful conversations and higher order thinking-based application and activities. Because mastery-level materials, which were described by Bloom (1956) as foundational skills for remembering, understanding, and applying, are learned at home, teachers can engage in more deeper, authentic, and higher-order thinking activities in the classroom than ever before (Crenshaw, Hale, & Harper, 2011). Students can then apply learning independently in more unique and innovative ways. Fulton (2012) explored the role of flipped learning in collaboration, including effective alternate uses of instructional time, and found that the flipped teaching strategy effectively moved class lectures out of the classroom, making more

significant amounts of time available for collaboration and application during traditional class time. This practice is consistent with current research on cognitive load theory approaches to instruction, indicating that "front-loading" instruction and lower-order thinking activities reduces cognitive load on students (Ayres, 2006; van Merriënboer & Ayres, 2005).

While researchers have begun to explore this model of instruction and theoretical foundations are being defined, many variables related to flipped teaching are yet to be investigated. Such variations include specific strategies for out-of-class activities, in-class technologies and strategies, teacher training, and student responses. Student perceptions provide a unique opportunity to yield insight into the practices that most successfully meet instructional objectives as well as those practices that promote student "buy in" for the learning process.

Background

Flipped teaching emerged as an instructional practice in 2004 due to a need to provide instruction to students who could not be physically in the classroom for varying reasons (Bergmann & Sams, 2012b; Musallam, 2010). The typical in-class instruction was recorded and made available to students to view outside of class, and homework was completed during the in-class time. Over time, this strategy has evolved into the current model, often referred to as flipped teaching, which is defined as providing the foundational knowledge of the lesson to students at home and leaving the in-class time to extend the lesson, apply the concepts, and encourage students to hone their critical thinking skills (Musallam, 2010). The "explore-flip-apply" model that Musallam (2010)

developed incorporates technology, critical thinking, and best-practice pedagogy to support flipped teaching as a credible method for instruction.

Flipped teaching is a unique phenomenon that encourages a progressive classroom change in culture and suggests a synergy of 21st century learning styles with technology and social academia. This synergy depends on the balance of two key components: An instructor that teaches with the flipped teaching strategy competently and effectively and students that are receptive to use of the strategy (Strayer, 2007). The following paragraphs will examine both of these components in more detail.

A "flipped" instructor has to be competent and effective with the model's strategy. Effectiveness with the flipped teaching strategy requires complex knowledge that goes beyond traditional content, pedagogical, and technology practice (Koehler, Mishra, & Cain, 2013). An effective instructor must know content misconceptions as well as how to teach content efficiently in a technology-based environment. The collaboration of content knowledge and pedagogical knowledge has been bolstered by the addition of technology knowledge in the 21st century classroom. Flipped teaching demands competence in all three areas. Mishra and Koehler (2008) updated a model known as technological pedagogical content knowledge (TPACK). This model was originally based off of Shulman's (Shulman & Shulman, 2008) explanation of how content and pedagogical knowledge are melded to yield productive teaching practices in the classroom. The authors stated that isolated content knowledge and pedagogical knowledge were not enough to be effective in the classroom. The TPACK model shifts the focus from technology use as an "add on" to using technology in a meaningful way

based on the tool's specific value the tool can add to the learning experience (Koehler, Mishra, & Cain, 2013).

In addition to TPACK to illustrate the effective use of teaching with technology, content, and pedagogical knowledge, Hamden, McKnight, McKnight, and Arfstom (2013) stated the current research suggested four main themes or "Pillars of Flip" (p. 4) that instructors wishing to be effective with this strategy should follow. These themes include: flexible learning environments, a shift in learning environment, intentional content, and professional educators. The first and second themes suggest a shift to a more student-centered learning environment where students can learn when it is optimal for them, which may not necessarily be during the chemistry or physics time slot allocated by the school schedule. The third theme, intentional content, uses the strategy to provide the "nuts and bolts" of the content to students out of class and then uses the classroom time to employ meaningful discussion or application. This practice takes much more preparation time for the teacher and effectively doubles the instructional time in the content area.

Current research literature provides some insight into initial overall outcomes of the use of flipped teaching and some of its specific components within specific content areas (Bergmann & Sams, 2012b; Musallam, 2010). While there is little evidence of research addressing direct student perception of flipped instruction, insights surrounding the effectiveness of components and classroom practices used within the flipped teaching model can be found, such as perceptions of the use of technology (Chandra & Fisher, 2009; DiVall et al., 2013; Khan, 2009), peer collaboration practices (Kalin, 2012;

Osgerby, 2013; Poellhuber & Anderson, 2011), teacher-student interactions, and the impact of those interactions on learning environment (Bergmann & Sams, 2012a; Chang, 2002). These studies can be used to establish a general background for the current study, but should be viewed as somewhat narrow in scope as they do not include perceptions of the full context of flipped instruction through intentional combination of components and practices. By considering student perceptions of their comprehensive experiences within the flipped environment, this study has the potential to more intentionally connect these components and fill gaps in the literature surrounding flipped learning environments.

Bergmann and Sams (2012b) and Musallam (2010) conducted research comparing depth of learning and content mastery in high school chemistry courses based on flipped or traditional instructional models. Ollerton (2014) presented similar results in high school mathematics courses. These researchers all found that students in flipped instructional models outperformed peers who participated in chemistry classes with traditional instruction, and students from flipped model classrooms engaged in deeper levels of critical thinking. Even though these researchers compared instructional models, they did not consider student perspectives, presenting a current gap in the literature. This boundary is just beginning to be breached in research. Brown (2012) indicated that students who participated in intentionally technology-rich environments indicated greater ease in learning a wide range of mathematical concepts. Students cited benefits related to ease of use, ability to explore content more specifically due to this ease, and increased levels of interest when using technological tools for both simple and complex mathematics (Brown, 2012).

Additional research exists in relation to student perceptions of components of or strategies that teachers use in flipped teaching models. Taylor, McGrath-Champ, and Clarkeburn (2013) examined student perceptions of learning supported by podcasting, which is one component of the flipped teaching model. Taylor et al. focused on the benefits of podcasting on student perceptions of team-based learning environments. Students reported that the podcasts are valuable resources in preparing them for collaborative classrooms where they are expected to interact with each other on more critical levels. Kalin (2012) also found that students value the use of technology for collaborative learning, emphasizing accessibility as well as the ability to work with diverse groups despite physical location. Kanevsky (2011) also found that talented and gifted students who received differentiated instruction through technology resources beyond the classroom voiced a preference for such activities. It is important to acknowledge that participants identified increased autonomy and self-directed learning as preferences rather than the technology resources directly. They also voiced a preference for more carefully planned collaborative learning activities. Although the technology resources were not specifically cited as their preferences, these tools were the path that led to preferred learning outcomes (Kanevsky, 2011). Similarly, Ford, Burns, Mitch, and Gomez (2012) and Ford (2012) found that even when students express a preference for video casted lessons, they do not always outperform peers who do not have access to such technological resources. These findings suggest that a combination of factors contribute to the success of flipped teaching that Bergmann and Sams (2008) and Musallam (2010) described. Current literature lacks information related to the lived

experiences of students as key members of the flipped learning process. This gap is best filled through providing students the opportunity to share these experiences, including consideration of the impact of a combination of factors.

Social implications are another factor to be considered when addressing the infusion of technology as part of the flipped classroom. Social media, including Facebook, Twitter, and text-messaging, have proved proven to be effective tools in motivating students to collaborate academically outside of the classroom using a tool that they are already socially comfortable with (November, 2007). Wang (2013) also considered the use of social media, but from a risk standpoint. Although students and teachers found social media to be an effective tool for collaborating in learning and for sharing school news with a wider audience, Wang also found that teachers and administrators had to carefully weigh risks related to the use of these types of public social media and their ability to monitor and manage correspondence that can become off-target or perceived negatively by some participants. Understanding student's perceptions of social interactions, including those using technology, is a gap in the literature.

While there is a base of literature related to flipped teaching, what is lacking is an understanding of how students experience flipped learning. Because students are ultimately the recipients of flipped instruction, their reception and perceived successes or struggles within this learning environment is an essential part of creating a more comprehensive view of this model. Student views of lived experiences within the flipped classroom, including related components and practices, will provide meaningful

understandings of the impact of this model on learning through the lens of the learner. Kalin (2012) found that students reported, while they have a strong preference for collaborating using both technology and social media, they may need further instruction in how to collaborate effectively for the purpose of learning. Lin (2013) suggested that students participating in technology rich learning environments infused with social media would be more effective learners, who are able to manage the demands of content, when they establish separate social media accounts for personal use and for educational use. Kalin and Lin also emphasized that, at least initially, collaboration does not occur naturally without direct encouragement and guidance from the instructor. Students voiced the importance of teachers setting a clear purpose for the use of technology in learning. Kalin supported this belief by noting that although students may be versed in social media, they may not be literate in all forms of social media and their different uses.

What is yet to be explored is students' comprehensive perceptions of the flipped learning phenomenon. While the literature may point to perceptions of components of this model in isolation, no direct attention has been given to the lived experiences of students who learn within this environment. This includes comprehensive consideration of views of flipped classrooms compared to traditional classroom components and practices, views of level of thinking and engagement in the classroom, and the social impacts of engagement in flipped learning.

Problem Statement

In order for effective learning to occur in the classroom, a teacher's instruction must be matched to the learners that receive the instruction. Student acceptance,

understanding, and engagement are an integral part of the implementation of innovative instructional practices. In order for students to learn successfully within the flipped classroom, research must consider more than just the tools used and strategies employed. More specifically, educators need a deeper understanding about how students perceive flipped learning in relation to other methods and how students view it impacting their ability to think critically, to collaborate, and to employ social and cultural tools for academic purposes. Even though the connection between flipped teaching and critical thinking has been studied with high school students in science (Bergmann & Sams, 2008; Musallam, 2010), higher education (Lage & Platt, 2000; Prober & Heath, 2012), and even elementary reading (Corcoran, 2013), little research has been conducted about student perceptions of this instructional strategy. More specifically, the current gaps in literature include students' perception of the flipped teaching strategy in comparison to a traditional classroom. Furthermore, an understanding of whether or not students perceive this strategy as leading to more meaningful learning, increased critical thinking, and changing social interactions in the classroom is still lacking. Therefore, the problem being addressed in this study is a gap in the literature related to how students perceive the flipped learning experience, including how they perceive it influencing their critical thinking and social interactions.

Purpose of Study

The intent of this phenomenological qualitative study was to describe students' lived experiences of flipped learning. Specifically, this study will focus on students' views of how flipped learning (a) compared to traditional learning, (b) influenced

learning math content and impacted critical thinking, and (c) influenced collaboration and other social aspects of learning. The phenomenon being focused on in this study was flipped learning.

Research Questions

The research questions for this study were organized into one central research question and three related research questions.

Central Research Question: What were high school math students' lived experiences of flipped learning?

Related Research Questions:

1. How did students perceive flipped learning compared to traditional learning?
2. How did students perceive flipped learning contributing to their ability to learn math content and improve their critical thinking?
3. How did students perceive peer collaboration and other social aspects of flipped learning?

Conceptual Framework for the Study

The conceptual framework for this study was based on concepts related to Vygotsky's (1978) sociocultural learning theory, cognitive load theory (Sweller, Ayres, & Kalyuga, 2011), and Anderson's schema theory (Anderson et al., 2004). Many other theories contributed to learning in technology-rich environments, but these theories impacted the study most significantly. Figure 1 is a graphic that shows how the three theories fit together to provide the study's framework. It depicts the relationships among

these theories and the contribution of each to the flipped learning culture.

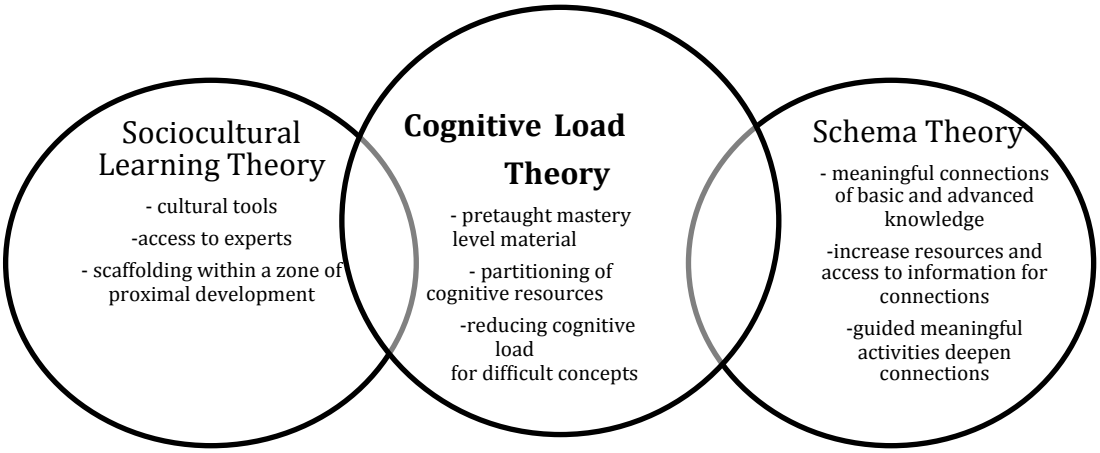

Figure 1. Conceptual framework relationships. This figure illustrates the relationships among the three theories encompassing the conceptual framework.

The larger circle of cognitive load theory forms much of the conceptual framework for this study; however, key concepts from schema theory and sociocultural theory lend credence to the underlying concepts of cognitive load theory. In Figure 1, the larger circle of cognitive load theory represents the major contributing theory and the smaller circles support the larger theory.

Vygotsky's (1978) sociocultural theory of learning supported the study through a focus on using cultural tools familiar to students in everyday social and academic settings, providing access to expert models during learning (i.e. in home and school settings through flipped resources), and through supported learning in the zone of proximal development through the provision of scaffolded resources in and out of the classroom. Anderson's (Anderson et al., 2004) schema theory supported the study due to

its ideas on the complex nature of how new concepts are linked to prior knowledge. The more connections that are made, the stronger the schemata, and therefore, it becomes easier for the individual to recall or build upon the concept that was learned. Cognitive load theory was the common ground between these theories, and it was what explained the benefits of storing concepts in memory effectively and the ease of recall affect the learner. As such, it served as the unifying theoretical foundation for this study and was represented as the largest of the circles in the diagram presented in Figure 1. Ultimately, the flipped teaching model focused on reducing cognitive load, as presented according to cognitive load theory, through practices that led to stronger formation of schemata by using appropriate cultural tools, access to experts, and meaningful instruction within a learner's appropriate zone of proximal development.

Vygotsky's sociocultural learning theory (1978) can be applied to several components of the flipped classroom. One Vygotskian term that is central to understanding learning is the *zone of proximal development*, which includes providing necessary expertise and cultural tools necessary to help students achieve. However, this support should be based on their current functioning level. In a flipped learning environment, this phenomenon was evident when students were learning with technology resources and interacting with experts and peers beyond the traditional classroom setting. With technology resources such as Twitter, blogging communities, and other online forums, students can access countless primary source documents electronically and can gain access to academic leaders in content through an e-mail or a discussion forum post on a topic mutually followed online. Students can also access content through YouTube

video or iTunes University to glean academic resources according to their interests, which promotes independent learning and responsibility. An additional strength of this instructional strategy is the enhanced use of a variety of communication avenues. Communication with the instructor is streamlined and peer-to-peer communication is enhanced and encouraged. In fact, in the flip-teaching model, roles can be enhanced and blurred. The instructor may serve as the expert in a video by presenting new concepts and explaining more difficult ideas (LaFrance, 1989). The instructor may also serve as a partner in learning as students and the teacher engage in problem solving activities surrounding authentic tasks (An & Reigeluth, 2011). In addition, the use of multimedia leads to access of an increased number of experts beyond the teacher (Berge, 2008). For example, precalculus students may engage in learning from tutorials presented by other professionals or they might collaborate with an engineer to consider authentic applications of content. Increased communication also means that an instructor might be aware of student questions related to a homework assignment and address these questions within minutes rather than the next day in class when the learning experience has long expired. Students are accustomed to rapid communication socially and a focus of this study investigated the student perceptions of this increase in communication of the flipped model.

While Vygotsky's (1978) theory supports practices that expose students to a variety of resources and supports for achieving learning, Anderson's adaptations to schema theory provide a framework for considering the development of new knowledge within the flipped model by defining how deep, meaningful connections are established

(Anderson et al., 2004). Anderson's schema theory was based on Piaget's (1959) theory of the cognitive development of children. Schema theory describes how individuals view and remember situations in order to force this information into memory. The person creates a web or *schema* of the relationships between the objects, and this relationship allows recall of important information for application. Applying Anderson's theory in a technology-infused classroom explains how larger webs may be formed as well as the potential to increase accurate recall due to the multiple connections in the person's schema. These connections become increasingly important as students incorporate new tools, including the use of technology, into their learning. Technology resources have the potential to contribute to increased schema, not only related to the topic of instruction, but also related to strategies the student may apply to gain knowledge and understanding. For this reason, teachers must think critically about the schema they develop when tying specific uses of technology to information being learned. Furthermore, teachers must also consider how students might generalize use of such tools across other schema. As students learn to navigate and ground information in their schema, they are more likely to employ similar strategies to developing later knowledge and understandings. However, if use of a technological tool interferes with schema development, students may avoid its use in the future.

While a framework for how students learn and create new knowledge and understandings was included within schema theory, cognitive load theory involves the next step in exploring how to most effectively build rich connections that lead learners to higher order thinking. Because there is only a finite amount of working memory, Sweller,

Ayres, and Kalyuga (2011) contended it is difficult to reach the goals of higher level thinking in small amounts of time. Sweller et al. suggested that a division of the cognitive load could occur through providing a certain amount of *pre-training* to assist learners in mastering basic concepts so they could successfully grapple with the more difficult concepts of the classroom and reduce the cognitive effort of the classroom instruction later. Sweller et al. concluded that learning would be more effective due to decreased learner effort and students having a partially developed schema already in place.

All three theories informed the study by providing a conceptual lens through which to design the research questions and the data collection instruments and to conduct the analysis of data. This included consideration of resources, learning activities, and intentional and implied connections made. By carefully considering the resources, characteristics of learning, and application of knowledge, questions regarding student perceptions of learning were more closely focused on the frameworks and intention of the flipped model, which yielded more meaningful results and increased the likelihood of representing student feedback accurately.

Nature of the Study

This qualitative study used a phenomenological research design. The purpose of this phenomenological study was to describe high school math students' lived experiences of flipped learning. Phenomenological research attempts to define the essence of an experience or phenomenon by exploring the views and perceptions of people that have experienced that phenomenon (Patton, 2002). This research design was selected because the purpose of the study sought to explore and understand the patterns

and unique characteristics of students' lived experience. Data were collected to better understand the phenomenon of flipped learning from the lived experiences of students in high school mathematics courses. Current literature covering best practices in innovation and faculty perceptions of technology use in the classroom were well-represented, but very little research had been conducted on the phenomenon of flipped learning. Flipped learning includes student perceptions of instructional practices commonly used in flipped classrooms as well as their perceptions of their learning and interactions with others in the flipped culture. The gap was even more evident in rural public high school settings. A phenomenological design provided an opportunity to provide an in-depth analysis of student perceptions about this phenomenon.

This phenomenological study was conducted in two public high schools located in the midwest region of the United States where teachers used flipped teaching strategies in advanced mathematics courses. In order to create a clear picture of the flipped classroom learning environment and how students interact within it academically and socially, data were gathered in three distinct steps. First, students responded to basic demographic survey questions related to the amount of experience they have had with the flipped teaching model in order to identify an appropriate array of participants for the later steps based on varying degrees of exposure to the instructional model. Students answered a few brief questions to gauge how much exposure they had to the flipped learning environment. The goal was to identify potential participants for the study who had varying levels of experience with the flipped teaching model. The next step involved individual, face-to-face interviews with four to six advanced mathematics course students

within the targeted levels of experience (i.e., low, medium, and high). After this, all student participants as well as students in the class with parental consent were invited to participate in a focus group to further discuss and add detail to information gathered in interviews.

Operational Definitions

Cognitive load: The amount of information a student can actively retain and work with at a given time. Students can handle a larger cognitive load when they have established a foundation in the topic or when they can relate the topic to existing knowledge (Sweller, Ayres, & Kalyuga, 2011).

Flipped teaching: 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, 2012, p.1).

Social media: For the purpose of this study, social media was defined as any technology used to communicate beyond the classroom, including technology developed for social purposes and which have crossed over for uses in professional and academic uses (Bingham & Conner, 2010).

Podcast and vodcast: A practice used to deliver foundational or mastery level information through audio or video recordings. This format is often used to deliver lecture or sample problems and solutions for student preview and review outside of class (Bergmann & Sams, 2011).

Traditional learning: Learning through pedagogies that focus on introduction, modeling, and practice of concepts moving from basic to advanced within the context of a physical classroom while independent work is focused on additional practice of content. This may include lecture, discussion, group, and individual learning within the regular classroom environment. The presentation of preskills, vocabulary, and lower-order thinking tasks are completed in the classroom (Musallam, 2010).

Assumptions

Several assumptions existed about the student population and teacher level of experience with flipped teaching. First, it was assumed that students in the class had consistent exposure and experiences with the flipped learning environment throughout the course, and that they were regularly accessing and completing course requirements in home and school settings, relying on teacher-defined resources. In other words, it was assumed that students had sufficient background knowledge and experiences to share their perceptions about flipped teaching accurately. This assumption was important because the study centers on students' abilities to describe lived experiences. Second, it was assumed that the differences between flipped and traditional learning models were significant enough for students to recognize them. This ability to differentiate was important because students must be able to articulate learning experiences unique to flipped classroom environments. It was also assumed that, when given the opportunity, the students would be honest in their perceptions of the flipped learning experience. Honesty was a critical assumption if their feedback was to be considered genuine descriptions of their experiences.

Scope and Delimitations

The scope of this study was limited to the unique experiences of high school students with the specific phenomenon of flipped learning in high school mathematics. For this reason, this study focused on describing these flipped environments before describing student perceptions about this instructional model. No attempt was made to measure the quality of instruction or student academic outcomes. Data collected were about student experiences related to the flipped classroom model, including their impressions of instruction, learning and critical thinking skills, collaboration, and the impact of this model on their social environment.

Delimitations emerged as the specifics of the study were designed. In the development of research questions, a specific path for the study was constructed. Data collection surrounded this limited information in an attempt to describe the experiences of students within this construct. The ability to identify any outlying factors that may also be contributing to student perceptions further limited data interpretation.

Transferability of the findings from this study inform future research by contributing to the research base on how students perceive this learning strategy as helping or hindering academic learning in the flipped teaching environment. The knowledge gained from this study provides insight as to better inform planning instruction with this pedagogy in the future and increases the opportunity for critical thinking and problem solving. Insights from this study also help enlighten instructors on how 21st century learners blend academics and their social world.

Limitations

Phenomenological studies rely heavily on the participants' ability and willingness to share their own thoughts (Groenewald, 2004). This reliance is perhaps one of the most significant limitations of this type of study. Student self-reporting can yield limited insights if they perceive any risks associated with their response. Additionally, qualitative studies consider the subject of study within a natural environment, making them difficult to accurately replicate. Another limitation that must be considered is the targeted focus of the study. Because the focus is specifically on four to six students' perceptions within one classroom setting, student perceptions cannot be generalized to larger populations or other courses. Finally, it is important to emphasize that a phenomenological study only involves describing a phenomenon and should not be used to imply causality or correlation (Yin, 2011).

Within this study, there were a number of elements in which biases might influence study outcomes including my prior experience with flipped teaching and student desire to please teachers' and administrators' views of this model. A bias that I needed to recognize and address with an open mind was my previous experience teaching science in the flipped teaching environment. My heightened awareness of this during interviews, focus groups, and the coding of data ensured that questions and interpretation of responses related to lived experiences were those of the students, without projecting my lived experiences as well. To accomplish this, researcher bias was controlled for through the development and adherence to the research designed phases. Bias presented by administrator or teacher points of view was controlled for through structured questions

and private interview and focus group environments that encouraged students' voice their thoughts and feelings without external pressure to respond a certain way.

In considering this more carefully, limitations in this study were minimized in four ways. First, targeted interview and focus group questions related to the research questions were developed to create direction, but were still open enough to encourage discussion and individual representation of lived experiences within this construct. Confidentiality was ensured and communicated regularly in order to encourage honest, authentic, and thorough responses. Activities took place in nonthreatening environments to increase participant comfort in responding. Furthermore, participants were reminded that participation was not mandatory, but the participants could choose to end the study at any time.

Significance

The significance of the study was determined in relation to improving practice in the field, to advancing knowledge in the field, to encouraging innovative practices, and to contributing to positive social change. In relation to improving practice in the field, this study has the potential to inform teachers, students, and administrators. Teachers currently using the flipped model, or those considering using the model, will benefit by better understanding the flipped classroom culture from the students' perspective. Educators may better understand the impact of flipped instruction by how students' perceive their learning and classroom experiences. Student insights from this study may provide specific flipped instructional strategies that are most effective in helping students achieve learning goals and that are least likely to be disregarded by students. Therefore,

instructors can use what they may learn from this study to modify current instructional strategies to improve student acceptance of flipped learning. Additionally, students also benefit as this study may provide best practices for a better flipped learning environment for the next generation of flipped learners. This study may also improve teaching practice in the field at the building and district level, as decisions regarding the structure and support of these curricular models are usually not made by teachers. A better understanding of how students view flipped learning can help the planning of technology use both in and out of the classroom, and maybe provide pedagogical support for instructors that align with results found in this study.

In relation to advancing knowledge in the field, this study also has the potential to help researchers develop a deeper understanding of the multifaceted impact of not only instructional practices, but also technology use for flipped learning. Students may provide insight on practices and technology that are perceived as most and least effective. By specifically considering student perceptions, this study will reveal further insights related to flipped learning and add new depth to the knowledge base surrounding innovative teaching practices that advance the social change process of improved student learning.

This study will also contribute to what is understood about learning, instruction, and innovation. Flipped teaching has been clearly identified as an innovative and effective method for reaching students for instruction, remediation, and enriched learning, particularly when infused with technology (ChanLin, 2007). Because many students are self-directed in their learning, they prefer the use of social and technological tools to access learning and the world around them (November, 2007). By considering

the perspectives of students about flipped learning, teachers in flipped classrooms might have insight into the instructional innovation that will support them in how to increase content-mastery skills while improving the overall experience students have in the flipped environment.

In relation to positive social change, this study has the potential to either further confirm that flipped instructional practices are an innovative teaching strategy that engages student learning and thinking, or the study may elucidate weaknesses of flipped learning, which could cause a shift in how instructors use the instructional strategy. If student perspectives add to past empirical research that flipped teaching is an effective use of technology and time, educators and administrators can forge ahead and consider talking to students within their own programs to gauge how students view the innovative practice. However, there is the potential that the perspectives shared by students may reveal weaknesses within the flipped model that were not previously identified. In that case, this study may provide the foundation for further research to evaluate and describe the issues within the instructional model.

Summary

This chapter was an introduction to this qualitative study that used a phenomenological research design. The background section included a brief summary of the research literature related to this study. The problem statement focused on the need for increased understanding of students' lived experiences related to flipped learning. The purpose of this study, as reflected in the central research question, is to describe this students' views of how flipped learning (a) compares to traditional learning, (b)

influences learning math content and impacts critical thinking, and (c) influences collaboration and other social aspects of learning. The conceptual framework was based on cognitive load theory with support from social learning and schema theories. In terms of the methodology of this study, the participants were high school students from rural schools in the Midwest participating in advanced mathematics courses. Data were collected through interviews and focus groups and was analyzed using NVivo coding of interview and focus group transcripts. Assumptions and limitations were also discussed. The significance of this study is that it will contribute to advanced knowledge, improved practice, and positive social change by considering flipped teaching and learning through the experiences of the learner, adding to the knowledge base of how students' perceive this model, and what components they feel are more or less beneficial to learning outcomes. By doing so, researchers will gain greater insight into how students interact within the observed environment in this case study. Although results cannot be generalized to any flipped learning environment, they can provide teachers with topics to consider when observing their own classrooms for student engagement in flipped approaches, giving more voice to students engaging in this learning environment.

Flipped teaching has the potential to shift learning environments from lower order thinking and memorization tasks to environments where students engage in higher order critical thinking, creativity, and application of skills in meaningful ways. Research related to this approach is emerging in the research literature and will be discussed in Chapter 2. Although emerging literature considers the components and practices in flipped teaching, little consideration has been given to student experiences within this model. This

phenomenological study will attempt to fill this gap by describing students' perceptions about their experiences with flipped learning through interviews and focus groups.

In Chapter 2, a review of the literature is presented. It will begin with a brief presentation of the background of flipped teaching. Research related to the conceptual framework will consider research related to theories, flipped teaching, technology integration, critical thinking, collaboration, and the use of social media. Benefits and drawbacks of the conceptual framework and flipped teaching are included. Where possible, student perceptions of the flipped teaching strategy and technology in general were examined. In addition to this, research concerning key variables and concepts were reviewed.

Chapter 2: Literature Review

This study addressed the limited voice of students in how they perceived their experiences when learning in a flipped classroom model. Therefore, this study also addressed the gap in the literature regarding how students viewed flipped learning. Educators need a deeper understanding about how students perceive flipped learning in relation to other methods and how students view it impacting their ability to think critically, to collaborate, and to employ social and cultural tools for academic purposes. The purpose of this study was to explore high school math students' lived experiences of flipped learning in order to better understand student perspectives of how flipped learning (a) compared to traditional learning, (b) influenced learning math content and impacted critical thinking, and (c) influenced collaboration and other social aspects of learning. The phenomenon being focused on in this study was flipped learning in high school mathematics.

Student perceptions of learning processes in the flipped classroom have the potential to deepen understanding about practices that are effective and likely to be embraced, yet our understanding of student perceptions to date are very limited. As a result, this literature review will extend into many different disciplines and fields of study. The spectrum of this review crossed between fields of psychology, technology, and learning theory. Research related to this problem addressed cognitive load theory approaches to learning, instructional models and components of flipped instruction, and 21st century instructional strategies. Within these larger themes, the literature I reviewed considered critical thinking, collaboration, and social aspects of learning.

Researchers have suggested that instructional practices must be focused on scaffolding cognitive load, in order to move students quickly into more advanced critical thinking and application of skills (Bergmann & Sams, 2012a; Kalynga & Hanham, 2011; Musallam, 2010). Still, Ford et al. (2012) raised the concern that technology alone, particularly video-casting lectures, does not always achieve such results, encouraging us to consider what other factors are promoting student engagement and deeper critical thinking, including resources (Chandra & Fisher, 2009; Ellington, 2006; Huang, Huang, & Chen, 2012; Kulik, 2003; McCulloch, 2009). Researchers in the field have also considered the impact of social interactions in and out of the classroom as integral to developing deeper critical thinking (Kalin, 2013; Osgerby, 2013; Poellhuber & Anderson, 2011). Perceptions were considered from both instructor (Roblyer, McDaniel, Webb, Herman, & Witty, 2010) and student points of view (Friedman & Friedman, 2013) related to the use of social media.

Currently, research exists to address these separate but related aspects of flipped teaching. What was not directly addressed in the literature were student perceptions of this instructional model. This literature review presents the related components of flipped instruction, including student perceptions from outside the context of flipped classrooms when possible, in order to establish a framework for considering these components in a combined manner through the lived experiences of learners in a flipped classroom.

The organization of Chapter 2 will begin with the background of flipped teaching, proceed into the conceptual framework, and then will examine studies that demonstrate the benefits and drawbacks of this strategy. In addition to this, studies that examine

student perceptions of the flipped teaching strategy and technology in general are examined. Finally, research concerning key variables and concepts are reviewed. The underlying theme of this review was to reveal characteristics of the flipped teaching model and to initially consider related student perceptions surrounding these characteristics in order to set a context for the central questions posed in this study.

Literature Search Strategy

An exhaustive literature search canvased databases for the disciplines of technology, cognition, psychology, and education. The literature search terms included: *technology, screencasting, podcasting, cognitive load theory, split attention, flipped teaching, flipped learning, inverted teaching, inverted learning, preteaching,* and other synonyms of these. As new literature was explored, reference lists were used to identify and search additional authors' names and related topics. The literature search was conducted using the search databases Education Search Complete, ED/IT Digital library, PsycINFO, and PsycARTICLES and multidisciplinary databases including Sage Premier, ProQuest, and Science Direct. The search included many research journals in other professional libraries. The literature search was conducted and recorded on a database until the results were consistently the same.

The sources cited in this literature review were peer reviewed according to the stipulations of each individual academic journal. The sources used were selected not only for the value of the content, but additionally for the academic weight and evidence value of the articles. The articles collectively form a web of interrelated ideas and the research base for the foundation of my study.

Conceptual Framework

This study was based on three theories: Sweller's (1998) cognitive load theory, Anderson's (2006) schema theory, and Vygotsky's (1978) socio-cultural theory. Schema theory and socio-cultural theory both complement cognitive load theory, and many of the concepts of cognitive load theory underwrite this study and the framework for how flipped teaching enables critical thinking, collaboration, and more effective use of classroom time. Each of the theories provided insight to how students might perceive flipped learning, which was the phenomenon explored in this study.

Cognitive Load Theory

Cognitive load theory was the first part of the conceptual framework on which this study was based. For the purpose of this literature review, the definition of cognitive load is the amount of mental effort that a learner expends solving an academic problem (Sweller, 1988). The cognitive load theory originated from Miller's (1956) research on cognition. In this historical study, Miller attempted to more clearly describe the limits of human memory. It was through this study that the standard idea of seven plus or minus two chunks of information could be held in working memory at a given time. Miller further described how the participants in the research had a limited working memory and a vast long-term memory.

Sweller, Van Merrienboer, and Paas (1998) explained that there were three different cognitive loads including intrinsic loads, extraneous loads, and germane loads. Intrinsic load was based on the difficulty of the material by learned. Extraneous load was based on how information was delivered. Finally, germane load was the actual mental

effort the student puts into learning the content. Sweller et al. indicated that intrinsic load had to do with the nature or content and cannot be changed. Paas et al. (2003) added to the definition of intrinsic load, explaining that it is related to the complexity of the learning material that is extremely high in advanced classes such as chemistry and calculus. Higher intrinsic loads require greater effort and interaction with experts in the content (Carlson, Chandler, & Sweller, 2003). A working definition of extraneous load was described by Plass, Moreno, and Brunken (2010) as the cognitive load created by the instruction and the learning environment (p. 12). Extraneous load includes the space where learning occurs and the mode of information presentation. Finally, Paas and van Merriënboer (1994) emphasized that germane load is the *useful load* created while the learner processes information. In understanding cognitive load theory, the goal is to minimize the extraneous load and increase germane load by providing more meaningful and targeted interaction with information.

Current research on cognitive load theory concerned interdisciplinary studies on self-regulation and heuristic learning. Ayres and Paas (2009) and Sweller et al. (2011) furthered the distinction between primary biological knowledge. These studies focused on what can be learned, but cannot be taught (example: speaking) and secondary biological knowledge such as writing, which can be learned and can be taught (Geary, 2007, 2008). More specifically, Ayres and Paas analyzed literature on cognitive load theory in order to more clearly define its attributes and applications. The researchers emphasized that cognitive load theory relies on the biological nature of students' memory. For example, long-term memory was vast while short-term memory was very

limited. Working memory, the area of memory where new information was related to existing knowledge and short and long-term memory interact, existed within the constraints of being able to attend to the correct information and make connections to stored information. Some types of knowledge, such as basic facts and foundational information can be learned best through exposure and repetition (Geary, 2007, 2008). Others required more meaningful learning experiences that root more abstract or new information to mastery level learning. These attributes have to be considered when designing instruction in order to make decisions on what students can learn through exposure and repetition and what requires deeper experience and interaction. While Sweller et al.'s original research on cognitive ability was focused on understanding the human mind with respect to the limits of cognition, current research has emphasized the potential that finite memory could have on the field of education (Ayres, 2006; Paas, Tuovinen, Tabbers, & Van Gerven, 2003). The researchers concluded that educators could learn a great deal from cognitive science research due to the complexity of content areas such as chemistry, physics, and calculus.

The developer of modern cognitive load theory summed up the intent of flipped teaching grounded in this theory by stating:

> The goal of flipped teaching is to address what teachers have the greatest control over in this formula – the instructional design used [extraneous load]. Intrinsic loads related to listening and note-taking are removed from the classroom and reviewed for mastery before moving into more tasking, heavier cognitive load activities that occur under the teacher's guidance to ensure smoother, more

> accurate mastery of understanding and application of the new knowledge. (Sweller, 1993, p. 7)

Cognitive load theory provided a clear foundation for flipped models of learning and instruction. In relation to flipped teaching, three premises fundamental to the flipped approach applied to cognitive load theory: (a) exposure to mastery level material was essential; (b) basic skills and concepts should be addressed and, to some degree, mastered before practice and application occur; and (c) some content areas required greater cognitive effort and application and therefore, require more focused and intense instruction that what can be accomplished in traditional classroom settings and time constraints (Sweller, 1988). More specifically, flipped learning environments operate on the belief that students are capable of exerting greater cognitive effort if they are given sufficient exposure and time to work with foundational materials before working with content experts on more advanced cognitive processes in a controlled environment before independent applications are extended. Working memory is conserved, freeing up space for application and transfer in the classroom, and therefore, lending support to all forms of pretraining (Musallam, 2010).

This concept was often opposite to what happens in traditional classrooms where mastery of foundational concepts is achieved through lecture, discussion, and limited guided practices before assigning higher cognitive load tasks as homework. Students may not understand what is happening at this theoretical level, but they should be able to consider how they experience learning related to the level of thinking and application of

skills. This study sought to describe student perceptions of the flipped learning experience to better understand this innovative instructional strategy.

Cognitive load theory has been criticized by Cerpa, Chandler, and Sweller (1997), based on several aspects including the vagueness of a specific measure, subjectivity of research results, lack of specificity of cognitive load attributes, and influence by affective and personal characteristics. Two measures of cognitive load developed by Paas (1992) and Cerpa, Chandler, and Sweller (1996) have been used successfully thus far, but are still not fully accepted as unbiased (Kirschner et al., 2011). Both of these measures rely on student self-report of mental effort (Paas, 1992) or level of difficulty (Cerpa et al., 1996) using a rating scale. Kirschner et al. (2011) argued that as cognitive load was further differentiated into intrinsic, extraneous, and germane loads, a need existed for a more specific measurement scale of cognitive difficulty to support arguments specific to these three areas. Paas and Van Merrienboer (1993) developed a measure of impact of cognitive load on learning by comparing level of mental effort to student performance outcomes on tests, in order to consider instructional efficiency related to accurate schemata development. However, in their review of this model, van Gog and Paas (2008) indicated that the measure was grossly misused to compare effort during the learning phase to testing outcomes rather than considering both components within the testing phase. In addition to measurement scales, more consistency in wording, collection, and efficiency need to be addressed before cognitive load theory is fully embraced in education psychology (van Gog & Paas, 2008).

In considering potential confounding variables in the use of cognitive load theory, Moreno (2006) noted that some research studies attributed some of the suggested cognitive effects usually attributed to cognitive load theory could also include motivational and affective factors. Additionally, Moreno (2006) suggested that cognitive load theory did not take into account the psychological effects of a person's beliefs, expectations, and goals have on their load perceptions. These cultural and individual components have the potential to reveal valuable information about the value students place on learning, including the learning process, strategies for collaboration, and the overall perception regarding a necessity for depth in learning. Understanding beliefs, expectations, and goals allowed a teacher to frame learning in a manner that is meaningful to students. Neglecting to clearly define these beliefs, expectations, and goals may lead to inaccurate perceptions of a students' ability to achieve based on different views between the teacher and student at the onset rather than actual representation of knowledge. Moreno (2006) emphasized that attempts to increase germane load through only addressing extraneous load by scaffolding mastery information to abstract learning has the potential to increase cognitive load, the culture of the classroom must also be addressed if students are to engage in the level of effort expected in germane loads. Students who have limited experience with abstract tasks, those whose place lower value on learning, and students who focus on mastery level learning may avoid or resist heavier load learning. Based on these potential barriers to application of cognitive load theory, additional theories should be considered related to how information is processes as well

as what environmental factors may also be impacting outcomes. Schema theory and sociocultural theory have the potential to address these concerns.

Schema Theory

Schema theory was closely related to cognitive load theory as part of the conceptual framework on which this study is based. Schemas (or schemata) are units of understanding that interconnect thoughts and ideas in memory (Piaget, 1959). In this theory, Piaget originally posed schema theory for explaining how concepts were learned and linked in memory along with environmental stimuli and emotions related to the experience. This process can be recalled as a schema and used effectively by the learner. Plass, Moreno, and Brunken (2010) explained the value of schema formation in this way:

> First, a highly complex schema can be manipulated as one element rather than as multiple interacting elements when brought into working memory. Second, well-developed schema can be processed automatically, minimizing the demands of cognitive resources to tackle the task at hand. (p. 14)

Schema theory is often used as a conceptual or theoretical framework for research studies in cognitive psychology and social psychology. Schema theory itself was more recently studied by Anderson et al. (2004) and McVee, Dunsmore, and Gavelek (2005). Authors in both studies indicated that schema involve more than just the information contained in the lesson. As content is learned in the classroom, schemata are formed that encompass the entire learning experience. Learning experiences that occur in rich context and which encourage learners to consider information through a variety of avenues and tasks will lead to greater mastery and generalization. The subsequent schema formed this

way can be linked to future content with greater ease. In terms of the flipped model, findings by Anderson et al. (1983) support the approach that schemata must be established. Furthermore, varied level of support, based on strength of schema, should be available. These varied levels of support are often achieved through the in class activities intended to firm up and deepen student learning.

Schema theory was chosen to be a part of this conceptual framework for two reasons. First, schema theory, as presented by Anderson et al. (2004) lent insight to this study by providing the framework how students stored and remembered concepts. The method that individuals make connections and form the web of experiences is how learning takes place. Flipped teaching targets increased learning through removing lower-order thinking tasks from the classroom setting so that time can be freed up for higher-order thinking and authentic tasks. In this model, the instructor seeks to increase the amount that a student learns by increasing responsibility for mastery level learning outside of the classroom, while expecting students to deepen their knowledge further through guided classroom activities and authentic application assignments. This practice was consistent with cognitive load theory, which served as a component of the conceptual framework for this study. Second, Schema theory explains how thoughts are coded into memory and the relationship that pretraining has with cognitive load. Schema theory supports cognitive load theory by confirming that concepts can be considered through chunking information (schema) and by emphasizing that certain tasks employ more regions of the brain. Additionally, the pathways moving between these regions carry a

larger cognitive load, requiring more time and work to process (Anderson, Pichert, & Shirey, 1983; Anderson, Spiro, & Anderson, 1978)

This study investigated student perceptions of what this relationship feels like with the research question of how the flipped teaching model has affected the students' ability to learn content and critically think. Schema theory is an important component of how students learn information and recall the concepts. Student perceptions of how this process is different with the flipped teaching strategy are important facets to discover and facets that warrant investigation.

Sociocultural Theory

Sociocultural theory was the third and final theory chosen to support the conceptual framework. While the schema theory added to the conceptual framework, sociocultural theory met an additional need in this study that cannot be addressed through biologically-based theories. Sociocultural learning theory is able to address the learning environment and interactions that occur within and surrounding that environment.

For the purposes of this literature review, sociocultural theory was defined as the impact that peers, caregivers, and the society in general have on the higher order development of an individual (Vygotsky, 1978). Vygotsky (1978) stated that learning was just as much as social process as a cognitive process. In Vygotsky's own words, "Learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and with his peers" (p. 90). Vygotsky additionally noted that providing a social environment for learning creates an opportunity for students to take advantage of the zone of proximal development (p.

79). The author theorized that there was an academic proficiency that a learner was capable of getting to with the guidance of an expert or peer collaboration. Vygotsky suggested that the social environment provides the expert access and cultural tools to help students at the precise time that they need help to get to that highest level of proficiency. Vygotsky also stated that the student's learning environment was as important or perhaps more important that the student's natural ability. Vygotsky stated that learning experiences appear initially on the societal level and then later at the individual level (p. 79).

Sociocultural theory is often used for studies considering human interaction and learning in social, psychological, and educational settings. A focus is placed on considering how individuals or groups interact, in this case, to accomplish learning. Central concepts of this theory evident in the literature surrounding flipped instruction included maximizing learning within the zone of proximal development and employing cultural tools that enhance student learning. Flipped teaching followed the idea that students learned the fundamentals prior to class and then used the classroom time to extend student learning with discussion, application, and a focus on critical thinking. The classroom time is used for societal learning and then students can extend these experiences later individually. The flipped teaching model is perhaps the biggest shift in classroom environment since the consolidation movement of the 1920s that closed many of the one-room school houses and brought those students to a central location (Tyack & Cuban, 1995).

Sociocultural theory was incorporated into the conceptual framework for three reasons: First, this theory presented opportunity to consider learning through the environment, while previous theories focused on biological bases of cognition. Second, the sociocultural theory takes interaction with resources and between people as part of the learning environment, which can be related to the interactions with various technologies and the types of interactions that occur between students and teachers as well as among peers. Finally, this theory can be directly tied to the intent of research question three 3 posed in this study: How do students perceive peer collaboration and other social aspects of flipped learning? With the implementation of these "four pillars of flip," the focus of class time is shifted from traditional lecture-based instruction to problem-solving, peer-instruction, reflection, and other "active learning" activities (McLeod, Waites, Benavides, Pittard, & Pickens, 2012; Rosenberg, Lorenzo, & Mazur, 2006). McLeod et al. (2012) studied 135 higher education professors that attended professional development by discipline for a semester and found that technology and hands-on activities improved faculty attendance and overall perception of the value of the professional development regardless of ethnicity, race, or tenure status. Likewise, Rosenburg, Lorenzo, and Mazur (2006) have been practicing flipping the classroom instruction for the last 20 years. The tools were different, but the idea is the same. The authors used the time out of class for learning the mastery level concepts and then during class, the students would engage in peer-instruction and discussion. The authors would project a question on the overhead and instruct students to persuade their neighbor that their answer was correct (Berrett, 2012; Rosenberg et al., 2006). In this study, the flipped instruction group showed gains

twice that of the traditional instruction group (p. 69). In the Rosenberg et al. study, the peer instruction/discussion method raised the average test scores on computational problems as well as doing much better on conceptual problems in an undergraduate Physics class versus equal ability students taught using traditional lecture instruction.

Conceptual Framework for Flipped Learning

The three theories within the conceptual framework for this study provided a unique purpose, and yet each dovetailed with the other in ways that provided a theoretical lens for the research design and data analysis. Three premises stood out in the literature as a framework for why flipped teaching works, particularly in content areas requiring a greater cognitive load. A supporting pillar for the use of flipped teaching in education was the first premise of exposing students to the mastery-level material prior to instruction to increase the repetition and comprehension of material (Bergmann & Sams, 2012a; Musallam, 2009). This was consistent with the first theoretical framework, cognitive load theory. Exposure to mastery-level material allowed students to more effectively master content (Seaman, 2011). Pre-exposure or pretraining underlying concepts are more beneficial to learning and application of skills because a foundation is established, but that alone is insufficient. Students must also have repeated and varied exposure to concepts and ample time to work with these concepts. While pre-teaching necessary skillsets and vocabulary is not a new concept to education, Seaman (2011) emphasized it's importance in conjunction with increased repetition and activities that focus on varied levels of comprehension. The second premise was based on the idea that, once mastery level knowledge is achieved, student intrinsic load can be increased with

greater ease through guided practice and application. This was supported further by schema theory and the consideration of how we remember and understand what we have learned. Finally, the third premise was that students must also be able to apply critical thinking independently through meaningful tasks once they have had sufficient practice and guided applications. This premise was consistent with Benjamin Bloom's taxonomy of thinking skills (Bloom, 1956). These meaningful tasks often required interaction with authentic information and other people through collaboration or information-seeking efforts. These tasks asked the instructor to consider the learning environment and interactions more intentionally, which is consistent with sociocultural learning theory.

Interaction of theories in the conceptual framework. Developing a conceptual framework grounded in three theories required further consideration of the similarities among the theories as well as the unique contributions each theory made. Cognitive load theory served as the overarching theme that was supported by underlying concepts found in schema and sociocultural theories. More specifically, cognitive load theory relies on schema theory concepts of how information is processed and categorized, including how much information we can realistically interact with internally at a given time. Cognitive load theory also relies on sociocultural theories to consider how students interact with resources, instructors, and each other within and beyond the learning environment. Schema theory and sociocultural theory both approach cognition from a view of building knowledge; however, each approaches from opposite directions. Schema theory contributes a biological framework for how cognition is developed through the categorization and connections of new information and existing knowledge, while

sociocultural theories allow the researcher to consider the external interactions that facilitate the development of these schema. By considering both, a more complete picture of the learning experience can be developed. While they approach learning from different arenas, the two theories complement each other within the conceptual framework through the overarching themes presented in cognitive load theory.

Each of the three theories, schema, sociocultural, and cognitive load theory assisted in research design and data analysis. Anderson's (2006) schema theory, Vygotsky's (1978) sociocultural theory, and Sweller's (1988) cognitive load theory each provide a piece that forms the conceptual framework for this study. The conceptual framework together was comprised of how students code experiences into memory, how students effectively used the environment, tools, and experts to learn more efficiently, and how certain pre-training activities can be used outside the classroom to make learning easier. This study focused on the students' perceptions of each of these parts. The purpose of this study was to better understand student perceptions of how flipped learning (a) compared to traditional learning, (b) influenced learning math content and impacted critical thinking, and how flipped learning (c) influenced collaboration and other social aspects of learning. The interview questions for the study were designed to investigate these perceptions.

Data analysis considering conceptual framework. All three theoretical frameworks contributed to data collection and analysis. Cognitive load theory directly related to data considering perceptions of traditional learning compared to flipped learning (research question one) as well as student perceptions of critical thinking skills

applied in each model (research question two). Schema theory most closely aligned with data related to Research Question 1 in that the focus was placed on how information is being related and stored. Finally sociocultural theory was directly related to data surrounding peer collaboration and social aspects of the learning environment (Research Question 3), but may also be present in data analyzed related to environmental characteristics and critical thinking interactions while comparing the two environments.

Literature Review

Before flipped teaching itself can be explored, some underlying concepts must first be considered. These concepts include understanding definitions of flipped learning, historical perspectives of this phenomenon, the roles of various technologies in this environment, and the potentially shifting roles of human interaction related to learning in the flipped environment. Therefore, this section of Chapter 2 includes a literature review on these topics.

Defining Flipped Learning

> Flipped learning is:
>
> 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, 2012, p.1)

For the purpose of this literature review the term “flipped”, refers to other practices such as: flipped teaching, flipped classroom, inverted classroom, inverted teaching, and flipping the classroom.

The purpose of flipped learning is to flip where students perform their higher-order thinking. Flipped learning and instruction is driven by the general hierarchy of Bloom’s taxonomy (Bloom, 1956). According to this model, student thinking and learning activities can be broken into lower order thinking skills (remembering, understanding, applying) and higher order thinking skills (analyzing, evaluating, creating). The target of most instructional content is mastery of lower-order thinking tasks and foundational knowledge, which leads to application of higher order thinking skills in hypothetical and life-like tasks. Traditional classrooms, in the context of this study is where the teacher is in the front of the classroom presenting a lecture, often present lower-order thinking skills as part of classroom instruction and assessment while entrusting high-order thinking tasks to students in a less-structured, isolated setting where a student has little chance of others reinforcing or challenging ideas (Cuban, 1983).

Historical View of Flipped Teaching

The underlying concepts of cognitive load and moving basic instruction out of the classroom to make room for more in-depth learning activities was not as new to the academic scene as one may think. Instructional strategies that emphasized student mastery of basic concepts through reading and out of class activities, followed by collaborative learning activities can be traced back to the 1850s, when West Point cadets were taught according to the Thayer Method (Shell, 2002). In this model, students were

placed in smaller classes where they interacted with content for longer periods of time and at greater depth. The students were expected to come to class well-versed in the content to be covered for the day, to the degree that key concepts could be recited and the students were able to develop targeted lessons surrounding the topic. After demonstrating this developmental and conceptual level of knowledge, students then worked collaboratively to solve problems or manipulate information to achieve new or deeper understandings. The Thayer method did not allow time for lecture, thus student ownership of outside learning was essential to the process. The instructor's role in this would vary based on student need and merit. In relating this to flipped teaching methods today, it is fair to say that, while the instructor's role is more clearly defined in providing foundational information, the intent to move lower order thinking responsibilities traditionally covered by lecture, out of the class, so that classroom interactions can be more specific and meaningful has its foundation in early military education (Miller, 1956). Still, at this point in the history of flipped learning and instruction, the concept and theory that clearly defined teacher and student roles, as well as targeted outcomes, were not intentionally developed.

More intentional methods emerged in the late 1990s and early 2000s as teachers sought ways to guide the critical thinking and project based learning activities, which were often completed outside of the classroom, in the more structured classroom setting while still exposing students to lower-order thinking tasks and mastery. This goal was coined as a "classroom flip" (Strayer, 2007).

In 2003, Bergmann and Sams, teachers from Woodland Park, Colorado, are often credited with bringing flipped instruction to the forefront of educational practices. They presented the original model of a screencasted lecture, which students who missed instruction, or those who needed repetitive lessons or reviews could reference any time they liked. Screencasting was defined in the literature as a variety of practices to produce a digital video or screen capture of basic information or work samples in order to relate key ideas, procedures, or visual and auditory representations of original works (Sugar et al., 2010). Instruction was initially presented in the form of a vodcast, or video podcast, of classroom instruction. Chemistry content and sample problems were presented and solved in this virtual environment using video screen casts and screen captures. As the authors practices evolved they sought to predict key information and prerecord these vodcasts with additional examples that could be referred back to, so that students would be more prepared to engage in learning when they came to class (Bergmann & Sams, 2012b).

Flipped Instruction as an Effective Tool for Enhancing Thinking and Learning

As Bergmann and Sams (2012b) worked to refine their practices, other educators and researchers began to explore the development of effective practices in order to develop a stronger foundation in theory and current practice. Sugar, Brown, and Luterbach (2010) explored the screencasting component in order to more clearly define this practice as an effective method for relating lower-order thinking concepts. The authors further noted that this may included online tutorials, streaming videos, and screen shots. In considering benefits of screencasting, the authors cited data related to the ease of

access in a variety of environments according to student preference, ability to replay information, the ability to have plausible step-by-step procedures modeled by an expert, and the ability to add a more life-like component to online learning environments. Sugar et al. noted the importance of being reflective practitioners in the development and modification of screen casts based on student needs and responses to this resource.

Lage, Platte, and Treglia (2000) addressed such practices as the "inverted classroom" (another term for early flipped teaching models) and described the practice as an effective way to better match instructor's delivery preferences while diversifying the models in which students learn best within the classroom. The authors cited instructor preferences, learning styles, individual, group, and problem-solving projects, and the easily accessible media in schools today, as both potential pitfalls and opportunities depending on how these resources are utilized (Lage, Platt, & Treglia, 2000). They suggested that inverted learning and instruction strategies allowed instructors to work in and outside of their comfort zone and to encourage students to do the same. Furthermore, inverted learning presented the opportunity for students to demonstrate an array of knowledge based on the several different "ways of learning" (p. 31) activities and challenges set before them as individuals or as groups, as part of classroom applications.

Today, flipped learning and instruction has become more intentionally grounded in research and theory (Musallam, 2010). Effective and sustainable flipped learning environments seek to engage students in lower-order thinking tasks through assigned readings, screencasts, and basic practice items outside of the classroom, while classroom time is used to expand students toward higher order thinking tasks that may include

working collaboratively to solve life-like problems, exploring concepts in greater depth based on teacher-posed challenges or personal interests, and the development of authentic assessments and presentation tasks. Musallam (2010, 2013) posed a model referred to as explore-flip-apply where students engaged in initial activities to their background knowledge and perceptions, after which they participate in the flipped learning through out of class assignments, lecture videos, etc., followed by in class applications which extend into critical thinking activities and assignments. In this model, the class proceeds beyond a traditional inversion of a lecture and homework flip, by focusing on more intentional guidance of higher order thinking while still extending some work beyond the classroom setting once the foundations is established through the previous steps of explore, flip, and guided practice.

Philosophical Reasons for Flipped Teaching

Philosophical reasons for flipped teaching are based on research and theory, in support of moving the cognitive load to class time, rather than as a take-home assignment. In considering flipped teaching through the lens of cognitive load theory, several benefits emerged in current literature, particularly involving collaborative learning, multimedia, and student-controlled task selection. Kirschner et al. (2011) conducted a meta-analysis of literature related to cognitive load theory in order to identify positive contributions to the field of education, challenges, and methods for measuring cognitive load. Within their meta-analysis, the authors identified themes related to collaborative learning, a common model used for in-class learning in flipped classes. More specifically, their review of the literature yielded consistent trends

indicating that collaborative learning was more effective than individual learning when learning complex information. Kirschner et al. emphasized trends in the literature further indicating that the opportunity to collaborate with peers and teachers allows students to be exposed to information from multiple viewpoints as well as affording them the opportunity to work alongside peers who are can relate learning experiences while working under the tutelage of the instructor. Furthermore, they indicated that faded supports within the classroom environment that moved toward an independent application activity, yielded greater transfer of knowledge and stronger development of generalized schemata. These findings were supported by the work of Kalyuga and Hanham (2011), who considered instructional practices that scaffold cognitive load, while learning how to operate a technical device, through the use of direct instruction not only in the content but in guiding the participants to accurate categorization of schemata in order to make knowledge of content more generalizable to other instances where it would be useful. They found that, when schema development and application was explicitly taught and then supports faded for learning and application, knowledge transfer was significantly improved. These findings supported the flipped teaching premise that by assisting learners in developing stronger schemata through guided classroom activities and intentional applications of knowledge, new knowledge could be acquired, assimilated, and applied more effectively in a variety of situations later. Individualized pacing and instruction is also a common facet of classroom activities in flipped teaching.

Similarly, a meta-analysis review by Kirschner, Kester, and Corbalan (2011) suggested that students can manage higher cognitive loads when incorporating

multimedia learning, considering a scaffolded approach that emphasizes the characteristics of the learning task, including their scaffolding as described above, and incorporating collaborative learning methods that increase germane cognitive load through active student engagement. The authors indicated that favorable results, in terms of cognitive load, retention, and transfer, were achieved when students were given freedom of task selection, as well as a preference for open-ended tasks in collaborative environments. Active student engagement was also supported through evidence by Corbalan, Kester, and Van Merriënboer (2006) in a study of 25 senior-level high school nursing students. In this pilot study, the authors developed a learning scenario that considered appropriate levels of cognitive load based on student autonomy through choice. The authors set out to examine whether personalized selection of learning tasks with shared instructional control led to better academic results than personalized instruction with full system control. The authors found that increased flexibility in task selection, as experienced through student-centered, guided activities, and applications in the classroom, increased student learning and transfer. Schwamborn, Thillmann, Opfermann, and Leutner (2011) considered the same issue in science courses. More specifically, they considered student control compare to curriculum control in the development and use of illustrations for understanding mastery level content. They found that students actually retained and transferred information more accurately in the teacher-controlled group. The authors suggested that, at least in entry-level courses working with mastery-level knowledge, teachers should maintain some control of the learning tasks until successful schemata have been established. This suggestion would be consistent

with the type of multimedia instruction and activities assigned prior to class as part of the flipped framework. Students have limited control of the presentation and their interaction with it until they engage in student-centered, guided, and collaborative activities in the classroom. Doing so allows the teachers to better evaluate student levels of understanding and readiness for more autonomy and increased cognitive load. All of these tasks are more difficult to implement in a traditional classroom setting, however; they are more common and indeed more achievable in the flipped classroom where the instructor is available to guide a variety of critical thinking tasks that would otherwise be assigned as homework.

Benefits of Flipped Teaching

Flipped teaching has experienced a diverse evolution in its application in classrooms, from an efficient way to make up lecture material that was missed and offer re-teaching opportunities (Bergmann & Sams, 2012b) to models that move students toward authentic application of critical thinking skills (Musallam, 2010). Bergmann and Sams (2012a) noted when they began using the flipped teaching strategy in 2004, that high school chemistry students showed significant increases in academic and standardized test performance compared to peers who learned in traditional classroom settings.

Benefits related to improved general student outcomes. More recently, numerous instructors have found benefits in trying the flipped teaching strategy in high school and college classrooms. The benefits ranged from increased repetition and exposure of key concepts, to extended opportunities for guided practices, and even to

creating greater student autonomy and ownership of the learning process (Strayer, 2012). To evidence the student ownership and perception, Strayer (2012) conducted a mixed-methods study by using two groups of participants; one group of 13 students were taught using the flipped method and one group of 15 students were taught traditionally. The participants were surveyed to measure perceptions of personalization, innovation, student cohesion, task orientation, cooperation, individualization, and equity of the learning environment both at the beginning and end of a semester. The intent of the survey was to measure the perceptions of actual learning environment versus what their actual learning environment might look like. The researcher found that out of 26 participants, most students felt that the actual learning environment in the classroom did not coincide with the students' preferred learning environment. Qualitative data bolstered the quantitative data as students stated that they felt that their actual learning in the traditional environment did not measure up to what it could be. The researchers noted that the flipped instruction group was more open to cooperation compared to the traditional instruction group. The author suggested a mismatch in the traditional teaching strategies used in the classroom and the way 21st century students learn and view success in the classroom. These results emphasized the importance of considering student perceptions related to the full picture of their learning experiences. While much of the literature on flipped teaching is quantitative in nature and relate to performance outcomes, Strayer's study was one of the few qualitative studies that provided an introductory insight into students' perceptions. More specifically, the study results indicated that flipped

instruction was capable of achieving positive collaborative learning outcomes and that flipped instruction was more likely to meet the learning needs of the 21st century learner.

Relating both discipline and instructional strategy, Sahin, Cavlazoglu, and Zeytuncu (2014) conducted a case study of 96 students enrolled in a college calculus course and found several points to consider. The authors stated in addition to increased levels in student achievement that students preferred watching the videos to reading the course text. The authors also found increases in preparation habits and higher levels of self-efficacy compared to a similar non-flipped college calculus group.

Other recent studies relating to general academic outcomes include Davies, Dean, and Ball's (2013) mixed-methods study with 207 participants in a learning technology skills course. They authors found that the flipped instruction students exhibited a significant increase (mean of 89) in academic performance over the traditionally taught group (mean of 85) on the post-test (p. 10). Davies et al. cited that this increase in academic performance was due to self-paced learning allowed by flipped teaching instruction. The authors also noted that in a student survey, the students were more likely to take another flipped course in the future. Talley and Scherer (2013) also conducted a mixed-methods study of college psychology students and found that in addition to increases in academic performance, students exhibited increased retention and engagement compared to a traditionally instructed class.

Benefits to student learning and critical thinking outcomes. Current literature presented varying contexts in which the flipped model could benefit student learning. Prober and Heath (2012) analyzed the effects of the flipped teaching model in a Stanford

Medical School biochemistry course and found the presentation of mastery-level concepts in the flipped approach improved the "stickiness" of concepts. The instruction for the course was modified to short, online presentations and left classroom time for interactive discussions of diseases stemming from biochemical origins. As a result, the attendance rose from 30% to 80% for the term (p.1659). The average scores for the students in the study were 74% compared to the prior term student average score of 41% taught in a traditional lecture-based setting. The authors also focused on one aspect of flipped opportunities, which was increasing the number of opportunities students were exposed to key concepts in a variety of contexts in order to better prepare them for application of the concepts later in their education.

Critical thinking and problem solving were also supported in literature regarding the benefits of flipped teacher and can be considered within these varied contexts. The idea that students must master lower-order thinking of conceptual groundwork before moving to more abstract ideas or applications, was consistent with movement across Bloom's taxonomy (Seaman, 2011) and critically important for students going into medicine. By emphasizing, remembering, and understanding through repeated exposure, students perceived that they were more prepared to explore, predict, and implement meaningful applications when faced with opportunities later in their medical training (Prober & Heath, 2012). The researchers found that students responded best to flipped lectures that appealed to student curiosity, encouraging them to engage in questioning and reasoning within the presented content. This practice led to improved attendance from 30% to 80% and test scored improving by 33% (Prober & Heath, 2012, p. 1659).

This was important to note because student behaviors toward course involvement through participation and attendance shifted significantly as a result of the instructional model. Understanding why students responded in this manner through exploring their perceived experiences might provide further insight into the more effective characteristics of the flipped instruction model. Gannod, Burge, and Helmick (2008) found similar results working with software engineering students at Miami University. In a technical report concerning best practices of blending classroom content with technology, students viewed 3 to 6 hours of recorded lectures outside of class per week. The authors found that reallocating times dedicated to different learning activities permitted students to move at their own pace and engage more readily. Based on their findings surrounding student readiness to learn, self-awareness of pacing, and overall engagement in classroom based activities as part of a reversal of in class and out of class roles, the authors presented a description of the classroom environment, culture, and learner in the flipped. Key differences noted between traditional and flipped classrooms included increases preparation time for the instructor; with a focus on developing quality videos and establishing carefully structured classroom activities for students to take ownership of. Gannod, Burge, and Helmick (2008) emphasized that the most significant changes noted were related to in-class activities where students were required to think more critically and demonstrate their own navigation of learning through increased interaction and collaboration. This shift would require change in the ways students and instructors viewed learning roles, including understanding that attendance is essential. Boutell and Clifton (2011) employed a practice they coined as SPLICE, which stands for Self Paced

Learning in an Inverted Classroom Environment, using similar strategies as those presented previously in order to allow for more class time in applying skills in more realistic settings. The authors emphasized the usefulness of additional time and opportunity for one-on-one and individually paced instruction in the classroom as highly beneficial to students who learn at different paces. They found that students were able to apply theory learned through flipped lectures at their own pace under expert guidance in the classroom. The live assistance while working real-life examples allowed for immediate help and correction and students were more self-aware of needs and progress. The authors noted that allowing for personalized pacing not only helped students learn software coding more efficiently, but that instructors also felt more confident in setting the pace for activities in class. Instructors also indicated a preference for the increased time available for expert coaching through in class application rather than homework only application. This supported concepts presented regarding sociocultural learning through resources and human interaction, components that students might be able to relate through consideration of their experiences as part of this study.

More recently, Overmyer (2014) conducted a quantitative study two sections of college algebra where there were 166 traditional instructed college algebra students and 135 students in the flipped instruction group. Overmyer found that the final assessments were statistically similar for the majority of the two groups; however, students taught by instructors that had previous classroom experience with inquiry-based or collaborative learning had significantly higher final assessment scores. Overmyer's study may indicate

that to receive the full benefits of flipped learning, students need multiple exposures to the learning or teachers need practice to teach with this pedagogy effectively.

Benefits related to time and demand of courses. Another benefit for flipped instruction related to how flipped instruction helps instructors deal with the time and content demands for learning in many college and high school courses. High schools are faced with content standards and standardized assessments that seek to measure mastery of prescribed information within a set time frame. College students are eager to learn industry standards that will allow them to compete globally while still graduating within a set number of years. These time and content constraints make flipped teaching a viable option for covering greater amounts of content in more depth. Toto and Nguyen (2009) found that they were able to cover more content with greater depth, alleviating some of the pressures of the industrial engineering program with increased student participation and satisfaction. The researchers noted the importance of ensuring that in-class learning activities were meaningful and engaging and that efforts were made to keep all students active, particularly when involved in collaborative work. Careful consideration of planned learning activities was further explored by Nielsen (2012) in cautioning teachers considering flipped instruction to move forward with careful planning. Nielsen noted that while flipped teaching increases exposure to instruction and application of skills moving from lower to higher order thinking tasks, if teachers are not prepared for the level of planning and structure required, the flipped teaching model only increases the opportunity for poor pedagogy (p. 46). Ultimately the target of learning and best practices must be considered along with teacher readiness for instructional models.

Looking deeper into the specific characteristics that benefit different types of students, Flumerfelt and Green (2013) identified and measured five characteristics that impacted the learning of at-risk students, noting that these students appeared to benefit even more than their peers from the flipped environment. The quantitative study employed 23 at-risk students in a flipped government class and used a second traditional government class as a control group for comparison. The survey data collected was focused on five characteristics related to how much time was:

- dedicated to learning tasks and activities that build positive learning relationships,
- dedicated to active vs. passive learning,
- focused on new learning activities,
- available for individualized attention,
- dedicated to differentiated instruction.

In this study, the data considering teacher contact time revealed that flipped learning environments allowed for increased time with direct contact between the teacher and individual engaged in learning tasks that also promoted the development of social skills. In addition to this, the data related to student level and type of engagement supported the philosophy that flipped learning promotes more active learning, even in lecture because the student must commit to listening and note-taking if he/she hopes to engage in class. In class, active learning is focused on deepening learning in a more individualized manner. The individualized focus promoted greater autonomy, intentional collaboration based on learning needs, and increased differentiation based on student application activities and

learning needs (Flumerfelt & Green, 2013). The authors found that student engagement in out of class activities increased by 25% with overall academic achievement improving by 11% (p. 364). Growth was also noted in reduced disciplinary reports and failure rates among at risk students decreased significantly across all content areas where flipped instruction was used.

Many benefits of the flipped teaching model were focused around better use of the classroom time for collaboration, increased student involvement in academics, and more meaningful student/instructor communication (McCallum, Schultz, Sellke, & Spartz, 2015). Green (2015), in a qualitative study of six marketing students found that coupled with flipped learning, in-class activities such as team-based, interactive, and hands-on interactions promote active learning. The researcher also noted teachers mentioned in interviews that students felt safe taking academic risks because "If something goes wrong [during the flipped classroom experience] in terms of students not understanding content, they know I'll be there to help them out" (p. 188).

Benefits discussed here were primarily from an instructor's point of view. Research on student perceptions will be explored in another section. While there are there are research-based reasons for implementing the flipped teaching model, there are also drawbacks, which can be stumbling blocks for teachers as they work to make a change in their pedagogy.

Drawbacks of Flipped Teaching

In some courses it can be more difficult to find authentic application of content, either because authentic uses are too abstract for the level of the course, or because the

focus of the course is on establishing firm understandings of the groundwork necessary in order to successfully use content in later courses or more advanced content beyond the content of the existing course. This is the case in many advanced mathematics courses not geared toward specific career fields. Pink (2011) described how one school made accessibility to practice and instruction a priority by creating and employing teacher and student YouTube accounts to increase student exposure to content in and out of the classroom. However, Ford et al. (2012) conducted a study over two semesters with two General Psychology classes averaging 30 participants and found that students that learned by watching video recorded lessons were not always effective despite student preference for video-casted lessons. Students were encouraged to access the videos for instruction, practice, and remediation when they did not understand content or received a substandard assessment score. However, even when given these additional resources, students did not perform any better on assessments compared to peers taught traditionally. This finding was important in indicating that the flipped model must address more than just access to materials and information outside of class. While student perceptions indicated a preference for the resources, the loosely structured interaction with those resources did not lead to improved mastery, collaboration, or critical thinking. In a quantitative study by Hutchings and Quinney (2015), the authors found that despite higher academic gains, the change to flipped instruction was too great from some students. The authors cited the combined disruption of inquiry-based learning with technology platform changes were challenging for all and caused dissatisfaction for some due to too much change (p. 118).

Fulton (2012) considered outcomes in a high school Pre-calculus class when flipped instruction was used to expose students to lesson presentations and sample practice items through videos prior to class. Students were expected to view lessons and practice basic items along with the video presentation in order to mirror the process and apply formulas step-by-step with the instructor. In class, students were encouraged to work increasingly more difficult problems while collaborating with the teacher and classmates. Collaboration allowed for immediate checks for errors and increased student willingness to try. Academic scores increased by 11 %, with state proficiency exams evidencing a 9.8 % increase. Additionally, the author found parents had a resounding preference (84%) for this model in helping students succeed in a difficult course with less frustration (Fulton, 2012, p. 16).

While the flipped teaching model showed some promise in the high school mathematics environment, benefits and drawbacks must still be carefully considered and addressed through careful planning. This includes considering the intentional use of resources and careful planning of collaborations that are likely to elicit student commitment and engagement in critical thinking. Strayer (2007) found that students in introductory statistics and calculus courses were evenly split on whether or not they felt in better control of their learning in the flipped classroom, indicating that student self-perceptions and confidence learning with this model needs time to evolve. The shift to learning in a flipped environment, as well what teaching entails, is a complete change of thinking and instruction from the traditional classroom environment (Bergmann & Sams,

2012a). These findings supported the idea that there is still more to learn about the characteristics the flipped classroom culture.

Student Reception to 21st Century Instructional Strategies

Understanding student reception to flipped teaching and other 21st century teaching strategies is important in establishing characteristics of these strategies that students are likely to embrace. Student engagement in learning activities supports commitment to learning tasks, particularly when students are being asked to take on increased cognitive load and more in-depth critical thinking tasks, including those that require more authentic application of learned skills. Student perception of classroom experiences has received limited coverage in the literature to date. However, the areas of research which does include student perceptions includes; student readiness to engage in flipped learning (Bergmann & Sams, 2012b), student and teacher interactions (Chandra & Fisher, 2009; Strayer, 2012), technology-based learning (Chandra & Fisher, 2009), video-enhanced learning (Khan, 2009; U.S. Department of Education, 2010), and strategies that take personal perspectives and interests into account (Kahveci, 2010).

There is some research that studied students' readiness to engage flipped learning. Students were more willing and interested in working collaboratively in flipped environments compared to traditional classrooms (Strayer, 2012). The more open or loose classroom atmosphere was described as promoting more comfortable relationships. However, looseness in the classroom was also easily picked up on by students and has been observed to lead to behavioral adjustments in the classroom as they attempted to navigate teacher expectations. Perceived looseness then has the potential to interfere with

program effectiveness and can compromise appropriate respect toward instructors as new roles and relationships are established where the instructor is perceived as a guide and not solely a provider of information (Finkel, 2012; Strayer, 2012). Even in instances where students appeared to take advantage of the casual classroom atmosphere, they still evidenced significant academic gains (Strayer, 2012, p. 7). The individual conversations between students that would normally be disruptive in class were changed into conversations about content in the classroom. These conversations, in turn led to a greater opportunity to discuss and hone critical thinking skills. When the instructor turned these negative classroom conversations into something more positive, the flipped instruction model also promoted greater focus and reliance on professional and positive teacher-student and student-student interactions.

Other research that addressed student perceptions considered how students and teachers interacted in the classroom. Students that participated in well-structured flipped learning environments felt they had more opportunities to get constructive feedback from their teachers while learning at a pace that best met their individual needs (Kahveci, 2010). Teachers voiced that conducting application activities in the classroom allowed them to keep a more careful eye on student learning, interaction, and responsibility for learning. Furthermore, doing so also allowed the teachers to more effectively target learning needs. The overall result was that students and teachers both voiced more positive and proactive interactions (Bergmann & Sams, 2012b; Chandra & Fisher, 2009; Strayer, 2012).

Student perceptions were also included in some research related to technology use. When technology integration is considered in content areas with higher cognitive loads, research continues to show positive perceptions of technology by both teachers and students. In a qualitative study by Chandra and Fisher (2009), a hybrid (30-70% of the content was learned online) classroom of 214 students from a single high school were surveyed about their perceptions of self-motivated learning at the completion of the students' science class. The authors found that the use of technology-based learning in science bolstered self-directed learning and permitted more self-regulation among the surveyed students (Chandra & Fisher, 2009). Additional studies reiterated have shown similar results when considering student and teacher perceptions of technology in the mathematics classroom (Ellington, 2006; Kulik, 2003; McCulloch, 2009). Using technology in the mathematics classroom was shown to improve students' mathematics skills as well as their attitudes towards mathematics. Khan (2009) added that students perceived the use of technology in the classroom as more engaging. Moreover, technology enabled material that was initially difficult to understand, easier to understand at a later time because students could return to posted resources at a later time for clarification. Another noted benefit was that use of technology increased student interactions with fellow students and/or instructors in mathematics classrooms.

There was also research on student benefits as well as their perceptions related to specific use of technology resources such as video and simulations. The U.S. Department of Education (2010) conducted a meta-analysis on the use of technology including teacher and student perceptions of their learning when technology was incorporated into

lessons. Three areas stood out as highly effective practices in the use of technology. First, when technology use incorporated a reflection component, comprehension and perceptions of learning success increased significantly. Second, embedded video examples, activities, or enhancements greatly improved retention (U.S. Department of Education, 2010). Finally, technology that specifically presented simulations significantly improved student perceptions of their abilities and measures of understanding the content (Castaneda, 2008; U.S. Dept. of Education, 2010).

Receiving content through a podcast or video was another area in which some research is identifying student perceptions on how technology supports their learning. Using a podcast or video were the two most common methods for presenting lecture, tutorial, and simulation content in the flipped classroom and thus deserve a closer look. In research by Taylor, McGrath-Champ, and Clarkeburn (2012), the authors surveyed six higher education classrooms ranging from 28 participants to 143 participants about their perceptions of podcasting in a team-based learning model. The data from the study suggested that teachers viewed podcasts as an extremely valuable resource for preteaching content, promoting deeper thinking, and aiding in repetition for remediation. Screencasting was a common step for moving from a podcast of lecture to video modeling created by the instructor. While it takes took to learn and perfect this practice, the benefits to student understanding and concept visualization through video examples supported screencasting (Richardson, 2010). Teachers indicated positive outcomes including the ability to implement a move collaborative classroom model and increased student-student and student-teacher interaction involved more advanced content and

critical thinking. In a study by Kay and Knaack (2008), data supported that participants voiced a preference and high level of comfort with learning by videos as it is a model they are accustomed to in their everyday interactions with technology. On the other hand, while many students preferred learning with technology resources such as podcasts, videos, and screencasts, some students (regardless of age, gender, race, or course of study) still prefer the face-to-face component that can only be found in a traditional classroom setting (Kazlauskas & Robinson, 2012).

While Chandra and Fisher (2009) indicated that students preferred a technology rich learning environment, citing convenience and accessibility, this preference still varied based on several student characteristics. In a study by Kolikant (2009), the researcher surveyed 74 participants from several history classes with very different backgrounds concerning students use of the Internet and technology in afterschool, student perceptions of technology self-efficacy and intellectual gain, and research processes using technology for academic use. In fact, Kolikant found that the preference of technology for some resources is actually highly polarized. When considering the use of technology to replace bound books, Kolikant found that students' preferences were very strong for or against this decision based on Internet competency and readiness to use the Internet as a study tool. Students did express greater skill at using the Internet than their teachers. Both technology literacy and personal preference were important to consider when planning for the flipped classroom because student competency must first be considered and necessary pre-training offered. Furthermore, teachers must be well-

prepared for understanding and recommending the studying tools the teachers expect students to use.

In addition to considering student interests and preferences, student attitudes toward technology-based instructional strategies must also be taken into account. Kahveci (2010) completed a study that randomly surveyed 158 9th through 11th grade gifted students from Turkey. In the study, the author considered student attitudes toward the use of technology-based resources according to basic demographics as well as experience and academic interests. The author found that, while students had positive attitudes about the use of technology for learning regardless of age, gender, grade level, previous experience, and content area of interest, female's confidence was lower than that of their male peers. Interestingly enough, more experienced students were less confident compared to less experienced students and students good at science and math were more positive about their ability to use technology compared to peers who viewed themselves as weak in science and math. These content areas are considered to carry a higher cognitive load and require greater student persistence in learning.

An additional study delves into these perceptions further by considering preferences of students identified as talented and gifted. Kanevsky (2011) found that talented and gifted students showed a stronger preference for differentiation with technology when asked to apply more advanced thinking or strategies to learned content. These demographic and individual difference factors would indicate that teachers should make an effort to provide increased guidance to certain populations in the flipped

classroom based on academic preferences and comfort level with technology, while attending to potential gender differences as well.

More recent literature addressing student perceptions for why or how flipped teaching and technology in education has also begun to emerge in the literature. In a mixed-methods study by Strayer (2012), the author measured 26 participants using a previously grounded perception scale amongst two groups: a lecture-homework group and a "blended" group. Strayer indicated that student showed a strong preference for the "blended" learning environment that resulted from the in-class activities. Students also expressed positive perceptions of the tutoring system of video examples and repeated exposure coupled with in class practice that could be more individualized. In another study, students indicated that they valued technology mediated instruction for its increased collaboration, accessibility, and the ability to work with diverse groups despite physical location (Kalin, 2012). At the collegiate level, Toto and Nguyen (2009) found that college students in an industrial engineering course felt they were able to accomplish more learning when they were able to view podcasted lectures before attending class. The students indicated that the podcasted lecture was effective for introducing basic concepts and allowed them to consider basic information at their own pace prior to class. Advanced preparation then made the students feel more ready for difficult assignments and tasks because they were more prepared to share and address understandings and misunderstandings prior to class.

Still, negative aspects must also be considered when technology becomes a prominent part of the classroom. Students may express feelings of alienation from their

instruction when learning and practicing through technology mediation (Anyanwu, 2003), a concern that was voiced as early as 1976, when a study of instructional models indicated that such practices may lead to the perceived absence of a meaningful relationship (Bye, Pushkar, & Conway, 2007; Kaplan & Maehr, 1999). In addition to the reduced relationship between instructor and student, Armstrong (2011) found that, although students valued the increase in independence and self-directed learning that technology-mediated instruction allows, students felt they were also losing direction from and communication with instructors. Thus effective flipped teaching must include careful consideration of the type of interaction the instructor employs in the classroom as well as their presence in video, podcasting, or other flipped activities.

The 21st century learner is dramatically different from students in the classroom 15 years ago. Today's student does not want to sit and simply receive information from the teacher. Students desire to learn and contribute, to edit and remix the content (Bonk, 2009). This is cause to further explore explanations of students' acceptance of non-traditional instructional methods and how they might relate to flipped instruction. More specifically, the "complementary fit" between instructional strategy and student learning strategies grounded in Vygotsky's socio-cultural theory (Vygotsky, 1978) should be explored, particularly in terms of the resources employed. Vygotsky's theory promoted using cultural tools in the learning environment to make mastery of content more efficient. All age groups are profoundly affected by the use of cultural tools to enrich the learning experience (Kalin, 2012; McCulloch, 2009) and the current generation may perhaps even more so. Tapscott (2008, p. 412) suggested that:

> Growing up digital has had a profound effect on the way this generation thinks, even changing the way their brains are wired…These young people are remaking every institution every institution of modern life, from the workplace to the marketplace, from politics to education.

Based on what is known about students today, the following sections will look more closely at cultural tools employed to engage students more deeply in the classroom, including common technology such as video capture, podcasting, and other field specific tools.

Technology Use in the Flipped Classroom

Research considering student perceptions of technology in delivering instruction, interacting with content, and collaborating for learning, indicate a strong preference among students for the resources. In a study by DiVall et al. (2013), the authors investigated the student, faculty, and administrator perceptions of technology use in higher education. The authors surveyed 466 pharmacy students to consider student impressions of the impact of technology use on levels of communication and quality of learning. The researchers found that 78% of students either strongly agreed or agreed that technology use increased communication between students and instructors (p. 4). Furthermore, 80% of students agreed or strongly agreed that lesson capture (using audio or video recording) enhanced their learning experience (p. 5). Students also felt that podcasts enhanced their learning experience with 63% agreement or strong agreement. Moreover, 70% of students suggested a greater use of podcasts in their courses. Only a minority of students (6%) would have liked to see less technology use in the course

(DiVall et al., 2013). This data sends a strong message that students are likely to be more engaged in learning if intentional technology integration is part of the flipped classroom strategy. Exploring this possibility further through this study has the potential to lend insight into which components of flipped teaching are most appealing to students. While appeal alone does not achieve increased learning, it may yield increased meaningful engagement.

Likewise, Weaver, Walker, and Marx (2012) employed surveys, semi-structured interviews, and observations in a college sports management course composed of 80 students. The authors found that student perception towards technology followed several themes: students expressed a desire to use technology, even without formal training, utilizing technology provided a creative way for students to learn from each other, technology worked because students perceived themselves as visual learners, and even though technology integration with the content was complex, the students were interested in trying regardless of the result. This further enhanced the view that flipped teaching allowed learners to access information in a multi-modal manner that encouraged a variety of learning styles when considering content. Students may express easier access to information when presented in this manner. Poellhuber and Anderson (2011) confirmed this result stating that 58.2% of distance learners indicated a preference for video sharing services such as Youtube or screencasts to promote visualization of the concepts being learned (p. 113).

These three studies related a view that, for a large percent of students, technology was not only perceived to enhance learning of content through a variety of forms of

interaction, but it also promoted greater collaboration, creativity and increased interest. In addition to this, Weaver et al. (2012) identified a sociocultural trend toward a desire to use technology in learning, even before formal training on accurate use is provided. Increased desire for the use of technology and its multiple applications may provide some insight into how students view learning culture and demands for learning within an era where technology is infused into many aspects of both living and learning.

Student Perceptions of Learning Strategies

Researchers have taken a variety of approaches to learn more about how students view learning in the classroom. Chen and Hoshower (2003) noted the prevalence of student ratings as the most common tool in assessing student perceptions of both teaching and learning styles. However, the authors cautioned that this was perhaps not the best approach. College students polled in their study regarding the effectiveness of such rating systems indicated that it did not allow for collaborative feedback and that students did not feel they were voicing concerns in a way that would lead to visible positive change in the classroom. This was important to consider when evaluating student perceptions related to the flipped environment because students must feel they have had an opportunity to thoroughly share thoughts and be understood as well as have an opportunity to see how their feedback may improve learning environments. In another study, Floyd et al. (2009) employed a variety of tools and develop a final survey to evaluate perceived course value, student engagement, strategies employed for surface learning, and strategies employed for deeper learning. The authors found that deeper learning occurred when students were asked to engage more regularly and when they placed a high value on the

course content. This was important to consider in understanding that instructional practices must be engaging and they may also have to promote a higher perceived value. This might be related to the presentation of student-centered, authentic tasks that students perceived as meaningful.

Teaching style has the potential to further impact learning outcomes as much as learning styles do. Gaining insight into student perceptions of both instructional strategies as well as the strategies they may apply in learning provides valuable insight. While there was a gap in the literature related to student perceptions of these components within the flipped learning environment, these concepts can be considered in a more broad nature. While many teachers tend to teach according to the way they were taught, or according to their own learning styles, research would indicate that students learn best when instruction appeals to a variety of individual learning styles (Sitt-Goheds, 2001). Farkas (2003) found similar results when modifying instruction for learning style among 7th grade students. In addition to this, student perceptions of learning style may be impacted differently based on the content being taught. Chang (2002) indicated that when students were taught using constructivist teaching and learning activities, the students voiced a strong preference for this model based on the content. Furthermore, students expressed a perception of deeper understanding of the content based on their interactions with the information. In addition to this, students who engaged in problem-based learning in various high school biology courses voiced increased intrinsic motivation to accomplish learning goals as well as an increased readiness to employ metacognitive strategies to learning (Sungur & Takkaya, 2006). This was important to consider in relation to flipped

instruction and student perceptions as teachers consider which teaching styles best support interaction with increased complex tasks within the flipped teaching realm. Students may perceive learning strategies that allow for problem-solving, collaborative interaction, and increased metacognitive strategies as more valuable aspects of the flipped classroom.

In addition to this Chang and Liu (2011) explored student perceptions of learning strategies in technology enhanced learning college physics course and found that students perceived their achievement to be associated with not only the instructional model employed, but also with prior knowledge, study habits, and the classroom atmosphere. Preference for technology-enhanced learning was stronger among women than among men in this study, suggesting that gender differences may exist in perceptions as well. This was important to consider when addressing all aspects of the intent of the flipped classroom including the perceived intentional use of instructional and learning strategies that link schema (prior knowledge to new information), support study habits, and build a positive classroom climate.

Finally, while studying student perceptions of classroom learning is important, some critics argue that student perceptions do not always align with the activities that actually occur in the classroom (Kennedy, Lawton, & Plumlee, 2002), while others have found that it does (Kuhn & Rundle-Thiele, 2009). Kennedy, Lawton, and Plumlee (2002) indicated that marketing students often overestimated their performance if they had not regularly practiced making informed judgments about personal abilities. Kuhn and Rundle-Thiele (2009) also considered student self-perceptions related to actual outcomes

and found that marketing students in higher education were able to accurately represent their learning in relation to their perceptions of strategies employed. Kennedy et al. offered some potential insight here. The authors cautioned that self-awareness of abilities must first be taught if students are to provide accurate perceptions of performance over time. Still, it is worth the effort to determine student perceptions because this aspect has the potential to reveal how and why certain components of the flipped learning environment have succeeded in many situations yet shown less promise in others. In addition to this, the current study did not pose to consider perceptions related to performance, rather the study sought to describe experiences and value of the flipped learning environment through the perceptions of the learner. The intent was not to judge the quality of outcomes, rather to describe the learners' experiences. Still, understanding student perspectives allows the teacher to make more informed decisions in how to adjust instruction to the individual and group needs of learners (Chen & Hoshower, 2003).

Critical Thinking

With a student's cognitive load being shifted in the flipped teaching model, the assumption was that students would be able to learn and apply critical thinking skills in more meaningful ways. Students' perception of their critical thinking was an important component that was explored in this study. There were a number of research studies that have looked at critical thinking, related to strategies used in flipped instruction but each approached data collection in a different way. In a meta-analysis by O'Flaharty and Phillips (2015), the authors found that the flipped learning model promoted student empowerment, collaboration, and problem solving skills in three separate higher

education classrooms. In a quantitative study by Gilboy, Heinerichs, and Pazzaglia (2015), the authors found that 56% of students in a higher education nursing course believed that they learned content more effectively in turn allowing them to become more actively engaged in the classroom activities (p. 112). Baepler, Walker, and Driessen (2014) found similar results in a quantitative study of a higher education science course, but emphasized the increased need for technology and time resources for success. Bailey (2014) studied student perceptions of critical thinking in asynchronous discussion boards as part of the learning and communication process in a college literature class. Students indicated that using discussion boards inspired critical thinking, analysis of written text, and made literature come alive for reluctant readers. The perceived non-threatening environment of the discussion board encouraged students to interact with increased personal input, but also allowed for students to further develop their own understandings based on the input of others within the discussion board. This model of social interaction to explore and deepen understandings outside of the classroom is an integral part of the flipped model, and is one reason the socio-culture theory was selected as part of the conceptual framework. The discussion board was a common academic path used to achieve student interaction through employing a more academic media model (discussion board) versus social media models (Twitter, texting, and blogging). Social media incorporation was explored further in a later portion of this section.

Critical thinking of students can also be measured in products that they create related to content they have learned. Frisch, Jackson, and Murray (2013) conducted a mixed methods study to consider the use of technology as a tool for creation rather than a

tool for reflection. In Frisch, Jackson, and Murray study, 52 college students enrolled in a senior-level biology course were asked to create websites related knowledge of content learned and then to evaluate accuracy and value of that content. The participants' content created was scored using the Critical Thinking Assessment (CAT) test. The authors found the students increased their depth of understanding with the content as well as honed the real-world skill synthesizing and creating new content from various sources. In the study, the participants reported that they felt the greatest gains were in critically reading for evidence according to their topic and distinguishing between scientific and unscientific sources. The instructional strategies described in the Frisch et al. study are consistent with flipped practices in that technology is a common pathway for demonstrating creative understanding and applications of content learned through deeper learning activities in the classroom. In fact, Musallam (2010) found similar results in considering his flipped model that also employs a technology-rich learning environment and collaborative learning activities. The author found that critical thinking was more evident in classes where flipped instruction included student-centered, technology-based deliveries of basic level information, while wrestling with more abstract, critical thinking tasks occurred in the guided and collaborative classroom setting.

In a quantitative study, Huang, Hung, and Cheng (2012) compared differences critical thinking abilities between two groups of students. One group was taught using traditional methods compared to groups of students who learned using technology-enhanced methods, including videos, animations, and podcasts. The authors evaluated 61 7th grade participants from Taiwan using a critical thinking scale and found similar

results. The authors administered the Critical Thinking Abilities Test (CTT-1) to students in both groups (traditional instruction and technology-enhanced) before and after instruction to consider outcome differences. The experimental group (technology-enhanced) showed a significant increase in critical thinking by analysis of variance and a 12-point increase in achievement over the traditionally taught group. While the study did not employ a flipped instructional method specifically, the study supported the claim that student technology use as instructional tool can help increase critical thinking. However, the study did not consider student perceptions of learning with increased technology, nor did the instructional methods implemented in the experimental group encourage the creation of new products, application of content, or the collaboration with peers. These additional variables still need to be further explored.

Sweet and Pelton-Sweet (2008) addressed critical thinking increases from a similar point of inquiry. The researchers suggested that a strong reason for the increase in critical thinking might be the increased level of accountability between collaborating peers. Sweet and Pelton-Sweet observed and recorded conversations between team members and analyzed how groups formed conclusion in multiple-choice assessments. The authors found that students stated critical and insightful comments in order to reach collective agreement.

Collaboration

Based on collaboration potentially contributing to deeper learning and critical thinking, this concept deserved closer consideration in terms of student perceptions and its role in the flipped classroom. Kalin (2012) noted that students preferred using

technology because of the ease of use, ability to collaborate with peers, and the ability to collaborate with learning groups from home, school, or anywhere that the student had access to the Internet.

Collaboration has shown to be a highly desired method for enhancing learning in other less traditional learning models as well, including online and hybrid settings. While it may be more challenging to achieve, perceptions presented by students in these environments indicates that collaboration is a key stepping stone in moving toward greater critical thinking as part of learning. In a mixed-methods study of college distance learners by Poellhuber and Anderson (2011), the authors surveyed 3,394 participants. Of those participants, 38% stated that they were interested or very interested in collaboration with peers because of the opportunity to bolster correct ideas or find misconceptions earlier. Osgerby (2013) found similar results in a study of 21 undergraduate and graduate students in a hybrid classroom environment. The author found that using a mixture of technology tools such as a Moodle (a web learning management system for storing, organizing, and downloading files), online quizzes, and other self-study materials, students were positive about interacting and collaborating with peers in the electronic environment.

To delve further into student satisfaction with collaboration in the hybrid environment, Sorden and Munene (2013) surveyed 108 community college participants about their satisfaction with social presence, collaboration, and technology-supported collaborative learning in the blended learning environment. The authors found high positive relationships between student satisfaction and collaboration in this environment.

The authors also found high positive relationships between student satisfaction and social presence; meaning how learners project themselves online and feel like they are in a community.

In a qualitative study by Clark (2015), he found students "desire to learn improved" (p. 102) despite no negligible change in academic performance versus a traditional classroom. Clark observed increased engagement, communication, and collaboration compared to a traditional classroom. Studies by Kalin (2012). Poellhuber and Anderson (2011), Osgerby (2013), and Clark indicated that flipped learning either supported or encouraged collaboration in the classroom environment. In addition to collaboration, the social aspect of learning is becoming more evident for the 21st century student.

Social Aspects of Learning

Social media has only recently emerged as a potential tool for infusion in learning settings, in part due to perceived roles for social interaction compared to learning interactions. In the flipped learning environment this may occur through collaboration activities, in and outside of class, with classmates or with outside professionals. Roblyer, McDaniel, Webb, Herman, and Witty (2010) studied faculty and student perceptions of use of social media in the higher education setting. The authors surveyed 150 participants to determine readiness and willingness to use social media within academic settings to focus on learning content compared to use for communicating basic course information such as deadlines and other reminders. The authors found that even though faculty respondents were unsure about how to use social media in the classrooms to deepen

learning, students indicated that they were willing and open to using social media for academic purposes.

The use of social media as a resource for increasing collaboration for learning is a somewhat newer approach in education, but is a common aspect in some models of flipped instruction and thus deserves a closer look in relation to this study. In a meta-analysis of current literature on social media use in classrooms, Friedman and Friedman (2013) identified several common themes related to student outcomes and perceptions. Social media integration into the classroom provided increased communication and collaboration, a perceived sense of a learning community, increased readiness for and demonstration of creativity, and convergence skills in pooling multiple sources of information to create a well-developed demonstration of understanding. The authors also found trends in the literature indicated that, through social media, students have opportunities to learn from a greater variety of sources, including peers, experts, and that they extended their application of social media use to collaborate on an entirely new and deeper level. Freidman and Freidman further suggested that social media use in the classroom promoted engagement, interactivity, and established relevance of learning and application to course material. These findings suggested that the use of social media in a flipped classroom has the potential to be employed both in and outside of the classroom as a useful tool for learning and for encouraging student mastery of the use of such resources to connect with each other and experts in ways that will benefit their lifelong pursuit of knowledge and connection with others for a variety of purposes. Students'

perceptions of the use of social media in that classroom are likely to be readily embraced by students when such valuable connections are made.

Roblyer, McDaniel, Webb, Herman, and Witty (2010) stated that students were "open" to using social media for academic purposes despite instructor skepticism. This was an important consideration that deserved closer consideration. Understanding that teachers may be hesitant to use social media, while students appear to be less skeptic reveals a potential consideration for methods that may be useful, but which may also go overlooked or underused if teachers are not aware of student preferences for this practice. In addition to this, current research posed an opportunity to consider social media on a deeper level to include potential bouandaries for it's use. This study sought to understand the relationship between social life and academic life with flipped teaching students and where are the boundaries if any exist.

While social media is not formally described as a common component in the flipped learning environment, this strategy is beginning to emerge in some models. Chen, Wang, and Chen (2014) presented a model of flipped teaching that incorporated the four pillars of flipped instruction described previously (Flexible environments, Learning culture, Intentional content, Professional educators) and adding new components of Progressive activities, Engaging experiences, and Diversified platforms. Social media may find a foothold within these added components. Considering this through the lens of sociocultural theory, social media as a cultural tool, has the potential to address all three posed additions. Incorporating social media is a progressive approach to using social strategies for academic gain. Social media also has the potential to add another

perspective to creating engaging learning experiences within diversified platforms. Initial success has been seen by Edwards et al. (2014). The authors sought to motivate pharmacy school professors to implement student-centered instructional strategies that incorporate technology. Strategies promoted in the challenge included the use of flipped teaching and the incorporation of social media in learning. The model was well-received by faculty and instructors perceived improved student outcomes and commited to continued implementation of these strategies. Both studies provided direction to future researchers and practitioners to more intentionally consider the combination of technology rich learning environments and social media as components of flipped instruction.

Summary and Conclusions

The review of literature for this study described the synthesis of three theories that form the underlying framework the flipped teaching model. As shown in Figure 1, from Chapter 1, Anderson's schema theory, Vygotsky's sociocultural theory, and Sweller's cognitive load theory meshed together and provided a useful conceptual framework for the study. The flipped teaching culture is not simply the way that students code and store information to memory (Anderson et al., 2004) or the effect that environments, technology, or access to experts have on student learning (Vygotsky, 1978). The framework addressed to the combined synergy of these theories coupled with the evenly distributed cognitive load (Sweller, 1988) of complex tasks enabled by providing students with the mastery material prior to the classroom time. The distribution or splitting of cognitive load enables students to critically think, discuss, and apply more efficiently in the classroom (Musallam, 2010). The literature review additionally detailed the benefits

and drawbacks from current research as well as students' general perceptions of technology, collaboration, and the use of social media. All of these concepts provided a background as well as a thorough view of the current research that has been studied within the last five years.

The flipped teaching model has been studied from a variety of perspectives including: perceptions of teachers, benefits, drawbacks, and implementation. Researchers have studied the perspectives of teachers using the strategy that found flipped teaching to be beneficial (Bergmann & Sams, 2012b; Musallam, 2010; Strayer, 2012) and other researchers that described the strategy being used with little improvement in student achievement (Finkel, 2012; Ford et al., 2012). Many academics recognize the impact that technology play and will play in students' lives in the future and speculate how technology can be used more effectively in the traditional classroom (November, 2001; Tapscott, 2008). Perhaps the area of research that was missing was the most important, the student perceptions of the flipped teaching model. Student perceptions of the flipped teaching instructional strategy were the gap in the research and what is not known in the academic community.

The following chapter on research methodology includes a description of how the study was designed to investigate that research gap. The research methodology includes a discussion of the research design and rationale, the role of the researcher, participant selection, instrumentation, and recruitment, participation, and data collection. A thorough description of the data analysis plan was also included as well as a discussion of issues related to trustworthiness in qualitative research and ethical procedures.

Chapter 3: Research Method

The purpose of this study was to describe student perceptions of the flipped model in relation to (a) how it compared to traditional learning and instruction strategies, (b) how it contributed to learning content and critical thinking, and (c) how the model may have influence on collaboration and social aspects of learning and instruction. Instructional practices and instructor perceptions of technology are well represented in the research literature, but little research has been conducted on student perceptions of these practices, including flipped teaching in mathematics. The absence of student perceptions related to instructional practices employed in flipped teaching is even more evident in rural school settings due to the geographic isolation and lack of technology resources.

In this chapter, a description of the research method is presented. A phenomenological design is discussed as the best way to get an in-depth analysis of the perceptions of a selected group of precalculus students in a rural community school district about their experiences with the flipped teaching model. This chapter includes a discussion of the research design and rationale, the role of the researcher, and methods for collecting and analyzing data. In addition, issues related to trustworthiness and ethical procedures are discussed.

Research Design and Rationale

Selection of a research design for this study was a complex consideration due to the diverse impact that technology has on classroom learning and instruction. Therefore, the following research questions were based on the conceptual framework and the

literature review. The central research question for this qualitative study was: What are high school math students' lived experiences of the flipped learning?

Subresearch questions included:

1. How did students perceive flipped learning compared to traditional learning?
2. How did students perceive flipped learning contributing to their ability to learn content and improve their critical thinking?
3. How did students perceive peer collaboration and other social aspects of flipped learning?

The central theme of this study was to give voice to student perceptions of the phenomenon of the flipped learning environment. By doing so, researchers and teachers can better understand the impact of this model on learning and teaching in order to better inform instruction. Specific phenomena considered included student presented perceptions based on research questions, depth of perceptions and insights, and students' sense of place and roles within this learning environment.

Considering the purpose of this study, a phenomenological design was deemed the best design to answer the research questions. The phenomenological design seeks to understand the very nature of what makes an experience what it is (Patton, 2002). The best way to uncover the essence of students' first-hand experiences with flipped teaching is a phenomenological design (Yin, 2002). Furthermore, a phenomenological study allowed me to describe the flipped classroom through the lens of the learner's experiences.

Other qualitative research designs were considered for this study, including ethnography, case study, and grounded theory. An ethnographic study is better suited to investigate the cultural changes and characteristics that an instructional model such as flipped teaching addresses over a long period of time (Creswell, 2013). A case study would have been a good choice for an investigating an individual or an issue with clear boundaries (Creswell, 2013). If the purpose of this study were to generate a theory as about this method, grounded theory would have been a reasonable choice. Based on the purpose of the study and posed research questions, the phenomenological approach was chosen for this study because of the nature of the purpose and environment, and focus on the lived experiences of the students (Yin, 2011).

Role of the Researcher

Within the separate phases of this study, I was the only person responsible for the collection, analysis, and interpretation of all data. I also transcribed all of the interview data. Therefore, the potential for researcher bias existed. In order to reduce that bias, schools were carefully selected to reduce the potential for any relationships between me and the participants. I did not serve in a supervisory or instructive role related to any participants and was not employed at either school or district in which the students are located. Furthermore, teachers and administrators who did serve in these roles were asked to introduce me with limited to no direct feedback regarding the research in order to minimize student perceptions of supervisory expectations.

Researcher bias was also controlled for through the development and adherence to the research designed phases. The phases were designed to minimize researcher impact

on classroom practices and student perceptions of the role of the researcher. Moving from targeted one-on-one interviews to focus group discussions where students lead the direction of conversation, I was established as a listener, discoverer, and describer of the phenomena rather than a decision maker. As I shifted between phases, the data were reviewed in order to inform next steps and re-establish a focus on the purpose and research questions. While not all ethical issues could be predicted in authentic settings, those issues related to perceptions of power or impact on the learning environment were carefully monitored. The teachers were also encouraged to assist in raising any specific concerns related to data gathering processes to me in private. In doing so, it was essential to adjust accordingly between researcher impact on the learning environment and student feedback. In order to ensure confidentiality, no student feedback was shared with teachers or administrators for the duration of the study.

Methodology

This phenomenological study included three phases of data collection and analysis: (a) a brief demographic screening survey that determined students' experience with the flipped classroom strategy, (b) student interviews, and (c) a general student focus group to get the *full circle* (Patton, 2002) of student perceptions. The study took place in two separate rural public high schools in two separate school districts in the midwestern region of the United States, where teachers employed the flipped teaching model in advanced mathematics courses.

Participant Selection

Participants were selected from among high school students in identified rural advanced mathematics courses including precalculus, trigonometry, or calculus. Selection also considered participant experiences with the flipped teaching model in order to represent students with varied backgrounds. Administrators aided in identifying the appropriate courses to solicit participation from. Surveys were used to determine experience level with the flipped learning model. Advanced high school mathematics classrooms were selected based on shared pedagogical models as well as similarities in school populations. Two high schools with similar populations were identified in order to increase the potential sample size and to provide opportunities for comparing data among students assigned to two different instructors. The selection of advanced mathematics classrooms with two different instructors focused on the conversations on the collective flipped teaching experience and not on a single instructor's teaching style. Potential participants were determined for this study based on the following inclusion criteria: (a) participants were enrolled as full time students at one of the research sites, (b) participants were enrolled in advanced mathematics, and (c) have participated in a flipped learning classroom. A minimum of three students from two different locations (six total students) with varying levels of experience (i.e., high, medium, and low) with the flipped teaching model and students were given the opportunity to describe their individual learning experiences through interviews.

The rationale for this sample size was based on several research studies. In a phenomenological study, Maypole and Davies (2001) were interested in studying

students' perceptions of constructivist learning in a higher education history course. The researchers surveyed 20 students and interviewed five students for their in-depth investigation. In another phenomenological study, Baytak, Tarman, and Ayas (2011) were interested in uncovering student perceptions concerning technology integration in the elementary classroom. Baytak et al. interviewed six participants to obtain an in-depth view of the lived experiences of these students. Dağhan and Akkoyunlu (2014) used a sample size of six participants to investigate teacher perceptions of using a problem-based learning approach in a constructivist classroom. Gibson (2013) chose three student teachers from a larger sample using a short survey to determine fit for purpose in a study investigating the perceptions of student teachers and technology practices. These researchers used similar methodologies as the proposed study. These researchers also surveyed a larger population to determine those participants who experienced the phenomenon. Therefore, in this study, three students were interviewed at each high school to increase the variation of the sample and to obtain a wider spectrum of students' experiences with the flipped learning and instruction model. Similar findings from the second research site would make the study more compelling and the evidence more robust (Herriott & Firestone, 1983). Moustakas (1994) noted that there are no in-advance criteria for finding and selecting participants for phenomenological research. The essential criterion is that the participants have experienced the phenomenon.

Prior to addressing the participants in the classroom, permission was sought from parents using e-mail correspondence. A sample of this form can be found in Appendix A. If I received no response, a reminder email was sent to obtain permission to speak with

the class. A sample of this form can be found in Appendix B. After obtaining permission to speak with the class, meetings were held with the identified participants to introduce the study and invite them to participate in the study. A sample of these documents can be found in Appendix C. It was at this point that letters of consent were obtained from parents with participants under 18 years of age, letters of assent for students under 18 years of age, and letters of consent from students over 18 years of age.

Instrumentation

When considering what type of data collection tool to use for a qualitative study, Yin (2011) suggested that researchers should consider different data sources. These sources include interviews, observations, documents, and artifacts. While these data sources all yield acceptable results, the data source used in this study was the interview because my focus was on seeking the participant's perceptions of their experiences about a phenomenon (Yin, 2011).

The first phase of data collection involved a short survey instrument. This instrument served as a starting point for determining student experience levels within the flipped learning and instruction model. The brief survey contained questions to determine students' general experiences with the flipped teaching model and fit for purpose.

In Phase 2 of data collection, an oral questionnaire was given to participants that was designed for the interviews, was the logical choice for getting in-depth responses of the student's experience in the participant's own words, and to provide an opportunity to read verbal and nonverbal cues. Observing participant gestures, social interactions, and other characteristics of the physical environment can yield valuable data, but an interview

was the best data collection tool to encourage participants to share their perceptions of the strategy and gain meaningful insight (Yin, 2011). Yin suggested that the only way to get the depth required for a research study is to interview participants. Interview questions were specifically designed to address the research questions. The interview tool was designed with the intention of accessing students' thoughts and recollections of the flipped learning and instruction experience. Questions were designed to be direct, yet open-ended, in order to obtain the richest responses possible. Table 1 is an interview matrix that describes how the interview questions are aligned with the research questions and the conceptual framework.

Table 1

Interview Questions Decision Matrix

Interview Questions	Research Questions	Relationship to Conceptual Framework
1. Describe how you perceive the flipped classroom compared with the traditional classroom. 2. What differences have you experienced between how you interact with other students in a flipped classroom, compared to a traditional classroom, if any? How has this impacted your learning?	1. How do students perceive the flipped learning compared to traditional learning? 2. How do students perceive flipped learning as contributing to their ability to learn content and improve their critical thinking? 3. How do students perceive peer collaboration and other social aspects of flipped learning?	Sociocultural theory

(table continues)

3. Describe how watching videos before coming to class has influenced your learning. What do you like and dislike about learning this way? 4. What differences, if any, do you notice between the role of a teacher in a flipped classroom, compared the role of a teacher in a traditional classroom? How do you feel about these differences? 5. Describe a situation in the flipped classroom where you felt you were in charge of your own learning.	2. How do students perceive flipped learning as contributing to their ability to learn content and improve their critical thinking? 3. How do students perceive peer collaboration and other social aspects of flipped learning?	Cognitive load theory Sociocultural theory
6. How has the flipped classroom changed how you learn math, if at all? What do you like and dislike about learning this way? 7. What ways, if any, does flipped learning make you think deeper about math?	2. How do students perceive flipped learning as contributing to their ability to learn content and improve their critical thinking?	Cognitive load theory & schema theory

(table continues)

8. In what ways, if any, has flipped learning contributed to your ability to work through difficult challenges?	2. How do students perceive flipped learning contributing to their ability to learn content and improve their critical thinking?	Cognitive load theory & schema theory
9. Describe times in class when you work with other students. What do you like and dislike about this aspect of flipped learning?	3. How do students perceive peer collaboration and other social aspects of flipped learning?	Sociocultural theory
10. What is the most challenging aspect of a flipped classroom from your perspective? Why is this such a challenge? 11. How has flipped learning affected your confidence of learning in general? How has the way you learn in a flipped class influenced how you approach learning in a traditional classroom, if at all?	Central Research Question: What are high school math students' lived experiences of flipped learning?	Cognitive load theory, sociocultural theory, and schema theory

Several studies supported the use of interviews for qualitative research. Interviews were used in similar situations by Gibson (2013) in a case study of student teachers who used technology in Northern Ireland. Gibson interviewed three student teachers chosen for their previous experiences with technology in specific learning environments. Researchers who have conducted phenomenological studies have also frequently

employed interviews for similar purposes. For example, Maypole and Davies (2001) used interviews to investigate students' perceptions of constructivist learning in a higher education history course, Baytak et al. (2011) used interviews to research student perceptions concerning technology integration in the elementary classroom, and Dağhan and Akkoyunlu (2014) used interviews to investigate teacher perceptions about problem-based learning in a constructivist classroom. In each of these studies, interviews of participants provided useful insights related to the studied phenomena. Interviews provide a vital source of data for qualitative research by presenting "another person's explanation of some behavior or action" (Yin, 2011, p. 131) and in order to obtain student authentic student perceptions, interviews aligned with the data sought in this study. Interview questions for this study were also grounded in the survey data.

In Phase 3 of data collection, students participated in an interactive focus group where they will respond to specific questions as a whole group. Focus groups are used across a wide variety of social science fields and in combination with interviews or surveys (Morgan, 1996) . In these instances, the interviews provided greater depth for the qualitative research and the focus groups provide greater breadth (Morgan, 1996). Kettunen, Vuorinen, and Sampson (2013) employed focus groups in a phenomenological study to investigate career practitioners' conceptions of social media used in a career services environment. Kettunen et al. noted that the aim of the focus groups was to "have a wide variety of career practitioners' accounts represented" (p. 304). Another phenomenological study that utilized focus groups was Samo's (2010) study on how head teachers in a Pakistan public secondary school made leadership decisions. The purpose of

the study was to explore the participants' decision-making styles when faced with challenges, and the Samo sought a shared description of the participants' experiences as well as their individual accounts.

Focus group questions were based on themes that emerged in the interview process. Examples of potential themes included perceptions of learning achieved, encroachment or enhancement of social exchanges in and out of class, and perceptions of the use of various forms of technology in and out of class. Focus groups provided an additional opportunity to ascertain the reliability of the data collected in the initial interviews. Additionally, students were given the opportunity to expand on their initial thoughts and add to, or differentiate from, a collective perspective. The focus group questions are presented in Table 2.

Table 2

Focus Group Questions Decision Matrix

Focus Group Questions	Related Research Question	Relationship to Conceptual Framework
1. What do you believe teachers should know about flipped teaching from a students' point of view. 2. A theme that emerged during the interview process was _____. Can you expound on this?	Central Research Question: What are students' perceptions of the flipped learning?	Cognitive load, sociocultural, and schema theories
3. What are the similarities and differences of a flipped classroom compared to a traditional classroom?	1. How do students perceive flipped learning compared to traditional learning?	Cognitive load, sociocultural, and schema theories

(table continues)

4. In flipped learning, you use technology to learn the math lessons you used to get in class. How do you feel about having to work through the lessons on your own before class?	2. How do students perceive flipped learning as contributing to their ability to learn content and improve their critical thinking?	Cognitive load theory
5. How do you feel your interactions with the teacher in a flipped model affect how you learn? 6. In the interviews, some students reported that they spend more time collaborating in the flipped classroom. How do you feel these interactions add or detract from your overall learning?	3. How do students perceive peer collaboration and other social aspects of flipped learning?	Sociocultural theory

Instrumentation was developed according to the needs within each phase of the research and to provide opportunities to compare data across different sources. First, a survey was developed simply to establish levels of student exposure to flipped learning. However, additional questions were also added to consider initial perceptions. While these basic questions did not provide any depth to understanding student perceptions, the purpose of the survey questions was only to classify students into low, medium, and high experience with the flipped teaching strategy. The survey was described in more depth under instrumentation.

The flow of the interview and student responses led to additional probing questions or merging of questions based on student response. After the interviews, coding helped me note trends and determine what new information could be confirmed through

discussions in the forum phase. Questions were roughly planned and anticipated, but available to change based on the individual interviews, which is normal for a phenomenological study (Groenewald, 2004). Questions for the forum discussion were developed based on the clarification needs after initial coding of data is completed.

Procedures for Recruitment, Participation, and Data Collection

In relation to recruitment, letters of cooperation were first sought from the school district located in this midwestern state, indicating that they were willing to be my research partners in this study. Meetings were held with the school district principals to explain the purpose of this study and obtained signed letters of cooperation from the school districts. A sample letter of cooperation can be found in Appendix D. After obtaining this letter of cooperation, the principals at each high school identified a time and building location where the interviews would take place. Consent to participate in surveys, interviews, and the forum was established through a consent form distributed to, and signed by the parents of students under the age of 18, and assent form for students. Likewise, for students 18 and older, assent forms had to be signed in order for participation in the demographic survey, interview, and focus group. Sample consent and assent letters can be found in Appendix B. Eligibility for the interviews was based on experience criteria determined from the survey results. As described in the previous section, participants were specifically recruited for interviews based on developing a diverse sample of respondents' levels of experience. Identified students were contacted via e-mail to solicit participation. Interview dates and times were established via e-mail or telephone correspondence and will took place in the school setting. After this, the

group face-to-face forum discussions will be held, open to any students who are enrolled in observed courses, interested in providing insights, and who have provided appropriate consents to participate. Students were informed of the date and time of the forum via an e-mail 1-week prior and again 1 day prior to the forum and through an announcement in class. The specific number of students was based on the number of students enrolled in the courses and on who met the criteria. The six original students participated in the forum discussion together, however; all students meeting the set criteria were invited to participate. More specific details related to participation are outlined in sections discussing each component of the study.

Eligibility for completion of surveys was based on enrollment in the identified flipped courses. For initial participation in the survey, a letter and consent form was sent to the parents of students under the age of 18, and directly to students 18 or older, who were enrolled in the courses identified as appropriate for this study (advanced high school mathematics courses employing the flipped instruction model). This letter included a statement of the purpose of the study, a confidentiality statement, and intent of the survey, interview, focus group, and a signature block for consent by the individual or a parent if the participant was under 18 years of age. A statement indicating parent consent did not mandate student participation was included. A sample of this letter can be found in Appendix B. Once written consent was received, a link to the survey was e-mailed to participants. Upon opening the survey, another purpose of the study statement and confidentiality statement was included along with a notice that advancing to the next page indicated further provision of consent. From this data, respondents were sorted by

years experience and at least one student was randomly selected from each level of experience (low, middle, and high) if available. This was done using the random sort function of excel within each experience level group. After interviews were completed all participants were notified of the date, time, and location for the focus group discussion. Any student who had provided written consent could attend the focus group activity.

The purpose of the initial survey was not to collect data for analysis, but instead to identify potential interview participants who represented the appropriate diversity of the subject pool. The survey tool can be found in Appendix C. Students who had completed consent to participate were given electronic surveys to complete within 3 days of dissemination. A timeline of 3 days was deemed sufficient to complete the simple survey outside of class. If sufficient responses were received in order to identify a large enough interview participant group, the survey was resent until the minimum number of participants was achieved. In order to participate in the survey, students who submitted appropriate consent received an email with a link to the secure survey hosted on surveymonkey.com, where they responded to six questions related to background experiences with, and very general perceptions of the flipped classroom. Further description of the survey is provided in the instrumentation section of this chapter.

In terms of data collection, 60-minute sessions were scheduled in order to conduct individual interviews with the six students within a 2-week period. Interviews began with an explanation of the purpose of the study and a reminder to students that the interviews were audio recorded and that recordings would be kept in a secure location. Students were also informed students that I would take notes during the interviews. No identifying

data were included with the audio recordings or any notes taken during the interview. During the interviews, students were asked the nine initial interview questions. They were encouraged to speak freely, and probing questions were posed as needed based on student responses. Even though interviews were scheduled for 60 minutes, some of the interviews took more or less time, based on the flow and detail of the participant's responses. The interview protocol for questions can be found in Appendix D.

Once all interviews were completed, students were invited to participate in a focus group to ask additional questions that arose from the previous phases. A face-to-face focus group was scheduled in a school district conference room at each high school. The forum was scheduled to last for 90 minutes and included all interviewed students and any students in the course that provided assent or parental consent. The classroom teacher and other school personnel where not present in order to encourage students to speak openly about their learning experiences in a flipped classroom. During this session, open-ended questions were asked based on preset guiding questions and topics for discussion based on the previous phases of research. Student participants were again informed that the focus group was audio recorded for record keeping, data management, and review purposes only and that I would be taking notes during the focus group. Students were also informed that all records would be kept in a secure location and that pseudonyms would be used.

The courses were considered senior-level courses. As such, most students were 18 years of age, however; due to the selected setting, the potential for minor participants to

be selected was possible and appropriate consent protocol was followed. For this reason, parent permission was sought for all students and required for those under the age of 18.

Data Analysis Plan

Once all discussion forums were completed, data were coded to identify relevant themes. Data were analyzed from interview and focus group transcripts according to a model adapted by Moustakas (1994) for phenomenological research. Moustakas posed a four-step method to phenomenological data analysis. This method encompassed identifying significant statements from the participants, clustering those statements into meaning units and themes, and then synthesizing those units into a composite description of the experience. Following this model, the transcripts were analyzed and coded the data for common themes using Nvivo software program. The interview transcripts, focus group transcripts, and surveys were personally transcribed and then analyzed using the Nvivo software program to search for initial codes, patterns, and trends. The Nvivo software program was used to find relationships between attributes of the data.

Data were coded initially by using the in vivo coding process. In vivo coding is a process separate from the Nvivo software program, which is a software program often used for data coding management. Miles, Huberman, and Saldaña (2014) stated that in vivo coding is a common method to code qualitative data and using "words and short phrases from the participants own language" (p. 74). In vivo coding is also an effective way to note phrases that are important to the participants by preserving them in their original form. This coding process aided in confirmation of trends as the questions posed in the focus group were based on coded data from interviews. Preservation of responses

in their original format ensured accuracy and further helped to clarify understanding of student experiences. By using short phrases from the participant's response, thoughts of the participants were summarized into succinct phrases to later analyze further. After the first cycle coding was completed, data were reviewed again to ensure accurate representation and coding. Miles et al. suggested the use of two coding cycles in order to look for recurring phrases in the first cycle of vivo codes. In the second cycle of coding, open coding was applied first to identify main points. Once sufficient amounts have been identified, axial coding was conducted by focusing on emerging patterns centered on similar themes identified through open coding. With a single researcher for the study, all transcription and coding were completed by one person, from start to finish, improving the consistency and credibility of the findings. Further efforts to address credibility are discussed in the next section. Results are presented according to each phase in the following chapter. Final coding was done again manually by reading transcripts of the interview audio recordings to check for concepts that may have been left out inadvertently.

At a later date, a brief presentation was delivered to the instructors, administrators, and school board members regarding the results of the study. The stakeholders were informed of the findings with the caveat that the generalizability of the findings lies within the studies specific parameters as recommended by Groenewald (2004). These debriefing sessions to stakeholders was done separately to continue to promote confidentiality. The session consisted of a visual and verbal presentation of findings followed by time for questions and brainstorming for moving forward. The

debriefings occurred within four weeks of the final discussion forums to keep the ideas fresh in my mind and to maintain accountability to the school districts that allowed me to collaborate with them.

Issues of Trustworthiness

The trustworthiness of qualitative research was considered in relation to the constructs of credibility, transferability, dependability, and confirmability or objectivity. Credibility refers to internal validity, or the trustworthiness, rigor, and quality of a study (Malterud, 2001). According to Simon (2011), credibility can be achieved in several ways, including triangulation of data gathered from a variety of sources and respondents, seeking feedback from respondents in confirming researcher data, and using expert reviews. Shenton (2004) also contended that qualitative studies often achieve credibility through the adoption of research methods that have already been established in similar studies, through a strong familiarity with the culture of participants employing practices that promote honesty, use of iterative questions, employment of frequent debriefing sessions, and presentation of rich, thick descriptions. Shenton also supported member checks or respondent feedback methods as effective strategies in achieving credibility. Member checks are used to validate participant responses and ensure that the researcher is interpreting the response correctly (Hatch, 2002). For this study, credibility was enhanced by employing targeted participant selection methods based on existing related literature as well as through the development of a high level of familiarity with the specific classroom cultures through interviews and focus groups. Several strategies were used to ensure participant anonymity and honest responses during the private interviews

and focus group sessions. Any e-mail correspondence was kept confidential, along with all gathered data throughout the research process. Iterative questioning was a key concept in the interview process for this study. Questions were intentionally designed to allow for overlap and further probing questions in order to give respondents a variety of opportunities to thoroughly describe their experiences and impressions. Finally, regular debriefing of key stakeholders allowed for a higher level of accountability and fidelity of research. Credibility was also achieved by collecting data during three distinct phases and across diverse respondents. Furthermore, the focus group provided an opportunity to confirm correct representation of the data and to further clarify respondent feedback.

Transferability can also be referred to as external validity or the ability to generalize findings to other populations or related topics (Malterud, 2001). In a qualitative study such as this, the intent was not to achieve generalizability to other populations or classrooms, but to describe a phenomenon experienced by a specific population (Groenewald, 2004; Yin, 2011). For this study, the specific population was calculus students in two schools where flipped classroom pedagogy was used. However, transferability should not be disregarded altogether as similar groups may exist in the larger population, and others may still attempt to generalize findings if they make such connections. In this case, Bassey (1984) proposed that when readers do attempt to make such connections, they should be cautioned to consider similarities only related to common populations and as a starting point, rather than generalizing to a larger group. For this reason, clear descriptions of the data collection and data analyses processes and results of each phase are presented in sufficient detail to allow for greater accuracy in

comparing groups. Based on recommendations by Fenton (2004), information that supports comparisons and which will be provided in this study includes the number of schools, class size, and participants in the study, how participants were selected and restricted in their roles and responses, clear description of methods for gathering data including the number of sessions and their length of time, and how long the data collection period was. This information allows those readers who make comparisons to consider similar steps in determining how consistent the population characteristics are. Ultimately repetition of the study in a population perceived as similar is the best method to ensure transferability, and readers should be cautioned about this limitation.

Dependability is often the word used to describe reliability in a qualitative study (Schwandt, Lincoln, & Guba, 2007). The intent was that if other researchers were to repeat the study with a similar target population, they would achieve similar results. In a qualitative study, dependability is more difficult to establish because the goal is to describe a specific phenomenon, which in this case, is the experiences of students in a flipped calculus class in a rural high school. As such, being able to reliably repeat the study in a similar population may be achievable; however, getting the same results cannot be guaranteed because the study was about perceptions, which cannot be controlled. In addition to this limitation, researchers cannot guarantee that the nature of the flipped classroom may vary to some degree based on local culture, demographics, and resources. Again, Fenton (2004) made some recommendations about the reliability of the practices for measuring the phenomena rather than the results themselves. Fenton suggested viewing the study as a "prototype model" (p. 71) that others can readily replicate.

However, a clear description of the study and the results must be provided with sufficient detail for replication. This recommendation includes describing data collection methods and resources with sufficient detail, as well as providing clear descriptions of experiences during data gathering and results of the process. Finally, a thorough reflection that includes evaluating the effectiveness of methods is essential for improving dependability.

Confirmability is related to maintaining objectivity during qualitative research (Schwandt et al., 2007). To achieve confirmability in this study, no personal opinions were imposed on the analysis or interpretation of the data. This objectivity was accomplished by using specific data gathering tools that focus on external information rather than internal processing of that information, which included the development and employment of targeted questions that maintained a focus on the research questions and the use of multiple sources of data to provide opportunities for confirmability of the data and multiple coding processes. Reviewing the word frequency reports from the Nvivo software program, the nodes created by coding, and transcripts taken by hand at 2-week intervals provided a measure of confirmability and objectivity. Multiple sources of data in this study included interview transcripts, handwritten notes from the interviews, and data from the focus groups. By doing so, this corrected any potential misinterpretations of data by examining trends in the data from the interviews and the focus group. Fenton (2004) further recommended maintaining a "reflective trail" (p. 72) that increases researcher awareness of thoughts during research, as well as an "audit trail" (p. 72), or description of the flow of data that led to the results, in order to maintain a data-oriented

approach. Both the reflective trail and audit trail will be presented in the results section in Chapter 4.

Ethical Procedures

Ethical procedures were addressed through approval of the Institutional Review Board (approval number 06-24-15-0046734). Transparency of the research procedures with involved parties, and understanding the limitations of the research approach (Schloss & Smith, 1999; Yin, 2011). Institutional Review Board approval as well as informed consent of the students, parents, teachers, and administrators was obtained prior to meeting the participants and disseminating the surveys.

Transparency included informed consent, voluntary participation, and confidentiality of the data. Participants had the option of participating in the study, and their responses were kept anonymous and confidential. The research data were kept confidential and will be destroyed 1 year after the conclusion of the study. The findings of the study will be presented to stakeholders no later than 1 month after the conclusion of the study.

The students and teachers were aware that I was gathering data. This knowledge may lead to initial behaviors inconsistent with regular classroom routines. In an effort to make the classroom teachers and participants more comfortable, an informal meeting discussing the purpose of the research was conducted after initial consent was received but before any further steps were taken.

There was also be a risk that students would misrepresent their perceptions about flipped teaching in hopes of pleasing their teacher or me by stating what they believed

others wanted to hear. This concern was controlled for in three ways. First, student responses to the survey, interviews, or focus group, were not associated in any way with the individual respondent, encouraging them to answer more honestly. Second, the survey of basic background experience with the instruction model was followed by voluntary interviews and a focus group to explore trends in the survey data in more depth. Finally, students were debriefed on the results of their feedback.

Whenever research involves instructional environments, the researcher must carefully consider the impact of the programming or phenomena being researched. For this study, previously described steps were taken to ensure that data collection procedures did not interfere with student learning. This included only targeting classrooms in which the model of flipped teaching was under implementation. Ensuring anonymity was essential to reducing risks of student perceptions that they must provide a desirable response. Teachers, parents, and administrators involved in the consent process were also be encouraged to avoid setting expectations or engaging in discussions surrounding the study during implementation. Ethical research practices are a primary concern in qualitative research, and therefore, for this study, a thorough plan was developed to ensure ethical treatment of participants and transparency in the research procedures.

Summary

This chapter included a description of the research method that was used for this phenomenological qualitative study. This chapter elaborated on the research methodology and the rationale for using a phenomenological approach. The participant selection and inclusion criteria focused on high school advanced mathematics students that experienced

the flipped classroom at several different experience levels. This chapter also described the role of the researcher in the study being the interviewer, collector of data, and data analyst. The chapter also included a description of the different phases of the methodology and why the choices were made to design specific instruments for those phases. In addition, this chapter included a discussion of trustworthiness, issues of transparency, and possible ethical issues in the study. The next chapter will include a description of the setting and demographics where the study took place. It will also elaborate on the actual data collection and data analysis for the study. Evidence of trustworthiness will be addressed and finally the results of the study will be presented.

Chapter 4: Results

The purpose of this study, as related in previous chapters, was to describe student perceptions of the flipped learning model. The central research question for the study was to describe high school math students' lived experiences of flipped learning in relation to (a) how it compares to traditional learning and instruction strategies, (b) how it contributes to learning content and critical thinking, and (c) how the model may have influence on collaboration and social aspects of learning and instruction. Limited research in this area makes this a timely and valuable study for providing initial insights in an area given little focus to date, namely student perceptions. Three specific research subquestions were posed and served as the primary nodes for considering results. They include:

1. How do students perceive flipped learning compared to traditional learning?
2. How do students perceive flipped learning contributing to their ability to learn math content and improve their critical thinking?
3. How do students perceive peer collaboration and other social aspects of flipped learning?

In this chapter, the presentation of the results of this qualitative study will begin with a discussion of the setting to include personal and organizational conditions that may have had an influence on participants and how they interacted during the study. Individual, group, and school demographics relevant to the study will be presented, followed by a thorough description of the data collection process as it occurred. The data analysis will include a description of the coding process, coding labels and categories,

and consideration of discrepant cases. Evidence of trustworthiness will address credibility, transferability, dependability, and confirmability consistent with Chapter 3. Finally, results will be presented to address the research questions including those of response trends and direct quotes supporting those trends.

Setting

It is important to consider the potential impacts of personal and organizational conditions that may influence participant response and interactions in order to ensure that the context of the study is considered in light of this information. Specific factors considered included timing of the study, personnel, facilities, and educational level of participants. The strategies I used for addressing those conditions follow.

The first dynamic impact was related to personal conditions. Both surveys and interviews were conducted within the school environment, but took place during summer months. This required contacting parents and students during the students' summer breaks, which posed impelling biases in participation. The timing of participant solicitation may have made participation by potential participants more difficult or inaccessible. Furthermore, a prospective influence of commitment to their school or teacher may have led to a greater sense of obligation to participate in the study for identified students. Students and parents were reminded that participation was voluntary and that they could choose to withdraw at any time. In addition to this, they were reminded of their anonymity and were encouraged to ask questions about any concerns if and when they arose. No questions or concerns were posed.

Another impact that was considered was organizational. Two separate school districts participated in the study. Both organizations evidenced stability of principals, department heads, and content teachers who interacted with the participants. Both leadership and instructional staff were supportive of the study and indicated readiness to address participation concerns of identified students if they arose. No contacts were made to suggest such conversations occurred, which may be reflective of the timing and accessibility of personnel for such discussions. The leadership and teachers of the flipped courses were advised not to discuss or encourage participation beyond basic recruitment procedures in order to reduce sense of obligation among participants.

An additional impact of the potential influence on participation was the location of the interviews. The first facility was typically familiar to the students, although not as busy as what they were accustomed to during the school year. School staff ensured that all lights were on and the classroom was open and well-lit prior to arrival of the participants to ensure that they didn't feel the emptiness of the school. The second school prepared in a similar manner, but was also under construction in areas during interviews and focus groups. This resulted in having to select a more remote area for discussions but also served as an opportunity to build rapport with students who were eager to discuss how the facilities had changed since their break had started.

One student's academic situation also presented unique unapparent impacts. One of the students participated in the district plus one program allowing an extra year of high school during which the student primarily attended community college courses. This had the tendency to result in reflection on experiences dissimilar to typical high school peers.

Awareness of this possible biasing condition allowed me to consider the responses carefully compared to peers in order to ensure identification of disparities if they existed.

Demographics

Demographics of both the participants and their schools are equally important when considering characteristics unique to this study. Students from the target schools who were considered for the study were identified as those who participated in an advanced flipped mathematics course as part of their high school course work. Students were selected from two schools in the Midwest. The schools were similar in size and general demographics and were considered rural based on population; however, based on proximity to the nearest urban area, one school was described as rural and the other as suburban. Students identified by school personnel and who submitted consent and assent forms were surveyed for basic demographic information. Once students were identified for participation, they were assigned a pseudonym in order to maintain confidentiality when reporting on individual interviews.

In the suburban school, eight students who were identified by school personnel submitted necessary consent and assent forms. They included six female and two male students ranging in age from 17 to 18 years old. Of these students, six had low levels of experience and two had medium levels of experience. Three students participated in the interview and five in the focus group. The first interviewee, given the pseudonym of James, was a 17-year-old male with low experience. The second interviewee, who will be referred to as Molly, was a 17-year-old female with low experience. The final participant, with the pseudonym, Kamie, was an 18-year-old female with medium experience

indicating the amount of exposure to the flipped teaching environment. The focus group consisted of one additional female age 17, and a male, 18 years of age. Three had low experience in a flipped classroom and two had medium experience. Focus group responses were not coded for individual students as content was considered collaborative information shared by the collective group. As such these data were coded and reported on at the group level only.

At the rural school, eight students were contacted and six students returned assent and consent forms. These students ranged in age from 16 to 19 years old and evidenced experience levels of low (1 student), medium (3 students), and high (2 student). Four students participated in interviews and six in the focus group. The interviewees included one 16-year-old female, Brianna, with low experience, an 18-year-old female, Brittany, with medium experience, a 19-year-old female, Mary, with medium experience, and an 18-year-old male, Julian, with high experience. The focus group consisted of all six students who consented to participation. A summary of participant demographics can be found in Table 3.

Table 3

Demographics of Participants by Location

Demographic	Rural				Suburban		
Pseudonym	Brianna	Brittany	Mary	Julian	James	Molly	Kamie
Gender	Female	Female	Female	Male	Male	Female	Female
Age	16	18	19	18	17	17	18
Experience	Low	Medium	Medium	High	Low	Low	Medium

Data Collection

Data collection included interviews and focus group feedback to targeted questions related to the research questions and purpose of the study. Information contributing to the data collection process includes participant data, data collection location and procedures, data recording and processing steps, and considerations of variations in the data and unique circumstances.

Participants included a total of 14 students completing surveys, seven participating in interviews, and 11 participating in the forum discussion. Demographic data regarding these students was included in the previous section. Students were recruited following procedures outlined in Chapter 3. Once participants were identified, students were invited to participate in one-on-one interviews with me with the intention of selecting a minimum of three students representative of the sample demographics of overall participants at that site in terms of levels of experience. All participants who submitted necessary assent and consent forms were invited to participate in the forum discussion. Target sample sizes of a minimum of three per site were achieved; however, no participants with high levels of experience were available at the suburban site, so the interview sample was selected to be representative of the demographics at that site.

Before data collection could begin, participant interaction was initiated in an electronic environment via e-mail invitation. Interviews and forums took place in classroom within each of the identified schools. At the suburban site, all three interviews were conducted on 1 day in the high school math classroom. Because it was summer

time, many of the tables and chairs were stacked for maintenance. A small grouping of three tables was centered in the room for the interviews and forum. Individual interviews lasted about an hour each, with approximately 30 minutes between each interview. The focus group discussion was held in the same classroom 1 week later. The forum duration was approximately 90 minutes.

Two weeks passed between data collection at each site. At the rural site, the interviews took place on 2 separate days to accommodate student needs. Interview and forum times were consistent with the suburban site, lasting approximately 60 and 90 minutes respectively. All interviews were held in the library café. This site was selected over a classroom based on its distance from the construction area and because classroom availability was limited. Interviews took place in the summer; therefore, there was no pedestrian traffic in this area. It was important to have a quiet place so the interview process would have limited interruptions and I could obtain a quality audio recording.

Data were recorded in several ways. Demographics data including age, gender, and experience level were gathered electronically via e-mail. Individual interviews and forum discussions were recorded on an iPad application called Voice Recorder, and I transcribed all of the recordings within the same day to better address intelligibility.

Data collection procedures identified in Chapter 3 were followed with limited variation. It is stated in Chapter 3 that "Eligibility for the interviews will be based on experience criteria determined from the survey results. As described in the previous section, participants will specifically be recruited for interviews based on developing a diverse sample of respondents' levels of experience." A deviation from this had to be

made at the first site because no students were identified with high levels of experience. This was justifiable as the population selected for the interview was still representative of the available study sample at this site. No unusual circumstances related to data collection were encountered at either site.

Data Analysis

As previously stated, each interview was transcribed from recording to script on the same day as the recording. Once transcripts were completed they were imported into NVivo, along with demographic data useful in considering responses by characteristics at a later time. Primary codes were given to each of the research questions to include differences between traditional and flipped classrooms, critical thinking characteristics, and collaboration and social impacts. Assigning these primary codes allowed the data to be more intentionally sorted among the research questions while also identifying themes within each research question through the formation of underlying nodes. Data were coded after the first set of interviews was completed at the first site in order to determine common themes for further probing in the forum. Additional themes were added after coding of the forum. This process was followed again at the second site.

Once general themes were identified, coded, and related to specific research questions, qualitative data were considered more closely in order to move from individualized coded units to larger representations of the categories and themes. Using NVivo software, coded items were considered according to the number of sources the code was identified within (interviews and focus groups) and the number of references made to the theme within the interviews and focus groups. Number of sources was

identified as a number between one and nine to be representative of the seven interviews and two forums. References were identified as the number of times a response was coded into a specific theme.

After coding all themes and subthemes, definitions of each theme was revisited to check for redundancies and reduce this kind of error. Themes that emerged within each research question are presented in Table 4 and defined after the table.

Table 4

Themes within Posed Research Question Codes

Research Question 1: Differences between Traditional and Flipped Classrooms	Research Question 2: Critical Thinking Characteristics	Research Question 3: Collaboration and Social Impacts
1. Types of Instruction 2. Types of Interaction 3. Types of Learning	1. Instructional Strategies 2. Self-regulated Learning	1. Peer Collaboration and Social Interaction 2. Collaboration and Social Interaction beyond the Classroom

Once themes were identified and all student responses from interviews and forums were coded, clearer definitions could be given to each theme. Primary and secondary themes are defined as follows:

- Types of instruction referred to how students viewed differences in instruction through comparative thought. This included concepts of consistency in instruction, no delay in learning, opportunities for review, and stronger assistance.
- Consistency of instruction referred to all students receiving the same message and content regardless of when their formal class met.

- No delay in learning was related to the ability to apply knowledge to work immediately after viewing it and also the ability to clarify ideas and concepts as they come up.
- Opportunity for review referred to the ability to pause, rewind, and revisit instruction at a later time for review or additional practice.
- Stronger assistance referred to the teacher or knowledgeable peer available to help students with questions when needed.
- Types of interaction referred to fundamental differences between flipped learning and traditional learning in the way the teacher and student interacted.
- Different levels of learning referred to changes in depth and application of learning from surface-level questions to deep, critical thinking questions.
- Instructional strategies referred to actions recognized by participants as teacher driven and included perceived expectations and learning activities.
- Teacher expectations referred to the standards, effort, and practices that the teacher held the students.
- Depth of learning activities referred to activities that went beyond rote learning of concepts.
- Individualized instruction referred to instruction that was one on one between the teacher and the student. The teacher tailored the learning to the student's level.
- Self-regulated learning referred to student ownership of the learning process in and outside of the classroom. It consisted of subthemes of individualized pace, learner confidence, and personal responsibility.

- Individualized pace referred to students being able to proceed through learning and lessons on their schedule, when the students are ready.
- Learner confidence referred to a stronger feeling of self-assurance and self-efficacy that students feel.
- Learning strategies referred to a mechanism or routine that students used to learn more effectively and/or efficiently.
- Personal responsibility referred to a sense of ownership and accomplishment in planning and completing a task.
- Collaborative and social impacts theme referred to factors that affected how students interacted in academic collaboration and social channels that may not traditionally be viewed as academic. It included perceptions of the types, purpose and value of collaboration and communication, such as competitive nature, resources for learning, and cooperation, as well as developing a readiness for challenges.
- Competitive nature referred to students keeping up with each other academically and wanting to be slightly ahead of their peers.
- Multiple resources referred to a student's perception that the student could use any resources available to learn or solve a problem.
- Learning from each other referred to specifically learning from another student in the class or out of class.
- Readiness for challenges referred to a student being comfortable and confident when attempting something either new or more difficult in their perception.

- Time to engage in questioning referred to students having sufficient time to ask questions in class as well as have the time to think about what questions need to be asked to go further in the problem.

Some themes or codes identified during the data analysis were considered discrepant because they were only raised by a few participants and were not addressed as a recurring theme in the focus group session. These themes were included in the coding to ensure that voice was given to them and will be explained in the discussion and considered more closely in Chapter 5. Discrepant themes included consistency of instruction related to the comparison of flipped and traditional instruction, competitive nature related to collaboration and social factors, and readiness for challenge related to collaboration and social factors. These items were included when they stood alone as factors related to a research question in order to consider interactions or individual perceptions more closely, but were not identified as major themes for the interpretation of results.

Evidence of Trustworthiness

Considering evidence of trustworthiness is essential to the process of evaluating qualitative data. The collection and analysis of data followed guidelines set forth in the previous chapter. Trustworthiness of the research was discussed in detail in Chapter 3 to include consideration of credibility, transferability, dependability, and confirmability.

Credibility was accomplished by using consistent interview questions for each study participant, prompting that encouraged honest response, the use of iterative questions, debriefing of general themes through focusing questions for clarification in

interviews and including targeted questioning in focus groups (Shenton, 2004; Simon, 2011). Through seeking clarifying feedback, presentation of student voice was more accurate, consistent with recommendations set forth by Shenton (2004). Conducting interviews and forums, allowed a high level of familiarity with the specific classroom cultures. Also consistent with guidelines set forth in Chapter 3, honesty was encouraged through ensuring anonymity and provided comfortable and familiar environments for interviews and focus groups. Iterative questioning was achieved through the use of overlapping, clarifying, and probing questions to encourage thorough response. This including promoting further discussion by stating, "Can you tell me more about…", and "What did you mean when you said…" The use of different locations, different experience levels, multiple participants, and different levels of interviews allowed for the triangulation of data across multiple opportunities and multiple respondents. In addition to this, focus groups provided opportunity for clarification and correction of potential misunderstandings.

Transferability, or external validity, in a phenomenological study such as this focuses on relating the targeted nature of the study and cautioning against attempts to generalize findings to other populations (Moustakas, 1994). This was achieved through the data analysis and interpretation as well as recommendations for how findings should be considered. In considering data, both similarities and uniquely different characteristics were taken into account. A focus on understanding of procedures and themes will result in the ability for replication of research practices in populations seeking similar student perceptions in order to take such unique characteristics into account.

Dependability was achieved through the clear description of the target population, employment of consistent strategies in recruiting, interviewing, and coding, and careful clarification of information in order to accurately describe the phenomenon of student experiences in the flipped classroom. Care was taken to ensure that student responses were authentic and not misinterpreted through the use of targeted questions, providing opportunities for clarification, and following predetermined practices in identifying students, targeting specific research questions, and facilitating discussion. Fenton (2004) emphasized that when addressing dependability in a qualitative study, the intent is often to establish reliable practices rather than reliable results and results may vary based on unique populations. As such procedures were clearly outlined to promote ease in repetition of the study.

Confirmability in a qualitative study refers to objectivity. This was achieved through careful development of initial survey items that targeted research questions, followed by specific follow up questions that focused on respondent clarification rather than researcher interpretation. Careful consideration of the intent of the study and a focus on student response without the imposition of researcher opinion or interpretation was necessary to ensure the voice was that of the participants. When points were unclear, clarifying questions were used to avoid making assumptions. Focus was given to student response as an external factor than internal processes in interpreting such responses. For example, when interview responses were unclear or minimal, guiding questions were phrased to encourage more responses, such as “Can you tell me more about your statement …” instead of imposing my interpretation through phrases such as “So what

you mean is…" By doing this, the response was authentic and my impact on development of ideas was minimal. In addition to this, node frequency was reviewed within Nvivo to confirm trends rather than making assumptions, and multiple sources of data included transcripts, hand-written notes, and focus group data. Finally, maintaining a reflective trail within the notes allowed for consideration and awareness of my potential bias to prevent infusion of interpretation in the data gathering process.

Results

Once all data were gathered and transcribed, with careful consideration of issues impacting trustworthiness, data could be considered more specifically using interpretive resources in Nvivo. Data were considered according to the three research questions surrounding perceived differences between flipped and traditional classrooms, perceptions on learning and critical thinking, and the roles of collaboration and social interaction and media. Data were considered based on the number of sources and references addressing each theme.

Major Themes Represented as Research Questions

The three research questions coded as differences between traditional vs. flipped, critical thinking, and collaboration and social interaction were the first level of coding. All three research questions were addressed across all nine sources. Differences between traditional vs. flipped themes were broken down into three additional themes with imbedded subthemes. This research question was referenced 104 times across the nine sources, accounting for 24.36% of the responses provided. The critical thinking node was related to two themes: instructional strategies and self-regulated learning, both with

additional subthemes. The critical thinking node was referenced a total of 244 times across the nine sources, accounting for 57.14% of the responses. Collaboration and social interaction included two themes with imbedded subthemes and was referenced a total of 79 times, which accounted for 18.50% of the total coded responses. Closer consideration within each research question provided greater clarification of themes and subthemes.

Perceived Differences Between Traditional and Flipped Learning

Research Question 1 addressed the differences between traditional and flipped classroom. This primary node was expressed across three primary themes with additional subthemes. Primary themes included types of instruction, types of interactions, and different levels of learning. Types of instruction contributed the most to conversations surrounding differences between traditional and flipped classrooms. It was discussed in all nine interview opportunities and accounted for 5.77% of the conversations related to research question one. This theme included ideas such as consistency between courses, no delay in learning, opportunities to review, stronger assistance, and increased consistency. Types of interaction had the second largest contribution to this node and was discussed by eight sources (88.89%), accounting for 35.00% of the responses. Types of learning was addressed by six respondents (66.67%) and accounted for 11% of the responses. This theme had the smallest contribution to this conversation, but ideas presented differed to a large enough degree to warrant a separate theme. The percent of sources and references for each theme are summarized in Table 5, to include the percent each theme contributed to the overall research question node. Student feedback related to each theme is presented following the table.

Table 5

Subthemes within the Differences between Traditional vs. Flipped Node

Node/Theme	Sources	References
Differences	9	104
1. Types of Instruction	**100% (9)**	**55.77% (58)**
a. Opportunity for review	*88.89% (8)*	*43.11% (25)*
d. Stronger assistance	*77.78% (7)*	*25.86% (15)*
c. No delay in learning	*44.45% (4)*	*22.41% (13)*
d. Consistency of instruction	*2*	*8.62% (5)*
2. Types of Interaction	**88.89% (8)**	**33.65% (35)**
3. Types of Learning	**66.67% (6)**	**10.58% (11)**

Further description of the themes and related subthemes within the differences between the traditional and flipped node follow with the greatest referenced theme discussed and then proceeding to the next greatest referenced theme. The first theme of types of instruction was discussed to the greatest degree and is broken down further by subthemes of opportunity for review, stronger assistance, no delay in learning, and consistency of instruction.

Opportunity for review. Opportunity for review was a theme that students perceived as an important difference between traditional learning and flipped learning. This node was the second most common theme addressing Research Question 1. Opportunity for review accounted for 43.11% of the responses surrounding types of instruction.

Brianna, a student with low-experience, related the importance of having original instruction available [referring to the original lecture being rewindable] when needed:

> I'm definitely like a visual person so you know if a teacher has something up on the board and erases it - you'll never see it again unless you go on your own time

> or in his free time and ask him so I liked that I could just rewind it if I didn't understand it I could listen again.

Many students commented that they would watch the videos over again when they were preparing for the test. Brittany, who has medium experience in the flipped classroom, stated:

> Like for finals I could rewatch all the videos and it was like I was sitting in class again and even when I was in college taking calculus I could still go back to his website and watch the videos over the section.

Brittany later added:

> I think that [the video being rewindable] definitely is a bonus but for me. It takes me a little bit. I can't just like listen to something and then know it. I think that's definitely just being able to go back and relearn and rewatch helped me a lot.

In rural setting form, students also discussed the use of videos to clarify their learning. One student stated:

> You can ask the teacher to show the problem again or explain it, but there's two problems with that. So first of all some kids don't like to speak up or want attention drawn to them, but also, you might hear something in class, then forget it exactly the way it was shared before and you can't go back to exactly what the teacher said. But with flipped teaching you can.

Many students used the videos simply for the repetition and getting the steps in the problem correct. Julian noted "We had instruction in videos that we worked through and learned from at home. I could go back and replay examples and practice problems

over and over till I had it down." James expanded by discussing motivation related to review. He stated:

> I was like more motivated to watch lots of videos and do the homework but I did like extra work for the like subjects that I wasn't very um, I didn't like understand very well, I'd watch the video multiple times then I would do the work and maybe do some extra problems if I wasn't sure about it.

Kamie, a student with medium experience, echoed this statement commenting:

> For me….I…. for math, specifically I really need to see examples to like learn it and with the flipped classroom it really helped because I could just keep watching the video over and over so I can keep seeing those steps happen where traditional you might take notes, but you'll get confused and you might miss something along the way. It really helped me this year being able to look back all the time whenever I needed to.

Mary voiced increased understanding as a result of having more opportunity to review. She indicated that:

> If anything I think I learned more because the videos you could go back and rewatch so say I didn't understand something – in [traditional] class I would have been I guess I just didn't understand that where in the flipped class I could go back and rewatch the videos and get it.

Stronger assistance. The stronger assistance node encompassed various comments surrounding students' perceptions of assistance from the teacher and their peers. This node accounted for 25.86% of the responses related to instructional

differences between flipped and traditional classroom. Comments centered around accessibility of support, questioning, and peer interactions in support of learning;

In the rural focus group, one student addressed accessibility in stating:

> Yeah, so I also felt that the teacher in my flipped class is more accessible simply because of the amount of collaboration we always had going on. It's not that traditional teachers are inaccessible; it's just that you have this different culture of how collaboration works and includes the teacher and others in a flipped class.

Brianna also related this sentiment in her interview, noting:

> I think they [the teacher] are more there for your questions I guess like you know like it's your responsibility to watch the videos to learn it on your own time. You know like to do the actual learning and then they're almost more there like extra help.

Mary revisited the value of questions when she stated:

> The other way [traditional learning] you do the learning in class and the homework outside of class and you really don't have anyone to ask questions when you have them until the next morning when the homework is actually due. It doesn't leave you much time to think about it.

Mary also later added:

> You can ask questions when you are actually doing the homework. Especially when you are learning Calc. and the questions aren't 2 + 2; there are multiple steps to the problem. So if you are not exactly sure how to start a problem, you go back

> and work on the problem and you get stuck somewhere, you can get help, instead of having that last two minutes of class to ask the teacher.

She explained further saying:

> I liked it better with the whole class asking questions because math was never my strongest subject so I would go home and my parents couldn't help me with Calculus so it's like I could ask the teacher in class, but I don't know how much time we'll have.

Other students commented on how the student's received stronger assistance from peers in flipped learning. Julian stated:

> There was no planned support here [in the traditional classroom], but you might call a friend to work through a problem or go to a website. You could also check your notes, but you sort of had to just remember back to what you did in class, so if you didn't remember correctly it was hard to make the comparison between what you learned in class and what you were doing in homework. In math, the problems usually get more difficult as you work through the assignment, like more steps or more abstract problems. So if you don't have it down, the harder problems can feel impossible.

No delay in learning. The no delay in learning node referred the ability to apply knowledge and clarify thoughts and ideas sooner rather than the next day when the student sought out the teacher. This node accounted for 22.41% of the responses related to instructional differences between flipped and traditional classrooms. This node was discussed by four of the respondents, and provides insight into students' use of

information in the videos presented outside of class. Some concepts expand on the "Opportunity for Review" node, while others consider the availability of information in circumstances that don't exist in traditional classes. In this node, students discussed the immediate availability of information and it's benefits in not having to wait to address difficulties, the ability to collaborate quickly with peers by referencing videos, and the opportunity to participate in learning despite absences.

Referring to this fact, Mary stated:

> The other way [traditional learning] you do the learning in class and the homework outside of class and you really don't have anyone to ask questions when you have them until the next morning when the homework is actually due. It doesn't leave you much time to think about it.

Kamie commented:

> Yeah, I feel like especially this year with math since we were all getting the same video we could ask at about 2 minutes did you get what he was saying you know and it was more easier to communicate than trying to like remember what the teacher said – because the information was right there… kind of useful at any time.

Julian added to this by expanding on ideas about the availability of information. He indicated:

> Umm, so, I guess I feel like I learned more for a couple of reasons. Like I worked harder, but it was easier to work harder because I had more information available

> to me whenever I needed it, and I also could think differently because I was seeing other people thinking differently about math too.

A different student, James, brought up a unique situation related to a delay in learning related to absences. He stated:

> When I was sick for so long in the first and part the second quarter, I needed to watch all the videos on my own and it wasn't because I never interacted with the teacher at all because I was sick for so long. I was at my house just watching videos on my own and doing the homework and so I was in charge of what I needed to do and how I got it done at that point.

James discussed another time he was absent and he mentioned to opportunities to travel and not miss class content. He stated:

> I went on an African vacation trip at the beginning of the year for two weeks so I had two weeks of math to catch up on and I could watch all the videos at my own pace to be able to catch up to everyone else in the class.

Consistency of instruction. Consistency of instruction referred to all students receiving the same message and content regardless of when their formal class met. This node was only discussed by one student in the interviews and by students in the suburban focus group. It accounted for 8.62% of the discussion surrounding instruction, but was still identified as a unique node in order to ensure student perceptions were addressed appropriately. Kamie, a student with medium experience, stated:

> I would say it's a good way to make sure all your information you are giving is consistent. If something you are saying kind of confusing at the time, you have

> the chance to go back and reword it. You [teachers] have the ability to edit and say it the way you really want to, instead of creating something confusing among students.

She later continued, noting, "I have had teachers before that the students have heard one thing in one class, but the teacher said something different in a later class and it can be a little confusing sometimes" and "I really like how we all got the same information and we were able to like pinpoint like in the video where we really had trouble and we could really help each other on that." She commented about consistency in a different context stating:

> I think that for missing school or being on vacation for a week in a math class you would be behind in a traditional classroom. There was one kid in my class that went to Europe for a week. He was fine because he watched his videos and he was right on track when he got back and there were no issues.

James who was rated as having low levels of experience in the flipped classroom, voiced similar ideas when he stated:

> I would say it's a good way to make sure all your information you are giving is consistent. If something you are saying kind of confusing at the time, you have the chance to go back and reword it. You [teachers] have the ability to edit and say it the way you really want to, instead of creating something confusing among students.

Types of interaction. Types of Interaction was a node that encompassed the different ways that students perceived student/teacher and student/student interactions

different than the traditional classroom. This node accounted for 33.65% of the responses related to differences between flipped and traditional classrooms. Feedback regarding types of interaction addressed perceptions of students, types of interaction, ownership of knowledge, and engagement in the classroom.

Some students perceived differences in the types of classroom engagement with their peers and teacher. Molly, a student with low experience, related her perceptions on how some students may misinterpret the interactions before participating in a flipped classroom:

> Some people think that by being in a flipped classroom you are just watching videos, but really it is discussion about misconceptions that you have had about the topic for the day. You can also have the same discussion as you would have in a traditional classroom.

In the suburban group's discussion, another student described experiencing a shift toward two-way discussions:

> In a traditional math class, you kind of are taught it and then you do it. The discussion is kind of a one-way discussion just like the teacher talking. In a flipped classroom, the discussion is like discussing the video so the students and the teacher are talking.

Julian, a student with high levels of experience with flipped learning, considered differences from the view of the teacher being the sole proprietor of information:

> Ok, well it's like this, you have one teacher who gives you all the information. They lecture in class or assign readings, and you might have

> group work, but it's mostly go to these websites, watch this video, read this, and use your notes to create some kind of presentation. All of the information sources are told to you. But in a flipped class you're told, ok now you should be able to work through these formulas with some level of accuracy so here's a real world problem, go work your magic. The teacher is walking around and you might ask him questions, but you are so busy working with each other that you start to trust that you can really do this.

Mary, who had medium experience, echoed this perception stating:

> It helped me realize that I have more resources. Like before flipped, I honestly thought it was me and the teacher and the textbook and math textbooks are not easy to understand. So I realized that I had more resources because with the flipped you have that technology to go out and look up other ways to do things. There is not just one way to do it. Because some of the Calc problems we had, there was a simpler way to do it from Physics. We learned that so we would bring that in. It has helped me realize there is more out there to help me learn. Like, there is not just one way to learn this.

Other perceptions related to type of interactions were based on how the teacher engaged the class. A student in the rural discussion forum stated:

> Well I think how you work with the teacher is a bit different too. So I was thinking about your question while they were talking and at first I was thinking the teacher lectures at us less in a flipped class. He is interacting with us more than in other classes. But I don't think that's quite accurate. The flipped teacher

> still has some form of lecture in the podcast. It's shorter, if you don't pause and work problems or rewind, but that's because the interaction is more limited. I'll bet if you record a class with lecture and discussion, then cut out all of the interaction they might be more similar. The difference is that because this sort of lecture is podcasted, there is a lot more time for the collaboration and challenging work we talked about earlier. So again, regular classes are still challenging too. That's good teaching, but it's usually assigned as homework in a traditional class where we collaborate on more authentic tasks in the flipped class and then have to hone our skills more on our own in homework or on our own parts of the group work. So the teacher becomes more of a mentor in that process."

Another student in the rural group followed that statement noting:

> Yeah, yeah, and he guides us along the way and asks questions to get us to think differently or he might point out an error that could get us off track. Like he'll say, you might check your work here, or do you think you might have missed a step there, or go back and check this part right here. Right, he never just says this part is wrong, it should be this. At first I just wanted him to tell me so I could move on, but then you start to appreciate it when you are successful on your own or as a team. And when he does review information from the podcast to make sure we have it, even then it's not a lot of lecture. He'll get an example going then encourage us to step in and lead each other through it and he'll just step in when he has to if we're stuck or off track. So there's not so much lecture as it is a lot of give and take in how we interact.

Yet another student stated concisely, “Yeah because I’ve sat in plenty of lectures and I’m not engaged at all but when I have to do something I'm more likely to learn it.” Other general comments were made about the teacher interactions. James, who had low experience in the flipped classroom, noted:

> In the flipped classroom I think the teacher more just directs the students to what they're supposed to do instead teaching them directly because I noticed the teacher would go over particularly hard on parts of the algebra but he would most of the time he would direct us during class to what videos to watch and where we should be in the homework.

This clarified teacher direction was also expressed in terms of opportunities to review more difficult concepts.

Different types of learning. The different levels of learning node referred to changes in depth and application of learning. This node accounted for 10.58% of the discussion on differences between flipped and traditional classrooms. Many students commented on the level of engagement in the classroom as well as the ability of the teacher to address the different learning needs of students.

Julian, who had high levels of experience, discussed different levels of engagement in the classroom when he stated:

> You know, there are days when you’re just like, I wish I could just go to math and relax through a lecture and some problems, but you’re always active. But that’s kind of a bad reason to be challenged huh? Still changing your mindset between classes can also be hard. For example, if I’m coming from a class where the

> teacher lectures a lot and we're just expected to memorize information and tell it back in multiple choice, matching, or essay questions, then I'm not really thinking for myself, am I. Then I go to my [Math] class and the teacher does a quick review of the podcast and we dive in to some abstract problem and you have to be ready to kick your brain into high gear. And it's not just math, you have to think what does this have to do with science or communications, or construction, or whatever, it sometimes crosses over into other areas of learning and the world.

Mary, who has medium experience, gave a different perspective noting:

> Because everything that we learned in class was going to be on the test. It was nice that everyone could understand at their own pace. We are all at different levels but we are in the same class at different levels of learning.

Julian also made connections to the responsibilities of learners in the flipped classroom in stating:

> Sure, so once we'd been at this for a while, the flipped classroom, we started using show me to demonstrate to others how we solved our own problems. We got to make our own mini podcasts to teach our peers on our own problems. Then we had to follow and critique each others work.

Not all students viewed the different levels of learning as a benefit. Some students thought this type of learning was challenging because of the different levels of learning. In the suburban focus group a student stated:

> When someone is watching a video at a different time, if you are next to a person that gets really behind and they are trying to ask you for help that you did weeks ago and you are right on date it's a little hard.

Another student in the group added:

> I think it was sometimes harder to work with the other students because some would be way ahead and some would be way behind so you kind of had to find the people who had the same method you know as you and like be like oh so and so was always way ahead so I can I can talk to them to help me but so and so it behind so they won't know what I'm talking about so that definitely changes who you talk to in the classroom and it kind of probably helps you get out of your comfort zone a little bit because maybe those kids that are way ahead….you don't usually talk to.

Years of experience and differences between classrooms. In addition to considering the data according to each node, data were also considered based on levels of experience in order to explore potential shifts and differences in views as a student gains additional experience with flipped learning. These rates of response are summarized in Table 6. Several trends were noted pertaining to this aspect. Types of interaction was broken down by subthemes to consider overall contribution to the conversation. This included consistency of instruction, no delay in learning, opportunity for review, and stronger assistance. Consistency of instruction was discussed primarily by students with medium levels of experience (80%). Students with high experience accounted for 20% of this node, while students with low experience did not contribute to this node. No delay in

learning was discussed fairly evenly by all levels of experience, with contributions by the medium experience group being slightly higher. Opportunity for review included 20% of the responses by students with low experience, 32% from medium experience, and 48% from high experience. The discussion on stronger assistance was lead by students with medium experience (46.67%), and included 33.33% of the comments being made by respondents with low experience. High experience accounted for 20% of the responses. The second theme of types of interaction was primarily discussed by respondents with high experience, accounting for 54.29% of the conversation, followed by medium experience respondents (31.43%), and touched on by those with low experience (14.29%). Finally, the theme of different types of learning was dominated by respondents with high experience, accounting for 72.72% of the conversation, with the remainder of the conversations being generated by students with medium experience. Students with low experience did not discuss this theme.

Table 6

Rates of Response by Experience within the Differences between Traditional vs. Flipped Node

Node/Theme	Low Experience	Medium Experience	High Experience
1. Types of Instruction			
a. Consistency of instruction	*0%*	*80%*	*20%*
b. No delay in learning	*30.77%*	*38.46%*	*30.77%*
c. Opportunity for review	*20%*	*32%*	*48%*
d. Stronger assistance	*33.33%*	*46.67%*	*20%*
2. Types of Interaction	**14.29%**	**31.43%**	**54.29%**
3. Different Types of Learning	**0%**	**27.27%**	**72.72%**

Critical Thinking

In Research Question 2, students were asked to consider perceptions of the level and types of thinking employed in the flipped classroom. More specifically, they were asked about their perceptions of critical thinking in flipped learning environments. Critical thinking was expressed across three subthemes with the first two having additional imbedded themes. Subthemes included instructional strategies, self-regulated learning, and time to engage in questioning. Instructional strategies were further defined in subthemes of depth of learning activities, individualized instruction, and teacher expectations. Comments related to different levels of learning were not discussed by students with low experience either. Students with medium levels of experience accounted for 27.27% while the majority of the discussion on this node came from those with high experience (72.72%). The node of no delay in learning was discussed more evenly across experience levels with 30.77% responses coming from those with low levels of experience, 38.46% coming from those with medium levels of experience, and another 30.77% from those with high levels of experience.

Instructional strategies were discussed in all nine interview sources and accounted for 33.38% of the references in the critical thinking node. Within this theme, depth of learning activities accounted for 23.46% of the responses, individualized instruction accounted for 20.99% of the responses, teacher expectations accounted for 35.80% of the responses related to instructional strategies, and time to engage in questioning accounted for 19.75% of the discussion on instructional strategies. Self-regulated learning was

further defined by subthemes of individualized pace, learner confidence, learning strategies, and personal responsibility. Overall, self-regulated learning accounted for 66.25% of the responses referencing the critical thinking node. Within this theme individualized pace addressed 20.13% of the responses, learner confidence addressed 15.72%, and personal responsibility addressed 37.11% of the responses referencing self-regulated learning. The number of sources and references for each theme are summarized in Table 7 to include the percent each theme contributed to the overall research question node.

Table 7

Subthemes within the Critical Thinking Node

Node/Theme	Sources	References
Critical Thinking	9	240
1. Instructional Strategies	**100%(9)**	**33.38% (81)**
a. Teacher expectations	*88.89%(8)*	*35.80% (29)*
b. Depth of learning activities	*77.78%(7)*	*23.46% (19)*
c. Individualized instruction	*77.78%(7)*	*20.99% (17)*
d. Time to engage in questioning	*66.67%(6)*	*19.75% (16)*
2. Self-regulated Learning	**88.89%(9)**	**66.25% (159)**
a. Personal responsibility	*88.89%(9)*	*37.11% (59)*
b. Learning strategies	*77.78%(7)*	*27.04% (43)*
c. Individualized pace	*88.89%(9)*	*20.13% (32)*
d. Learner confidence	*66.67%(6)*	*15.72% (25)*

Further description of the subthemes within the critical thinking node will be presented sequentially by primary themes of instructional strategies and self-regulated learning, and time to engage in questioning. Within each primary theme, subthemes will be addressed with the greatest referenced theme discussed first, followed by the next greatest referenced theme, until all concepts are addressed. Instructional strategies

included ideas such as teacher expectations, depth of learning activities, individualized instruction, and time to engage in questioning.

Instructional strategies: Teacher expectations. Teacher expectations referred to the standards, effort, and practices that the teacher held the students to and was most cited subtheme. This node was discussed the most within instructional strategies and accounted for 35.8% of the discussion of this node. Discussion topics included readiness for assessments, self-discipline, teacher supports, participation and collaboration, trust, the learning process, and challenges.

Briana, a student with low experience, started this conversation by talking about readiness for assessments:

> Our teacher you know just said quizzes are these days and tests are these days so this quiz is over this much. He said you should have this much done by the quiz and then by the test you need to have all of it done of course so you know if you don't get that far before the quiz then you kind of have to suck it up and take it and you know see the consequences. For me, I liked the fact I could choose you know when I was going to watch the videos every day you know.

She continued on discussing self-discipline according to teacher expectations:

> It [flipped learning] definitely teaches that [self-discipline] which I think is good for college because college professors sometimes just let you go and say you know what we are having this quiz on this day and so it is realistic in that aspect where someone isn't spoon-feeding you every day.

This perception of self-discipline was reiterated by a student during the suburban focus group discussion when she said, “One thing the teacher would say in class is that students need to try.”

In the rural focus group, a topic of discussion related to self-discipline included not only effort in the classroom, but also expectations for personal readiness to learn. One student in the rural focus group said, “I learned quickly that the podcasts were what prepared me to do well in class and I had to be responsible for that learning and understanding if I wanted to be involved in the more challenging collaboration activities.” Then another student extended this discussion to include perceptions of trust toward the teacher added:

> I feel like you really have to trust your teacher, especially as he expected us to be more responsible for the learning. That was really hard to do. You know, the teacher tells you he expects more of you, that you can do this, and that you need to move beyond working basic and advanced problems to solving real life scenarios.

The conversation continued with this discussion of teacher support for the learning process. Another student added:

> And I’m like, I don’t know, but then he reminds us of what we’ve done and that this is just the next step. He doesn’t give us the answers or even tell us how to get there. He says that the whole process of getting there helps us more than just doing it all the same and getting the right answer.

Conversations continued to narrow in on the role of the teacher in supporting self-discipline:

> The teacher makes a big difference here in helping us discover how we can contribute to the group best. Because he's actively working with us and supporting our groups he knows who he needs to be encouraged to step up and who needs to give up some of the responsibility. You know, he'll come over and if someone's not participating enough he ask what they think.

In his individual interview, Julian, a student with high experience, further discussed how the teacher encouraged collaboration. He indicated that:

> We were also encouraged to work together outside of class. Sometimes we had to turn in screenshots of messaging or show me for collaboration credit. We had challenging problems that we solved together in class and we also worked with each other and professionals to look at real world problems for example at NASA or with architects or engineers. We still had to show we could solve problems on our own, but we were also encouraged to work together and learn from each other.

Students presented realistic views of their experiences by considering difficult areas as well. Several of the students interviewed discussed challenges with teacher expectations. Julian noted, "I think probably the greatest challenge is changing your mindset as a learner. You have to be a lot more active in the learning process." He explain further:

> I think it's because the expectations change. So I know what is expected of me from one class to the next, but when you're changing every hour, it's hard to turn it on and off. I suppose if I think about it, I should just continually think more abstractly, but it's hard when the teacher or content doesn't challenge you as much.

Instructional strategies: Depth of learning activities. The second most common subtheme under instructional strategies was depth of learning activities. The depth of learning theme referred to activities that went beyond general surface learning of concepts. This accounted for 23.46% of the conversations surrounding instructional strategies. Students discussed topics of ability and readiness for learning, instructor interactions, and changing views and thinking about the role of math.

In the suburban focus group, students discussed feeling more prepared for class. One student voiced that:

> You feel like you have the time, and like, the ability to, like, learn the information before you get to the class. When the teacher is describing it again, it clicks more the second time around and stays with you more that just hearing it once and trying to memorize it.

Another student added, "So you watch the video get a rough idea of what you're doing and then while he's going over in class it just clicks into place." Students in the rural focus group had similar conversations. One student indicated:

> And when he does review information from the podcast to make sure we have it, even then it's not a lot of lecture. He'll get an example going then encourage us to

> step in and lead each other through it and he'll just step in when he has to if we're stuck or off track. So there's not so much lecture as it is a lot of give and take in how we interact.

And then another student from the rural group added that the teacher's interaction lead them to think differently about math:

> Also, you start to think differently about math. It's not just the memorization and computation of formulas. You start to see it as a way to think about certain things in the world. That doesn't mean that math can be used to solve all problems you think about though, but at least now I find myself thinking, ooh I can solve this, I get this.

Julian also addressed this in his interview, stating that, "I guess it's like, the type of work we did together was more meaningful or purposeful." Upon further probing, he explained:

> Yeah, well, I learned a lot about how math works in the real world. It made math a lot more interesting to me. I'm not necessarily a fan of math. It was really hard for me. It took some getting used to, but it was nice because we learned much more this way and we took more responsibility for our own learning.

He also stated, "I find myself asking deeper questions if they're not posed by the teacher others, but I don't always ask them out loud."

Instructional strategies: Individualized instruction. The final subtheme of instructional strategies shifted away from teacher and group roles and interactions and honed in on individualized instruction. The subtheme individualized instruction referred

to the tailored instruction that was one on one between the teacher and the student. This subtheme accounted for 20.99% of the conversations surrounding instructional strategies. It included discussions of asking questions, accessibility, individualized guidance, awareness of individual and group needs, and persistence.

A student in suburban setting form began this discussion by pointing out teacher perceptiveness to student needs despite their fear of asking questions in front of peers. He stated, “I think there's a lot of people that have questions that are too afraid to ask because of a large crowd. With a flipped classroom, you have more time to make sure each student is getting the information.” In the rural forum, similar discussions lead to conversations about teacher accessibility. One student voiced that the teachers collaborative efforts made him more accessible to individual students:

> Yeah, so I also felt that the teacher in my flipped class is more accessible simply because of the amount of collaboration we always had going on. It’s not that traditional teachers are inaccessible; it’s just that you have this different culture of how collaboration works and includes the teacher and others in a flipped class.

This discussion continued with another student’s input regarding the teacher’s guidance:

> Yeah, yeah, and he guides us along the way and asks questions to get us to think differently or he might point out an error that could get us off track. Like he’ll say, you might check your work here, or do you think you might have missed a step there, or go back and check this part right here.

Another student added that this guidance helps them contribute more meaningfully and encourages them to take responsibility for their roles:

> The teacher makes a big difference here in helping us discover how we can contribute to the group best. Because he's actively working with us and supporting our groups he knows who he needs to be encouraged to step up and who needs to give up some of the responsibility. You know, he'll come over and if someone's not participating enough he ask what they think.

Julian discussed his own difficulties with math and how the teacher's individualized attention helped him to persist:

> The teacher really encouraged me to give it a try and he said I'd be fine. It was very tough for me. I think I probably would have failed in a traditional model. The flipped model let me learn when and how I learned best and it made me willing to work harder, think differently, collaborate, and stick with it when it was tough.

Kamie, a student with medium experience, summed up her view of the teacher's individualization voicing what many other students indicated:

> I would just say there is more time for questions definitely and yeah I mean throughout the day, a traditional classroom is just as repetitive for some teachers, the teacher doesn't have to be so if repetitive. He can like be a little bit more like individualized I think with the students.

Time to engage in questioning. Time to engage in questioning accounted for a smaller portion of the discussions on critical thinking and instructional strategies . It accounted for 19.75% of the conversation, but was addressed by six of the seven respondents. The theme time to engage in questioning referred to students having

sufficient time to ask questions in class as well as have the time to think about what questions need to be asked to go further in the problem.

Brianna, who had low level experience, discussed increased preparedness for classroom activities and the helpfulness of being able to engage in increased questioning during class time:

> I liked it because I kind of felt more prepared coming in so rather than sitting in class and watching the video in class and if some videos for calculus you know take like a long time and so then as soon as the bell rings then you're like oh no I need to ask this question whereas if I had watched it before I came to class then I have that full 40-50 minute period to ask questions when I'm with the teacher.

Kamie, who had medium level experience, also discussed the ease of collaborating on personal and peer questions in the flipped classroom:

> It was more like if you had any questions you could just like… it would easier to figure out what each other was asking and with the flipped classroom you have more time the next day to ask your teacher questions too. Which helped a lot.

Mary, another student with medium experience, also indicated that questions could be more targeted because students interacted with podcasts more intentionally prior to class:

> I mean yeah the videos are done by the same teacher, but it was nice because he didn't have to explain everything. If there were different steps to a problem and one of them was confusing, in class you could just talk about that one step.

Mary goes on to discuss her comfort with difficult tasks because of the teacher's increased availability for questions during class:

> Math was never my strongest subject so I would go home and my parents couldn't help me with Calculus so it's like I could ask the teacher in class, but I don't know how much time we'll have [in the traditional classroom].

Molly, who had low-level experience, expressed similar thoughts in her interview:

> It [the flipped model] lets you like ask more questions in class um because since you've like learned outside of class you have more time in class to ask questions, but a traditional classroom they might take most of the time teaching it and you don't really have time to ask questions.

Self-regulated learning: Personal responsibility. Self-regulated learning involved the students' perception of taking more responsibility for the learning process. The first subtheme for the self-regulated learning node addressed personal responsibility. The personal responsibility subtheme referred to a sense of ownership and accomplishment in planning and completing a task. This subtheme accounted for 37.11% of the conversations related to self-regulated learning. Topics discussed included independence in learning, time management, prioritization, self-awareness of learning habits, and teacher understandings.

Brittany, who had medium experience in the flipped classroom, discussed independence in learning and taking responsibility for herself:

> It's taught me to be more independent and to not rely on anyone else. You're in charge of yourself. Like traditional classrooms, they expect teachers to teach you. Like, you're my teacher, teach me, but [in the flipped class] you're in charge of

> your own learning which many of the students don't understand. Like, what you learn is up to you.

Brianna, a student with low level experience, had similar discussions surrounding taking responsibility for her learning by managing her time effectively and prioritizing her activities according to her schedule:

> For me with being out for, like, a lot of sports and having a lot of extracurricular activities, so if I knew that I had a game this night, and had to host FCA this night, you know, I had a bunch of things lined up, I could sit down over the weekend and do like three lessons in one weekend and then not do any lessons you know until like Thursday, you know, or something. So I really like that because it gave me a chance to more organize my day.

In the rural focus group, this conversation expanded to discuss how one student transitioned to taking more responsibility for his learning and time management:

> I would put off the videos at first, thinking that homework that had to be turned in should take priority. I sort of figured the teacher would be explaining in class anyway so I could just go back and watch anything that was confusing later, but then I got to class and I couldn't hang with everyone else and I got behind because I didn't have the background I needed to do the collaborative work. I learned quickly that the podcasts were what prepared me to do well in class and I had to be responsible for that learning and understanding if I wanted to be involved in the more challenging collaboration activities.

Julian voiced similar thoughts as he described his experiences:

> At first, if I had a lot of homework I would put off the videos thinking I would just get the information in class then next day. It was hard to prioritize right. So then I would get to class and just be confused. If the teacher knew I didn't watch, then he would assign me to watch it before joining the group learning. After a while, I figured out when it worked best for me to watch the videos, which was usually on the bus or just after dinner, when I could focus. But still, that was a bit of an adjustment, realizing that learning could be a lot more in depth once I got the routine down.

Brittany described further how she learned to manage her time and fit podcasts into her schedule:

> If you had to leave early for a basketball game or a track meet you couldn't be in class but if you pre downloaded the video before then or sometime saved the videos to the laptop you can just put your headphones in on the way to a basketball game and so you don't get behind in your schoolwork.

She also added, "Plus, with the podcasts, I can learn when and where I learn best. If I focus better at 1 in the morning, the teacher is there for me to learn from."

Another topic related to personal responsibility, is that of teacher's understanding of the shift that flipped learning is for students. In the rural focus group, discussions also transitioned to the importance that teacher's be aware of the shift in student thinking that must take place as students go through this discovery process. One student stated:

> I also think it's important for teachers to know that when it comes to flipped teaching, we as students still have to learn to think differently for that class. The

> teacher should understand that newer students will take some time to get used to that and it was very helpful that our teacher walked us through it the first few times. We have to learn a lot about who we are and how we learn and we have to get comfortable with the whole collaboration and challenging work at a different level. Patience is important, but also being clear about expectations so we know what participation is supposed to look like is helpful.

Another student from the rural forum, added to this discussion by describing her own experiences:

> Yeah, that part took some getting used to. You know, it's already sometimes hard to listen to a teacher when your sitting in a classroom in a desk and your mind's just not in it, but there [flipped classroom] you have this expectation that you're going to get it. You're accountable to the teacher and your classmates. Changing to being accountable to yourself and knowing how to listen and take part in a lecture on your own is hard at first. It's easier when you put the whole picture together. Like, knowing that once I get this basic piece down, we can do some more exciting stuff in class. Once we got that down and I made a commitment to understanding that this podcast lecture and math work was my homework, it got easier. But that didn't happen overnight.

Self-regulated learning: Learning strategies. The subtheme "Learning Strategies" was the second most-discussed topic on self-regulated learning, accounting for 27.04% of the conversations on self-regulated learning. This subtheme referred to a mechanism or routine that students used to learn more effectively and/or efficiently.

Topics discussed included awareness of learning styles, self-awareness of what works for the individual, awareness of study habits and activities that interfere with learning, awareness of attentional habits, and additional discussions of personal responsibility for learning.

Brianna discussed her awareness of her learning style and the ease of reviewing information that was continually available:

> I enjoy it because for me I'm definitely like a visual person so you know if a teacher has something up on the board and erases it you'll never see it again unless you go on your own time or in his free time and ask him so I liked that I could just rewind it if I didn't understand it I could listen again.

She described additional strategies she employed with podcasts in regulating her own learning:

> If I watch the videos somewhere else I'd have to like pause it and like write down the questions so I wouldn't forget so it is kind of nice you know to just be able to stop him in the middle and have them explain something rather than having to like try and remember what you wanted to ask him later.

Yet, Brianna explains that she had to work to get to a point where she was self-aware in a useful way:

> I was always the type of kid that I would like listen the whole time and then he'd get done talking and we'd have those last fifteen minutes to start working on our assignment and I would like stare at my paper. I would be like, oh no, what did he say about this, what did he say about this? So I was always like, having to go up

> and ask questions. And I'd ask questions a lot. So it was kind of nice that, in the videos, I'd watch this section and pause it, and then do those five questions while it was like, fresh in my brain. And then I could like, watch you know, the next five minutes, and then do this section. So that was nice for me. Rather than like 30 minutes and then having to like turn my brain back, you know, to the beginning of the lecture so that I could do the beginning of the assignment. So I guess that really helped me in that sense and it changed the way I, you know, did my assignments rather than sitting down and doing it all at once.

In the rural focus group, similar discussions lead to a student describing her own experiences of discovering how she learned best:

> Yeah, I'm still getting used to that. At first I tried all of these different strategies and now I feel like I'm at the point where I know which ones work better for me and so it's taking less time to get it done. I try to watch the lesson early so if I need to use Show Me or a tutorial I'll have time to do it. For me texting or twitter is okay, but I like to see the math not read how to do it so I'm more visual. Sometimes I'll rewind and rework too.

Another student added:

> You know if you if you're really tired at night you could be like oh well I'll just get up really early and watch it in the morning and its really just based on what you want. And I remember sitting of the fair grounds in the cattle barn and I hadn't downloaded the videos so I like put my phone on the hot spot and connected my computer up to my phone and I would like sit there and watch my

> video and do my homework like in the cattle barn at the fair so that was kind of cool is that you can literally like do it from anywhere and have it be your choice as long as you like have the means to do it like you plan ahead and download them ahead of time.

In the rural focus group, students returned to the topic of individual differences and personal responsibilities to the self and the group. One student discussed the different types of responsibility and learning in the following statement:

> Well, we kind of already talked about it, but how you learn is different. So I'm responsible for the basic information on my own. Well, the teacher recorded it ahead of time, but it's my responsibility to learn and master it to some level before I come to class so I'm ready to deal with more advanced thinking in class. I have to know more about how and when I learn best so that I am well-prepared for class, whereas in other more traditional classes there might be more overlap. You can get away with not having the groundwork down before walking in the door because it's usually covered at some point during lecture or class activities.

Julian, who had the highest experience in the flipped classroom, also discussed discovering what worked best for him.

> After a while, I figured out when it worked best for me to watch the videos, which was usually on the bus or just after dinner, when I could focus. But still, that was a bit of an adjustment, realizing that learning could be a lot more in depth once I got the routine down.

Self-regulated learning: Individualized pace. In considering self-regulation that supports critical thinking, students again returned to the concept of individualized pace as an effective way to achieve deeper learning. The subtheme individualized pace referred to students being able to proceed through learning and lessons on their schedule, when the students are ready. This subtheme accounted for 20.13% of the conversations surrounding self-regulation.

Brianna, a student with low experience, discussed how presentation in podcasts allowed the student to set the teacher's pace as well as her view that this freed up more time for meaningful questions and individualized help during class time:

> Like, they're not standing up in front of you lecturing the whole time so they're more there for, like extra individual help at whatever pace you need, because you know if you pick stuff up really, really fast and you learn really well with the way he's speaking to you in the video, then you really don't have to ask him questions, but someone else might need to.

James, who was also a student with low experience, also voiced the idea that he had more control over his pace of learning:

> The flipped is more you go at your own pace and you still learn the same stuff, but maybe better. It's just you do it more independently and you more rely on yourself rather than the teacher to learn it's up to you what you want to learn and how you wanna learn it compared to traditional where you just sit there and listen and hopefully you learn it.

In the rural focus group, this conversation was extended to discuss how students paces often changed depending on their perception of the complexity of the learning and that they learned to be more comfortable with this complexity. This was voiced in the following comment:

> On the same note, it was also good for if you just had a day where you weren't entirely focused or just nothing was sinking in. You knew you could go back and review that important information that might be throwing you off in class. There wasn't this sense of urgency to go get help immediately. You're more confident in struggling with it a bit first.

While in the suburban focus group, students expressed a preference for control of the pace that allowed them to feel challenged rather than bored or frustrated. One student added, "Some classes kind of go too slow, with the flipped classroom, you can kind of go at your own pace or you could get ahead if you're bored." Another student also discussed better readiness to regulate learning within her busy schedule and still accomplish the learning goals:

> I felt like the course was more manageable with our busy school schedules. Say I had an athletic event, or missed class for some other reason. I wouldn't be stressed about getting notes or going in early to have something explained to me. I had a downloaded podcast that I could work through and because I already had that groundwork, I could pick up on the learning that I missed in class pretty quickly. I was ready to do the harder work that I wouldn't be ready for if I missed the information in class.

James discussed his perception that the flipped classroom was geared to be more individually paced:

> The flipped classroom is more student oriented I guess because they are kind of in charge of how fast they do the homework or at like what rate they do the homework and how the videos that they watch it's more up to the students it gives them more responsibility and more freedom of how they do the class work.

Kamie, a student with medium experience, expressed similar thoughts. She discussed how individual paced allowed her to learn when she was prepared to do so, which made her more likely to succeed:

> I like that when I want to focus on math, I have the choice of when I can. I learn more that way. Because sometimes you'll be like really tired that day because you didn't get much sleep the night before and daze off in class. Well, with the flipped classroom I can like wait until I'm actually prepared to like actually like sit down and hear a math lesson.

Self-regulated learning: Learner confidence. In addition to self-regulation, several students also discussed increased confidence that resulted from self-awareness and instructional strategies. The subtheme of learner confidence referred to a stronger feeling of self-assurance and self-efficacy that students feel. This accounted for 15.72% of the conversations on self-regulation. Comments included an increased readiness to be independent, confidence in working with others, a desire to know more, a readiness to collaborate in learning, a sense of accomplishment and a willingness to persist.

Brittany, who had medium experience, began by voicing her increased readiness to be an independent learner in stating, “It’s taught me to be more independent and to not rely on anyone else.” She went on to make connections to her confidence in working with others in sharing her knowledge to others after developing collaborative skills in her flipped classroom. She related this to one of her science courses:

> Like in chemistry, so like I might understand something and another student doesn’t, and the way the teacher says it they may not completely understand, because the teacher has like years of experience, like that’s their expertise, and I am at the same place learning as they are an I can break it down to help them understand how I understood it.

In the suburban focus group, students had deeper conversations about their desire to know more and go beyond expectations set for their learning. One student started the conversation by discussing the role of math and their confidence in independently solving math problems by stating, “That doesn’t mean that math can be used to solve all problems you think about though, but at least now I find myself thinking, ooh I can solve this, I get this.” Then another student goes a step further stating, “Also, you start to think differently about math.” The conversation continues with the following statement:

> Although the first purpose is go get the homework done, but while you doing that you are secretly searching because you are the one wanting to know more information. You are choosing to open your laptop and watch the videos after dinner.

In the rural focus group, students discussed confidence in working with others the role of collaboration in helping them feel more prepared for academic challenges. This included a readiness for challenge. One student specifically stated, “Yeah, and the collaboration makes you feel more comfortable with taking on difficult learning and with being challenged in general.”

Julian, the student with higher experience, discussed his growth in confidence in more depth, relating his difficulties with math and his readiness to persist despite those difficulties:

> Umm, so, I guess I feel like I learned more for a couple of reasons. Like I worked harder, but it was easier to work harder because I had more information available to me whenever I needed it, and I also could think differently because I was seeing other people thinking differently about math too.

He added to this readiness to persist, describing his adjustment process:

> So at first, it was hard to pay attention to the videos and interact by taking notes or working problems. Getting a routine was really important and I kind of had to figure that out for myself. Once we got going and activities included interacting with my classmates it got easier. Also, it was important to realize how I studied best so that I got the most out of the videos. It probably sounds silly, but at first I would be like “what did he just do, oh yeah, I can pause and rewind” That was very helpful.

Julian recognized the role of self-awareness in building his confidence and persistence as well:

> Well, I wouldn't say it was necessarily anything groundbreaking, but I became more aware of my own learning needs and I got more comfortable with working with difficult topics. I'm less likely to give up now because I'm more comfortable with my weaknesses and I understand better how I learn. I also am not afraid to ask for help and to collaborate on difficult things.

He added that he is more prepared for the challenges and process of learning:

> I think I'm more comfortable with not having all of the answers. I'd say I'm more interested in the process of learning and the interactions in learning instead of just getting the right answer. For example, in architecture problems, sometimes it was the process of solving a problem that revealed flaws in a plan and lead to a better model. So maybe I'm not more confident in my math abilities, but I'm definitely more confident in my ability to learn, plus I know more about how I learn and I'm more confident in working with others as part of learning.

Years of experience and critical thinking responses. Student perceptions of critical thinking were also considered according to respondents' experience with flipped learning. Rates and area of response were considered by primary nodes of instructional strategies and self-regulated learning. Results were presented according to the subthemes within these primary themes. A summary of these findings can be found in Table 8.

Instructional strategies concepts were related to student perception of strategies the teacher employed to support learning in the flipped classroom. This theme was considered in more depth through the subthemes of depth of learning activities,

individualized instruction, teacher expectations, and time to engage in questioning. In the subtheme of depth of learning activities, the low experience group accounted for 8.33% of the responses, with the medium experience group accounting for 41.67% of the responses. This subtheme was discussed the most by the high experience group, which contributed to 50% of the responses. In the subtheme individualized instruction, the low experience groups' feedback comprised 20% of the discussion. The medium group made the largest contribution to this subtheme, accounting for 70% of the responses, while the high experience group contributed the least, with 10% of the responses. Teacher expectations, responses were more evenly distributed. Both the low and medium experience groups each consisted of 31.58% of the responses. The high experience group contributed slightly more with 36.84% of the responses. The final subtheme was time to engage in questioning. The low experience group accounted for 36.36% of the responses regarding this concept. The medium experience group led this discussion with 54.55% of the responses; and the high experience group contributed to 9.09% of the responses.

The next node considered was the self-regulated learning node which was further broken into subthemes of individualized pace, learner confidence, learning strategies, and personal responsibility. Considering subthemes revealed where deeper conversations were held. The first subtheme was individualized pace. Students with low experience group accounted for 42.31% of the responses; the medium experience group accounted for 53.85% of the responses; and the high experience group contributed to 3.85% of the responses. In the subtheme learner confidence, the low experience group contributed to only 5.56% of the responses, while the medium group also contributed a small amount,

accounting for only 3.33% of the responses. The high experience group carried the majority of this topic and contributed to 61.11% of the responses. In the subtheme of learning strategies, conversations were evenly distributed across the low experience and medium experience groups, who each contributed to 42.5% of the responses, while the high experience group contributed to 15% of the responses. Lastly, in the subtheme personal responsibility, the low lead the conversations with 54.17% of the responses, followed by the medium experience group who accounted for 33.33% of the responses, and the high experience group which contributed to 12.5% of the responses.

Table 8

Rates of Response by Experience within the Critical Thinking Node

Node/Theme	Low Experience	Medium Experience	High Experience
1. Instructional Strategies			
a. Depth of learning activities	*8.33%*	*41.67%*	*50%*
b. Individualized instruction	*20%*	*70%*	*10%*
c. Teacher expectations	*31.58%*	*31.58%*	*36.84%*
d. Time to engage in questioning	*36.36%*	*54.55%*	*9.09%*
2. Self-regulated Learning			
a. Individualized pace	*42.31%*	*53.85%*	*3.85%*
b. Learner confidence	*5.56%*	*3.33%*	*61.11%*
c. Learning strategies	*42.5%*	*42.5%*	*15%*
d. Personal responsibility	*54.17%*	*33.33%*	*12.5%*

Collaboration and Social Interaction

The final research question addressed student perceptions of collaboration and social interactions in the flipped classroom. Collaboration and social interaction was expressed across two primary themes of peer collaboration and social interaction and collaboration and social interaction beyond the classroom. Common topics under peer

collaboration and social interaction included learning from each other, competitive nature, and time to engage in questioning. Peer collaboration and interaction accounted for 62.96% of the overall conversations surrounding collaboration and social interaction. Within this theme, learning from each other accounted for the largest percent of responses with 80.39% of the responses related to peer interactions. Time to engage in questioning accounted for 15.69% of the conversations regarding peer collaboration and interactions, while competitive nature was a topic raised by one student, accounting for 3.92% of the conversation. The second primary theme of collaboration and social interaction beyond the classroom accounted for 37.04% of the conversations related to research question three. This included conversations about multiple resources for learning, which accounted for 76.67% of this theme, readiness for challenges, which accounted for 23.33% of responses related to this theme. The subtheme of competitive nature was identified as a discrepant them as it was minimally addressed by two sources with a total of two references. Readiness for challenge was also discrepant and was only presented by two sources with seven references. The number of sources and references for each theme are summarized in Table 9, to include the percent each theme contributed to the overall research question node.

Table 9

Subthemes within the Collaboration and Social Interaction Node

Node/Theme	Sources	References
Collaboration and Social Interaction	9	81
1. Peer Collaboration and Interaction	**100% (9)**	**62.96% (51)**
a. Learning from each other	*100% (9)*	*80.39% (41)*
b. Time to Engage in Questioning	*66.67% (6)*	*15.69% (8)*
c. Competitive nature	*22.23% (2)*	*3.92% (2)*

2. Collaboration and Social Interaction Beyond the Classroom	**66.67% (6)**	**37.04% (30)**
a. Multiple resources	*66.67% (6)*	*76.67% (23)*
b. Readiness for challenge	*22.23% (2)*	*23.33% (7)*

Learning from each other. The theme of learning from each other accounted for the largest portion of conversations surrounding collaboration and social interaction. This theme referred to specifically learning from another student in the class or out of class. Discussions explored ideas to include the use of technological tools, interaction extending beyond school time, collaborative work, perceptions of each other as teachers, authentic tasks and networking, general readiness to collaborate more extensively.

In considering the technological tools used in collaboration, a student with low experience, Brianna, highlighted the variety of resources accessed by her and her classmates in stating:

> We could all, like, communicate through the computer so whether it was, you know, social media, or emailing, or um, at one point we had the facetime type stuff, or skype, or whatever, so we could use that as much as we wanted. So I think I definitely reached out a little bit more, you know, when I was at home, um, to other students you know for help and stuff.

Brianna discussed this further describing additional tools and how they promoted collaboration when she said, “We would like, outside of class, I would call them [classmates], text them, Facebook message them, be like, hey how would you do this or can you explain this to be or something?”

Brianna then discussed this idea further in terms of increased interactions that extended beyond the classroom setting when she said, “I think I interacted with fellow students outside of school a lot more rather than like just inside of school hours.” She also stated:

> Like in study hall we’d all work together and like we’d work on a problem and be like hey I got this what did you get and we can most of the time we’d have different answers and we’d all have to go back through and rework it and find out what the right answer was so we’d do this one problem and we’d do it like five different ways and then we’d like talk it all out and find the right way to do it.

This concept was also discussed by Brittany, who had medium experience:

> I worked with the students inside the class and outside the class. When you were in class and you had a question, it’s just hey can you help me figure this out? I like that because there’s 30 students and one teacher, and so like I didn't have to wait to talk to him. I could ask another student for help.

She later expanded on this idea:

> In a flipped classroom we’re more likely to work together because, uh, all of us working together is better than working by yourself and in here we did. We did in the flipped classroom and in study hall. We would all be working together, like doing the homework and collaborating and helping teach each other.

James expanded on the theme of collaborative work in stating, “we collaborate more because we would watch the videos together sometimes and then work on the homework together and figure out how to solve it with one another.”

Julian discussed similar collaboration, adding views of teacher expectations for increased interaction. He stated:

> Out of class we might call or text each other to ask what you got or how you got it. But in a flipped classroom you watch examples and instruction out of class, so we might watch them together, especially if we were travelling and work on problems together like in class, but we were also encouraged to work together outside of class. Sometimes we had to turn in screenshots of messaging or Show Me for collaboration credit.

Mary, who had medium experience, expressed a view that they became more intentional learning groups:

> In a flipped classroom, you watch the videos the night before and you got to class with another student you're like let's work through this together and if we have questions, we can ask the teacher. It was more group learning I guess. I remember we would help each other understand. So we wouldn't just have the teacher. We would have the other students in the class. Because some kids would learn some things faster than others. If the teacher was helping another student, we could have our friend help us.

She described interactions further, discussing the value and challenges of interaction when she stated:

> I liked it because I remember we would get like six people in a group and we had six brains working together to solve a problem – you know Calculus problems aren't easy so if one person learned one part of it, they could teach the rest. As

> another person learned another part, they taught that part, this is how we do that then. You're bouncing ideas off of each other, strategizing, brainstorming I guess, yeah. That's what I liked about that. The hard part about it was if someone in your group was ahead of you and they would just like hurry through problems so you are like "what did you do there" and wait up for me, but I like working in groups because it helped me understand more. Again it was another resource.

In the rural focus group, students began to discuss their perceptions of each other as teachers and facilitators of learning. One student stated, "It's like you get five or six teachers instead of just the one. So if you don't get something the way one person explains it, we're encouraged to collaborate and try other avenues until we get it." Another student in the rural focus group voiced excitement about the increased collaboration and authenticity of learning in noting:

> I think the collaboration is what gets us excited about math. It's more interesting when you can work on real issues with real people and with each other. We might still be solving the formulas ourselves, but the collaboration makes our work more meaningful.

Still, another student added the value of networking skills in stating, "Right and also you are so used to working with others outside of the class that you kind of build this network of people who can help you with different types of problems." While another student combined several of these concepts in stating:

> Right and also you have to think about collaboration differently. Sometimes you're watching videos and working through a problem and you're having a hard

> time with it. So you might rewind the video or check the math materials for other examples. But as you get used to the flipped lecture, I also started calling classmates or going to other tutorials like Kahn Academy or using show me to work through it with another student. You have to think differently about how you do that work and that takes some getting used to, but after a while you do it without even thinking twice about it. You just use Twitter or texting or show me or something else because that's what our teacher encouraged us to do.

The discussion in the rural focus group also considered students' views of each other shifting to consider roles as both learners and teachers. They discussed greater awareness of a variety of resources. One student stated:

> Oh and you also are more comfortable about collaborating with others, like asking for help and going to people you see as experts, even if its not your teacher or even someone at the school. You realize that collaboration puts a lot of resources at your fingertips if you just go out and seek them.

Time to engage in questioning. Another important aspect of collaboration, identified by students was the time to engage in questioning. This topic was discussed by six sources and referenced within the transcripts eight times related to collaboration and social interaction. Students expressed ideas related to using video accessibility, ease of understanding and responding to each other's questions, more opportunity for questioning in class, and the value to questioning in managing difficult learning.

Video accessibility was identified as a resource for helping students interact and ask questions more readily, Kamie, who had medium experience, stated:

> I feel like especially this year with math since we were all getting the same video we could ask, "At about 2 minutes did you get what he was saying…" you know and it was more easier [sic] to communicate than trying to like remember what the teacher said – because the information was right there… kind of useful at any time.

Julian voiced similar ideas while expanding his thoughts regarding ease of understanding and responding to each other's questions, stating:

> After a while we got pretty good about texting, tweeting, or messaging and just saying things like I'm confused about the problem at 5 minutes 23 seconds in the video. I don't get step two, and then chatting with my classmates and teacher on the problem until I got it. But you kind of have to rely on the likelihood that they are working at the same time unless it's a planned discussion time.

Molly, a suburban student with low experience, expanded on the idea of questioning being encouraged as part of the collaboration process in the classroom, more specifically the idea of more opportunity for questioning in class. She indicated:

> I think it's more like interactive um because like in a science class I might just be telling you it but a um flipped classroom they're more like kind of talking with you and you can ask them questions and they're not just standing in front of the board like telling you all the stuff.

Mary added to this idea by noting the increased comfort with managing difficult learning:

> I liked it better with the whole asking questions because math was never my strongest subject so I would go home and my parents couldn't help me with

> Calculus so it's like I could ask the teacher in class, but I don't know how much time we'll have.

Competitive nature. While a student in the previous discussion pointed out that, "Learning isn't a competition to see whose smarter, now it's look at what we can accomplish when we work together," students in the suburban focus group felt a sense of competition that motivated them to work harder. The competitive nature theme referred to students keeping up with each other academically and wanting to be slightly ahead of their peers. One student voiced, "You like kind of motivate each other in a way. Because you kind of see one of your friends working ahead and think I could do that too instead of just sitting here doodling in my notebook or something." Another student added:

> I sat by one of my good friends [laughing] and we would always like to see who was further ahead and we would want to be the one farther ahead, but we would also want to catch up to the other person so they could help us.

Multiple resources. A common topic of collaboration was related to recognizing that peers could serve as a source of information. This concept was also recognized as a standalone theme of multiple resources by going beyond peer interactions to a recognition that a variety of resources were available to the learner. The multiple resources theme referred to a student's perception that the student could use any resources available to learn or solve a problem.

Julian, who had high experience in the flipped classroom, expressed this most directly in stating, "You realize that collaboration puts a lot of resources at your fingertips if you just go out and seek them." In the suburban focus group, students voiced

similar awareness, stating, “You know, the people you ask for help might not always be in your class. They could be in your study hall and in a different math class and the video will help them.” In the rural focus group, a student added:

> Also I think the amount of collaboration that goes on in the classroom and in our work after the podcasts is really important to talk about. I learned so much more this way. I think I told you before, math is not at all my forte, but with all of the collaborative work we did in class, with each other, and with professionals who use math every day, it just made more sense.

To which another student in the rural group added:

> You learn to access so many different resources that you just naturally pick the ones that work best for you. Sometimes it’s your teacher, sometimes it’s a classmate, and sometimes it’s an architect in Des Moines or a Welder in the next town over.

Mary, who had medium experience, contributed to the idea of multiple resources by reflecting on her own needs and the variety of resources she accessed to help her learn:

> You are not seeing who is teaching you [in the podcast]. I knew it was the teachers voice, but I didn’t always feel like it was and I would go ask other people. Sometimes it wasn’t even a video that he made. Sometimes it was a Khan Academy video because he thought that the video explained it better, but if we didn’t understand how they explained it, we would go ask him or our friend. We had all of these options.

She then explained further:

> It helped me realize that I have more resources. Like before flipped, I honestly thought it was me and the teacher and the textbook and math textbooks are not easy to understand. So I realized that I had more resources because with the flipped you have that technology to go out and look up other ways to do things. There is not just one way to do it. Because some of the Calc problems we had, there was a simpler way to do it from Physics. We learned that so we would bring that in. It has helped me realize there is more out there to help me learn. Like there is not just one way to learn this.

Julian shifted the discussion by making connections between the increased availability of resources and his readiness to think differently about math concepts. He stated:

> Umm, so, I guess I feel like I learned more for a couple of reasons. Like I worked harder, but it was easier to work harder because I had more information available to me whenever I needed it, and I also could think differently because I was seeing other people thinking differently about math too.

Readiness for challenges. Students also discussed an increased readiness for the challenges presented in the flipped classroom. For Mary, questioning was a helpful tool in preparing her for the challenges of her Calculus course, which she recognized as a weak area for herself. Similarly, in Julian's response related to multiple resources, he introduced the concept that students felt more prepared to face learning challenges when he said, "I also could think differently because I was seeing other people thinking differently about math too." The readiness for challenges theme referred to a student being comfortable and confident when attempting something either new or more difficult

in their perception. Besides Julian's response, this topic was only targeted in the rural focus group discussions. One student voiced increase comfort with feeling prepared for challenges in stating, "Yeah, and the collaboration makes you feel more comfortable with taking on difficult learning and with being challenged in general." Another student added, "I don't feel like I have to do this on my own. Learning isn't a competition to see who's smarter, now it's look at what we can accomplish when we work together." The conversation also addressed being able to express learning needs and strategies that helped students rise to academic challenges:

> As a learner, I have to be able to say, wait a minute, I don't know how we got there, I missing something here so I need to back up a minute. It can be easy to just want to rely on the work of your group or just copy steps from a tutorial and not really master the content. The unit assessments helps some because I know I will be accountable for showing that I've mastered the work through my homework samples, discussions, and the exams, but I can see how it might be easy to sit back and let the group carry you.

Students also discussed challenges in taking on the responsibility for learning for the teacher and learners. One student identified teacher challenges, stating, "I think leaders can struggle with sharing the responsibility for learning while more introverted students can have a hard time coming out of their shell." Another student added:

> I think it's also hard for students who are used to classes where the teacher gives you information and you might add your own interpretation of it, but ultimately you're just telling them back what you've learned and you might have just

memorized it not mastered it. So that can make sharing the responsibility for learning uncomfortable.

Years of experience, collaboration, and social interaction. As with previous research questions, the node for collaboration and social interaction related to research question three, was also considered by experience level. Since no subthemes existed within collaboration and social interaction, the themes considered are limited to competitive nature, learning from each other, multiple resources, readiness for challenge, and time to engage in questioning. Competitive nature and readiness for challenge were topics primarily raised in focus groups. As a result, contribution to these could not be related by experience level as all students were influenced by the generated topic and addressing the topic could not be attributed to any one level of experience. When students discussed learning from each other, 43.75% of the theme was addressed by students with medium experience. Students with low experience contributed to 31.25% of the discussion, and 25.00% of the discussion came from students with high experience. Students with medium experience also contributed the most to discussion of accessing multiple resources for learning. They were followed by students with high experience (31.25%), and then those with low experience (18.75%). Finally, time to engage in questioning was addressed by students with low and medium experience equally, with each group contributing to 42.86% of responses. Students with high experience contributed to 14.29% of the responses. These rates of response are summarized in Table 10.

Table 10

Rates of Response by Experience within the Collaboration and Social Interaction Node

Node/Theme	Low Experience	Medium Experience	High Experience
1. Peer Collaboration and Social Interaction			
a. Learning from each other	*31.25%*	*43.75%*	*25.00%*
b. Time to engage in questioning	*42.86%*	*42.86%*	*14.29%*
c. Competitive Nature	*NA*	*NA*	*NA*
2. Collaboration and Social Interaction Beyond the Classroom			
a. Multiple Resources	*18.75%*	*50.00*	*31.25%*
b. Readiness for Challenge	*NA*	*NA*	*NA*

Summary

The results of the qualitative analysis were carefully aligned to each research question in order to relate authentic qualitative feedback according to three primary categories of differences between flipped and traditional classrooms, critical thinking, and collaboration and social interaction. Themes, also referred to as nodes, and related subthemes emerged as the data were analyzed. Data presented included depth of topic coverage based on number of respondents and total responses, as well as presentation of rich quotes representative of themes. Each of these themes was further considered based on participant respondent experience levels.

The question posed for Research Question 1 was "How did students perceive flipped learning compared to traditional learning?" When considering student responses related to this topic, the main themes that emerged included experiencing different levels of learning, less delay in learning, increased opportunity for review, receiving stronger assistance, and different types of interactions. Increased consistency in delivery of content was also discussed but this topic did not emerge as a major theme.

Research Question 2 was stated as "How did students perceive flipped learning contributing to their ability to learn math content and improve their critical thinking?" In considering students perceptions of activities related to critical thinking, themes that emerged included instructional strategies, self-regulation, and time to engage in questioning. Students spent the largest amount of their time discussing ideas related to this topic. As a result, several subthemes emerged as well. Instructional strategies revealed subthemes of depth of learning, individualized instruction, and teacher expectations. Self-regulation was further delineated into a self-regulated pace of learning, increased learner confidence, strategies for learning, and responsibility for learning.

Finally, Research Question 3 asked, "How did students perceive peer collaboration and other social aspects of flipped learning?" As students explored these topics through interviews and forums primary themes that emerged were related to learning from each other, recognition of multiple resources for learning, and increased opportunities to engage in questioning between and among both teachers and peers. A positive competitive nature and increased readiness for challenge were also concepts that were presented but that were not addressed as major themes.

In Chapter 4, a thorough analysis of the data identified specific themes that emerged in student responses. The presentation of rich qualitative quotes representative of these themes gives an authentic voice to student perceptions. Ultimately, this process of analysis and presentation of authentic quotes yields more accurate data for interpretation and discussion in Chapter 5.

Chapter 5: Discussion, Recommendations, and Implications

Giving voice to student perceptions and descriptions of their experiences as participants in flipped classrooms is an essential part of understanding the impact of this model of instruction. The purpose of this study was to describe students' lived experiences of flipped learning. More specifically, this study focused on students' views of (a) how flipped learning experiences compares to traditional learning experiences, (b) how flipped learning contributes to learning content and critical thinking, and (c) how this model of teaching and learning may have influence on collaboration and social aspects of learning and instruction.

Through analysis and coding of interview and focus group interviews, themes were identified and then organized to address each of the study's research questions. The first related research question was regarding differences between flipped learning and traditional learning. Students' interviews and focus groups revealed primary topics related to instructional consistency, different levels of learning, reduced delay in learning, increased opportunities for review, increased assistance for learning, and different types of interaction. When considering contributions to learning and critical thinking, discussions centered on instructional strategies including depth, individualization, and expectations, as well as self-regulated learning characteristics including pacing, confidence, learning strategies, and responsibility. Having time to engage in questioning was also raised when discussing critical thinking concepts. When considering collaboration and social impacts, students discussed the topics of seeing each other as learning partners, recognizing multiple resources for learning beyond the teacher, positive

competition, readiness for challenge, and again, increased opportunity for questions. Each of these concepts was considered based on overall experiences as well as by respondent level of experience. In Chapter 5, these findings are further interpreted according to each research question. Limitations are reviewed in order to realistically consider results and address cautions for interpretation and generalization of findings. Finally, implications and recommendations related to the findings are presented.

Interpretation of Findings

When interpreting the findings of this qualitative study, no attempt was made to read further into individual responses beyond the coding conducted in Chapter 4. Doing so would risk reducing the authenticity of student responses and lead to potential misinterpretation of individual comments (Moustakas, 1994). Instead, a focus was placed on synthesizing themes to describe patterns in overall perceptions related to each research question and interpreting them in context of both the conceptual framework and current literature presented in Chapter 2.

Related Research Question 1

Research Question 1 stated: how do students perceive flipped learning compared to traditional learning? The primary differences considered in this research question yielded three themes of different types of instruction, interaction, and learning. Within these themes, students voiced that the type and depth of learning differed in a variety of ways, including types of interactions, opportunities for review, stronger assistance, no delay in learning, different levels of learning, and consistency of instruction. These

themes and related concepts can be considered in relation to the conceptual framework and current literature.

The conceptual framework and Research Question 1. In considering the conceptual framework related to Research Question 1, clear connections to sociocultural learning theory (Vygotsky, 1978), schema theory (Anderson, 2004), and cognitive load theory (Sweller et al., 2011) can be presented. Types of instruction and interactions discussed by students are representative of scaffolding in sociocultural learning theory in that students perceived interactions as more meaningful to individual and group learning needs by targeting understandings and misunderstandings more directly as well as through the provision of immediate information (no delay in learning) through available podcasts and stronger assistance for learners (Sweller et al., 2011). Themes related to interactions and instruction were also closely related to cognitive load theory in that simpler learning tasks occurred in individualized interactions and podcast activities where students could have repeated exposure and practice (opportunity for review), while more difficult tasks involved more collaborative interactions and instruction (Sweller et al., 2011). Different levels of learning were compartmentalized within podcasts for low cognitive load and in class for high cognitive load. The descriptions of different types of learning engaged in to achieve authentic and deeper learning by students in the flipped classroom is related to schema theory in that students were able to make more meaningful connections to the course content, which supported their ability to apply content more readily (Anderson, 2004).

Current literature and Research Question 1. In addition to the conceptual framework, related current research included consideration of reduced cognitive load, deeper learning, openness and collaboration, and opportunities for practice and review.

In their meta-analysis of the literature on cognitive load, Kirschner et al. (2011) found that the availability of learning through multimedia, coupled with a scaffolding of instructor support and peer collaboration consistent with flipped environments, assisted students in the transfer of knowledge and stronger development of schema. The findings of this study yielded similar results in that students clearly identified both multimedia resources, such as podcasted lectures, along with intentional teacher supports and collaborative learning provided them stronger assistance to tackle difficult math concepts.

Seaman (2011) described different levels of learning as varying levels of comprehension, while Geary (2007, 2008) focused on the difference between concepts that can be taught versus what must be learned. The findings of this study supported and added to the findings of Seaman and Geary in that the teacher was able to move students efficiently to the level of thinking the teacher wanted them to achieve, students valued the challenge and depth of learning they experienced, and students made meaningful connections to content that they perceived as a weakness. This is a key factor identified in schema theory (Anderson, 2004).

Findings by Musallam (2010) and Sugar, Brown, and Luterbach (2010) regarding flipped instruction and increased opportunity for review and Seaman (2011) concerning the cognitive effects of prior exposure to mastery-level material are also consistent with reduced cognitive load related to the conservation of working memory. Those researchers

noted that this review time for mastery level learning, referred to as pretraining or prior exposure, freed up space for application and transfer in the classroom. The findings of this study support the current literature because students perceived that flipped learning provided them opportunities to review lessons through interacting with and revisiting podcasts for further clarification as needed.

Related Research Question 2

Research Question 2 stated: How did students perceive flipped learning contributing to their ability to learn math content and improve their critical thinking? The primary themes that emerged around this question were related to instructional strategies and student achievement of self-regulated learning. These themes can be considered within the conceptual framework and current literature presented in Chapter 2.

The conceptual framework and Research Question 2. In cognitive load theory, Sweller et al. (2011) indicated that partitioning of cognitive resources allows for reduction of cognitive load for difficult concepts by moving mastery level learning to activities outside of the classroom, allowing for greater support within the classroom. Students in this study indicated that there was a learning curve related to this task. They had to develop self-regulation skills for thinking about and managing time differently in the flipped model. Once they accomplished this, students expressed an increased readiness to wrestle with difficult learning, not only because they felt more supported, but also because they were making more meaningful connections to the course content, a concept consistent with schema theory (Anderson, 2004). They were also more self-aware of what it takes to be a successful learner. The students' recognition of themselves

and their peers as potential resources for learning serves as evidence of this, as well as relation necessary interactions supported by sociocultural learning theory (Vygotsky, 1978). Another significant concept voiced by students at all levels of experience was the importance of having time to engage in questioning during class. The concept of time to engage in questioning is related to the conceptual framework components of sociocultural learning and schema theory. Questioning is an important part of both accessing experts and the provision of appropriate scaffolding during learning, concepts key to sociocultural learning theory (Vygotsky, 1978). In considering schema theory (Anderson, 2004), critical thinking that results from meaningful questioning results in connections of basic and advanced knowledge.

Current literature and Research Question 2. Research Question 2 was also considered within current literature. Specific attention was given to expectations for learning and instructional strategies as well as strategies for self-regulation. This included instructional support, the use of technology, self-regulation, and continued success in learning.

Musallam (2010) found that students perceived instructional targets and expectations as providing ongoing support for learning through the availability of consistent foundational information so that the teacher could intentionally support and challenge students in more meaningful ways in the classroom. HaBler, Major, and Hennessey (2015) found that overall learning gains were most often due to the instructional approach, more than the specific technology employed. The findings of this study support current literature in that students voiced that teacher expectations,

availability, structured learning activities, and collaborative efforts were enhanced by technology, but technology itself was only identified as a tool.

In considering self-regulation, students voiced that they learned to manage time more effectively based on their ability to prioritize learning tasks. These elements of self-regulated learning were consistent with work by Ahn and Class (2011), who found that students' realization that they are agents in their own learning evolves over time. With this call for increased responsibility in learning, students were able to articulate strategies that helped them experience success as well as a sense of increased confidence in mathematics and overall learning. Sahin, Cavlozglu, and Zeytuncu (2014) similarly found evidence of changes in preparation habits and improved levels of self-efficacy of college students in a flipped calculus classroom. Ultimately, the findings of this study supported the current literature related to self-regulated learning because students described experiencing becoming autonomous and more confident learners through having to take more responsibility for learning outside of class as well as through increased commitment based on the benefits and requirements for collaboration.

Time to engage in questioning was also considered within current literature as it relates to both instructional strategies and self-regulation. Clarik (2015) and Green (2015) both found that students valued individualized class time because it increased student opportunities to ask questions and address challenges and misunderstandings. Similarly, Ziegelmeier and Topaz (2015) found that, despite equal academic outcomes between the flipped and traditional instruction groups, the flipped group had more time to ask

questions in class, more time to complete hands-on activities, and completed checkpoint quizzes more regularly than the traditional group.

Related Research Question 3

Research Question 3 stated: How did students perceive peer collaboration and other social aspects of flipped learning? The primary themes that emerged in student interviews and focus group discussions included peer collaboration and social interaction as well as collaboration and social interaction beyond the classroom. Within these themes, the concepts I explored included identifying opportunities to learn from each other and recognizing that there were multiple sources of information available to support learning. Other concepts that were addressed included a sense of a competitive nature and readiness for challenges in learning. These themes can be related to both the conceptual framework and literature presented in Chapter 2.

The conceptual framework and Research Question 3. Students discussed collaboration and social interactions related to academic and social behaviors in and outside of class. The themes can be directly related to the conceptual framework presented in sociocultural learning theory, schema theory, and cognitive load theory. This included considering opportunities to learn from each other and accessing multiple resources for learning .

The concept of learning as a social construct is consistent with sociocultural learning, which specifically identifies access to experts as a key variable to learning (Vygotsky, 1978). As students became more experienced with this model, they voiced increased comfort with the idea of collaboration and were, in fact, ready to redefine their

view of who an expert was, including recognizing peer and community interactions as valuable to their learning. Sociocultural learning theory (Vygotsky, 1978) promotes increased access to meaningful information and activities that promote connecting with others and with content as presented in schema theory (Anderson, 2004), and the partitioning of resources through preteaching of mastery level information as promoted by cognitive load theory (Sweller et al., 2011). The use of video podcast technology and tutorials presented an opportunity to preteach mastery level material. Students were able to extend their learning of mastery level material outside of class through their collaborative efforts with each other (Sweller et al., 2011). The intentional partitioning of cognitive resources in mastery level, individualized content, and challenging authentic activities allowed students to wrestle with information in different ways which increased their awareness of which learning strategies and resources best supported the learning objectives.

Current literature and Research Question 3. Consideration of social and collaborative activities related to learning in and outside of class is also addressed within current literature. The findings of this study are consistent with research by Strayer (2012) concerning increased student ownership and autonomy in the learning process among high school mathematics students. The findings also align with research by Prober and Heath (2012) citing the creation of curiosity and an increase in questioning and reasoning in the flipped environment with medical graduate students. Viewing the collaborative nature of flipped learning as creating a shift in their learning mindset also

led students to a greater self-awareness of learning strengths and weaknesses as well as increased awareness of support networks for learning among peers.

This can also be related to the theme of multiple resources. Khan (2009) and Chandra and Fisher (2009) suggested that students favored technology resources due to the prevalence, accessibility, and convenience of resources, as well as the rewindable nature and this helped them be more active in classroom activities. Kay and Knaack (2008) stated that students were comfortable using videos for learning because they were accustomed to learning that way normally, a statement echoed in this study. Love et al. (2013) and Sahin et al. (2014) found that participant perceived the screencasted videos as helpful in improving level of understanding and self-efficacy with the content. Finally, Clark (2015) found that students' desire to learn improved with the flipped classroom. It is this desire to learn which motivates students to look for many and all resources. While the data in this study supported studies related to the helpfulness of technology in learning, it did not support current literature that found technology a barrier to student learning. Students voiced ease of use and comfort with the learning and social media tools as a seamless transition between social and academic applications. This contradicts research found by Hutchings and Quinney (2015) that despite higher academic gains, the combination of student-centered learning and adaptation to new technology platforms was too challenging to be comfortable for students. Findings in this study were also inconsistent with Ford's (2012) research that even though students in his study were provided with resources to use outside the classroom, the students did not use them effectively. Students in this study did voice difficulty in self-regulating their use of

resources initially, but also voiced that once they mastered use of the resources, learning was enhanced. The positive interaction of students in this study relating to technology use is worthy of further exploration to determine why students in some studies see technology as an additional learning resource and why other students see it as a barrier.

Limitations of the Study

Several limitations to this study should be taken into consideration when reviewing the findings, implications, and recommendations. Phenomenological studies rely on participant self-reported descriptions of their own experiences within a specific phenomenon. As such, the sample size is smaller in this case involving seven primary respondents and 11 focus group members distributed across two school systems, and the phenomenon of a flipped classroom is unique to the environmental characteristics experienced by these 11 students within two unique settings. In addition to this, generalization of learner experiences and views cannot be made to other students, classes, or content areas without caution and consideration of characteristics that make these different settings unique.

Potential student and researcher bias were additional limiting factors that were addressed proactively. Student bias through potential desire to please teacher and administrators was controlled for through assurance of anonymity as private sessions for interviews and focus group, as well as through giving reminders of the right to withdraw from participation at any time. Due to the timing of interviews over the summer, limited opportunity for interaction with school professionals also served to reduce perceptions that student responses might impact grades or status.

Researcher bias was another limitation of this study, including my background employing flipped instruction in science courses, as well as potential to infuse personal views and interpretation of student responses. Carefully structured interviews and transcription of interviews provided initial control of bias. In addition to this, heightened awareness was maintained through use of reflexive journaling to ensure my experiences were maintained separate from respondent experiences. This practice raised awareness of my own perceptions in order to increase likelihood of recognizing and preventing generalization of these perceptions onto student responses. In addition to this, researcher bias was controlled for through the development and adherence to the research designed phases.

Finally, it is important to emphasize that a phenomenological study only involves describing a phenomenon. This type of study should not be used to imply causality or correlation (Moustakas, 1994). While recommendations can be made based on the experiences of students in this unique setting, caution must be taken not to generalize findings and recommendations without first identifying and understanding the unique characteristics of learners and the environment to which concepts might be applied.

Recommendations

Based on student perceptions and connections made to existing literature, recommendations can be made for instructional practices, teacher awareness, and attentiveness to student feedback according to each research question and the related themes identified within this study. It is important to consider that recommendations for practice can only be made directly to the systems in which the phenomena were

researched. While guidelines for support may be considered in general for flipped instruction, this research would not support them as best practice without those applying concepts first considering the unique characteristics of their students, classrooms, and systems. A more ethical approach would be to first consider the phenomena of student experiences in those unique experiences and then identify and address similarities and differences. Careful consideration of the limitations of this study must be given; however, the guidelines presented here encourage teachers to attend to the unique characteristics of the content, the classroom, and the learners within it. Recommendations are also made for further research advancing flipped classroom cultures.

Supporting Learning in Flipped vs. Traditional Classrooms

Several recommendations can be made based on student perceptions of the flipped classroom compared to the traditional classroom. First and foremost, it is important to establish that one model should not be related to students as better than another. Students with more experience in both models were able to articulate this idea in this study; however, it is also a valid point to be related to students as they initially learn to navigate this instructional model. Students should be made aware of the intent for use of this model and the type of content it is often successful within. They can be further encouraged to recognize strengths in both instructional strategies as well in differences in the types of learning occurring within each so that they can more accurately attend to learning targets. To accomplish this, instructors should clearly define learning activities and expectation to students both during podcast and practice tasks as well as during classroom interactions. When deciding whether or not to flip a course, teachers should

carefully consider content and the learners. Content requiring intricate teacher interactions that cannot be related easily in a podcast should be avoided. If a student cannot grasp a challenging concept by simply rewinding and reworking, then that content needs to be taught in a setting where the student can ask meaningful questions at the same time as the instruction. Finally, teachers must also consider sustainability of the flipped classroom. In the first years of flipped teaching, the teacher may need to focus more heavily on student supports and developing clear and concise podcasts that provide meaningful and foundational information to the learner. As students become more confident and gain experience with the flipped model, the teacher can shift to an increased focus on classroom components that present content in both individualized and collaborative ways that also provide opportunity for deep and challenging learning. The key here is to be as intentional as possible, as students perceive that the flipped classroom was designed to do these things. Students in this study expressed a perception of intentionality. Although it cannot be confirmed that a lack of intentionality might hinder student learning and result in negative perceptions, teachers are cautioned to avoid reducing structure within this model until research can explore what happens in classrooms where flipped instruction has not been successful.

Supporting Critical Thinking

In order for students to achieve deeper levels of learning and advance critical thinking skills, teachers in flipped learning environments should focus instructional strategies on setting clear expectations for timelines for learning as well as verbalizing and presenting clear learning objectives. When setting expectations teachers should also

consider setting expectations for student questioning and focus on expressing confidence that students can achieve learning objectives. Individualization should focus on developing students' self-awareness and questioning skills so that the student is guiding the decisions about what should be individualized. This will allow the teacher to address learner needs more quickly and work among all students and it will support an increased sense of independence among learners.

In addition to this, students in this study expressed initial struggles with learning to think differently about their role in learning and in navigating flipped learning tasks. It may be beneficial for teachers to expose students to podcasts in class initially and offer opportunities to practice navigating them effectively. Students would benefit from instruction on how to view a video with a learning mindset, including pausing, rewinding, and reflecting on learning and developing questions to advance learning. Teachers should clearly define expectations for viewing podcasts and implications for not giving priority to learning tasks. Initial discussions and activities might also address study habits, attentional awareness, learning styles, and environmental factors, including when and where individuals learn best.

As students master general expectations of the flipped learning model, the instructor should encourage more abstract mindsets for application of learning as well as increased learner confidence in learning. This should include encouraging a variety of models of collaboration among peers and with content and people outside of the classroom, in order to expand student views of where and how learning takes place. Teacher should encourage learners to identify additional resources and applications of

content by initially making connections for them, then encouraging them to pose additional connections. It will be imperative that teachers express confidence in their students' ability to achieve these expectations and then to provide appropriate individualized supports as students gain experience with the flipped model.

Supporting Collaboration and Social Interactions

In considering student feedback for collaboration and social interaction several key points emerged. First, expectations for collaboration should be clearly related and supervised initially, but can be gradually released to student-driven responsibilities. Second, tools for collaboration may be presented by the teacher, but student selection may also achieve learning goals when students are already familiar with a variety of social interaction resources. Third, the teacher should establish a culture of awareness that learning can occur anywhere and with anyone so long as learner are aware of what an expert may look like. Finally, providing opportunities for meaningful questioning appears to be an imperative piece of the collaborative learning and critical thinking process.

Students voiced that the teacher encouraged collaboration and set expectations for how students would demonstrate collaboration both for learning and for use of technological tools. Initially teachers may need to encourage and even establish working groups. Modeling and structuring collaboration strategies may be necessary as students navigate the shift from viewing the teacher as the sole proprietor of information to recognizing the self and others as a valuable learning network as well. In addition to this, the teacher should provide opportunities for students to recognize other professionals in related fields as valuable sources for learning in order to expand student views of

resource networks. Over time students should be given more autonomy and responsibility in identifying appropriate learning resources.

These same concepts apply to the use of technology and social media. Students in this study evidenced the ability to readily apply a variety of social media resources as well as social learning tools with little guidance. If new tools are introduced, use of the tool should be clear, but students did not indicate any difficulty with employing a variety of resources. Initially, teacher structure should provide a framework for use of resources, particularly when encouraging students to use social channels for learning. In student described experiences, this included providing screenshots or samples of work completed in social media environments as well as encouraged peer interaction, project-based learning, and community based collaborations with professionals in related fields. Still, ongoing discussions described that much of the collaboration through social media became self-driven as students learned what worked best for them. This would suggest that while there were times that a prescribed tool was necessary, such as discussing a concept with a professional via Skype, much of the time, once students understood the use of social media and technology as a resource for accessing academic information, students were comfortable with self-selecting the tool that was most useful for them. Initially, the teacher may need to establish expectations for use of tools to collaborate in order to create the desired culture for learning. At this point, clear procedures, expectations, and evaluation of use would be beneficial. As students become more adept, the teacher may choose to take a more hands-off approach.

Following the strategies described above should support a culture of learning communities over isolated learning environments. Teachers should intentionally direct students to collaborate with each other, outside resources, and the teacher. Teachers should initially identify who additional potential learning partners might be both within the school and community. A sense of shared responsibility should take priority over creating a sense of complete teacher control of the content and learning. Students in the study described a culture where the teacher became one of many resources for learning and that the students themselves, other teachers, and members of a professional community are just as likely to support learning. This type of culture must be cultivated and encouraged by the teacher in order for students to gain comfort with and generalize such strategies to math and other areas of learning.

Finally, questioning was a topic consistently raised in multiple areas of discussion. Questioning as a strategy for learning is a skill that teacher should teach, model, and encourage. Initially, students in a flipped classroom may benefit from coached questioning based on podcasts, classroom discussions, one-on-one interactions, and collaborations. Dedicating a portion of time for questioning would provide opportunity for modeling and practice of effective questioning strategies that promote effective communication and collaboration in learning.

Recommendations for Further Research

Developing a learning culture that supports flipped teaching as a model that supports deep learning, critical thinking, and intentional social interaction merits further consideration in the literature. Findings of this targeted phenomenological study yielded

some interesting data for further consideration. Beyond repetition of the study in other unique areas of learning, research might also consider themes that emerged within each research question.

By repeating this study in a variety of content areas, different demographic regions, and over sustained periods of time, more comprehensive studies of the new literature might reveal consistent trends across schools evidencing positive perceptions and outcomes for students in flipped classrooms. In addition to this, rich descriptions of flipped classroom models employed would allow for ease of comparison across different systems and content areas.

When considering the differences that exist in flipped vs. traditional classrooms, there are several potential areas for further study. The first is to determine whether different levels of learning are a construct of the content or the instructional model. It would also be valuable to consider whether different types of interaction is a unique product of increased collaboration in classroom activities that results from reducing cognitive load through flipped teaching or if this phenomena is similar to interactions that may take place in traditional classrooms that employ other models of instruction such as project- or problem-based learning. In addition to this, while student reference to consistency of instruction was minimal in this study, this phenomenon might deserve further consideration related to the sharing of knowledge across similar classes and content.

In considering the component of critical thinking in the flipped classroom environment, further research should consider the intentionality of teacher expectations

and objectives for learning in order to understand the role of the teacher in this learning environment. Studies might address the role of the teacher in establishing guidelines for learning and facilitating activities that extend student thinking beyond the content of the podcast. More specifically, what do good teachers do in flipped classrooms to promote critical thinking through activities that extend beyond viewing podcasts and practicing with the teacher in class? Consideration of increased student awareness and self-regulation also deserves a closer look in the literature. Research should center on what self-determined learners look like in a flipped classroom and what teacher actions facilitate such ownership of learning and confidence in learning.

Research related to collaboration and social interaction should consider the structure of such interactions as well as the tools and resources used to facilitate such interactions. Studies should be developed to consider what types of interactions within and beyond school classrooms are unique to flipped classrooms. Student perceptions of their roles and responsibilities for learning, as well as their views of teachers as sole proprietors of knowledge, are also valuable research topics. In addition to this, research should also consider the intentional use of technology and social media in the flipped classroom, including more intentionally considering student ease of use and perceptions of potential encroachment of academia in social realms as well as the partnership between teachers and students in identifying the most useful tools and structuring learning around those tools.

Finally, research that considers the structure of the flipped classroom, including targeted instruction in navigating classroom strategies and expectations, as well as a

gradual release of responsibility for accessing, navigating, and collaborating within the flipped classroom merits further investigation. Research might focus on describing various methods for introducing the flipped model, expectations and strategies for navigating multiple sources of information, and best practices that promote increased student ownership of collaboration.

Implications

This study is foundational in that has established initial groundwork for understanding how students perceive one unique model of instruction, flipped classrooms. It adds valuable insights to a limited field of research on practices that support learning in flipped classrooms. While much of the research focuses on best practice and unique components of the instructional model, this research provides fresh perspectives through the eyes of the recipient of the instruction.

An increased understanding of student perceptions of flipped learning has the potential to impact positive social change at an individual, classroom, and societal level. First, individual classroom teachers used the flipped model may make careful consideration of the student experience and interactions shared in this study in order to better facilitate learning. Considering the voice and experiences of the learner allows educators to understand the impact of their practices at a more targeted level. Because the data from this study indicated that students benefit more with increased experience with the flipped model, at the classroom level, more students may benefit if more teachers provide students the opportunity. At the societal level, this study may impact positive social change by posing opportunity for more schools to support similar models,

particularly in rural settings where collaborative resources may be more restrictive. In addition to this, students in this study expressed a greater sense of self-motivation and personal responsibility for learning, collaborating and applying their skills. This self-motivation and self-regulation are valued through their emphasis within the 21st century skills content standards and in society today. Promoting self-motivated and self-regulated learners through flipped learning models may prepare students for the type of thinking and collaboration demanded in 21st century learning, living, and working.

Conclusion

Existing theory and preliminary research points to the instructional model of flipped classrooms as an effective strategy for reducing cognitive load and encouraging collaboration, critical thinking, and creativity (Bergmann & Sams, 2012a; Kalynga & Hanham, 201l; Musallam, 2010). Some researchers have attempted to isolate the components of the flipped classroom in order to consider their effectiveness as components of a larger picture. Technology and other resources employed do not account for success of this model when considered alone (Chandra & Fisher, 2009; Ellington, 2006; Ford et al., 2012; Huang, Huang, & Chen, 2012; Kulik, 2003; McCulloch, 2009). Nor can simple consideration of collaboration and social interaction fully explain the full picture of the effective flipped classroom (Kalin, 2013; Osgerby, 2013; Poellhuber & Anderson, 2011). While research in each of these components adds valuable insights into this model of instruction, little attention has been given to the experiences of the individuals who interact within this learning environment (Friedman & Friedman, 2013; Roblyer et al., 2010). By describing the phenomenon of experiences lived by a select

group of students in two flipped mathematics classrooms, this study presented a strong introductory consideration of what students perceive they are gaining out of flipped learning. Findings allow researchers to consider already explored topics through another view, particularly topics related to defining the flipped classroom more clearly as uniquely different from traditional classrooms, discovering pathways to critical thinking, and exploring the impacts of collaborative experiences. Considering students experiences revealed insights related to the value of learning experiences, perceptions of the role of a learner and a teacher, self-regulation and confidence, learning strategies, technology as a learning resource, and meaningful collaboration. As such, this study has the potential to expand the research on flipped learning. It serves as an invitation to researchers to consider the phenomena of the flipped classroom through a larger lens that addresses both practices and experiences.

References

An, Y.J., & Reigeluth, C. (2011). Creating technology-enhanced, learner-centered classrooms: K-12 teachers' beliefs, perceptions, barriers, and support needs. *Journal of Digital Learning in Teacher Education*, *28*(2), 54–62. doi: 10.1080/21532974.2011.10784681

Anderson, J. R., Bothell, D., Byrne, M. D., Douglass, S., Lebiere, C., & Qin, Y. (2004). An integrated theory of the mind. *Psychological Review*, *111*(4), 1036–1060. doi:10.1037/0033-295X.111.4.1036

Anyanwu, C. (2003). Myth and realities of new media technology virtual classroom education premise. *Television & New Media*, *4*(4), 389–409. doi:10.1177/1527476403256210

Armstrong, D. (2011). Students' perceptions of online learning and instructional tools: A qualitative study of undergraduate students use of online tools. In *World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (Vol. 2011, pp. 1034–1039). Retrieved from http://www.editlib.org/p/38847

Ayres, P. (2006). Impact of reducing intrinsic cognitive load on learning in a mathematical domain. *Applied Cognitive Psychology*, *20*(3), 287–298. doi: 10.1002/acp.1245

Ayres, P., & Paas, F. (2009). Interdisciplinary perspectives inspiring a new generation of cognitive load research. *Educational Psychology Review*, *21*(1), 1–9. doi: 10.1007/s10648-008-9090-7

Baepler, P., Walker, J. D., & Driessen, M. (2014). It's not about seat time: Blending, flipping, and efficiency in active learning classrooms. *Computers & Education*, *78*, 227–236. doi: 10.1016/j.compedu.2014.06.006

Bailey, A. (2014). Teaching Alice Walker's The Color Purple: Using technology and social media to foster critical thinking and reflection. *Virginia English Journal*, *64*(1), 17–26. Retrieved from http://search.ebscohost.com. (Accession No. 98060385)

Baytak, A., Tarman, B., & Ayas, C. (2011). Experiencing technology integration in education: children's perceptions. *International Electronic Journal of Elementary Education*, *3*(2), 139–151. Retrieved from http://hdl.handle.net/11486/760#sthash.P5bZGFow.dpuf

Berge, Z. L. (2008). Changing instructor's roles in virtual worlds. *Quarterly Review of Distance Education*, *9*(4), 407–414. Retrieved from Academic Premier Search database. (Accession No. 37803016)

Bergmann, J., & Sams, A. (2012a). Before you flip, consider this. *Phi Delta Kappan*, *94*(2), 25–25. Retrieved from http://pdk.sagepub.com/content/97/2/42.full.pdf+html

Bergmann, J., & Sams, A. (2012b). *Flip your classroom reach every student in every class every day*. Alexandria, VA: International Society for Technology in Education; ASCD.

Berrett, D. (2012). How "flipping" the classroom can improve the traditional lecture. *Education Digest*, *78*(1), 36–41. Retrieved from http://chronicle.com/article/How-Flipping-the-Classroom/130857/

Bingham, T., & Conner, M. (2010). *The new social learning: A guide to transforming organizations through social media* (1st ed.). San Francisco, CA: ASTD & Berrett-Koehler.

Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals Handbook I*. New York, NY: McKay; Longman.

Bonk, C. J. (2009). *The world is open: how web technology is revolutionizing education*. San Francisco, CA: Jossey-Bass.

Boutell, M., & Clifton, C. (2011). SPLICE: Self-paced learning in an inverted classroom environment. *Proceedings of the 42nd ACM Technical Symposium on Computer Science Education* (pp. 1–8). Retrieved from http://www.curtclifton.net/storage/papers/BoutellClifton11aa.pdf

Brown, M. J. W. (2012). *Teachers' and students' perceptions regarding technology-assisted instruction in 10th-grade mathematics classrooms*. (Doctoral Dissertation, Walden University). Retrieved from http://gradworks.umi.com/34/94/3494890.html

Bye, D., Pushkar, D., & Conway, M. (2007). Motivation, interest, and positive affect in traditional and nontraditional undergraduate students. *Adult Education Quarterly*, *57*(2), 141–158. doi: 10.1177/0741713606294235

Carlson, R., Chandler, P., & Sweller, J. (2003). Learning and understanding science instructional material. *Journal of Educational Psychology*, *95*(3), 629–640. doi: 10.1037/0022-0663.95.3.629

Castaneda, R. (2008). *The impact of computer-based simulation within an instructional sequence on learner performance in a web-based environment*. Retrieved from the PyschINFO database. (Accession No. 2008-99170-444)

Chandra, V., & Fisher, D. L. (2009). Students' perceptions of a blended web-based learning environment. *Learning Environments Research*, *12*(1), 31–44. doi: 10.1007/s10984-008-9051-6

Chang, W. (2002). *The impact of constructivist teaching on students' perceptions of teching and learning.* Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, New Orleans, LA.

Chang, W. & Zhi-Feng Liu, E. (2011). Technology enabled active learning (TEAL) in introductory physics: Impact on genders and achievement levels. *Australian Journal of Education Technology, 27*(7), 1082-1099. Retrieved from http://www.ascilite.org.au/ajet/ajet27/shieh.pdf

Chen, Y., & Hoshower, L. B. (2003). Student evaluation of teaching effectiveness: An assessment of student perception and motivation. *Assessment and Evaluation in Higher Education, 28*(1), 71-88. doi: 10.1080/0260293032000033071

Chen, Y., Wang, Y., Kinshuk, & Chen, N. (2014). Is FLIP enough? Or should we use the FLIPPED model instead? *Computers & Education, 79,* 16-27. Retrieved from http://www.eduimed.com/index.php/eimj/article/view/316

Clark, K. R. (2015). The effects of the flipped model of instruction on student engagement and performance in the secondary mathematics classroom. *Journal of Educators Online*, *12*(1), 91–115. Retrieved from http://www.thejeo.com/Archives/Volume12Number1/Clark.pdf

Corbalan, G., Kester, L., & Van Merriënboer, J. J. G. (2006). Towards a personalized task selection model with shared instructional control. *Instructional Science*, *34*(5), 399–422. doi: 10.1007/s11251-005-5774-2

Corcoran, J. (2013). Flipping reading lessons at a Title I school. *School Administrator*, *70*(3), 22–23. Retreived from http://search.ebscohost.com. (Accession No. 87682153)

Crenshaw, P., Hale, E., & Harper, S. L. (2011). Producing intellectual labor in the classroom: The utilization of a critical thinking model to help students take command of their thinking. *Journal of College Teaching & Learning (TLC)*, *8*(7), 13–26. Retrieved from http://journals.cluteonline.com/index.php/TLC/article/view/4848

Creswell, J. W. (2013). *Qualitative inquiry and research design: choosing among five approaches*. Los Angeles, CA: SAGE Publications.

Cuban, L. (1983). How did teachers teach, 1890-1980. *Theory Into Practice*, *22*(3), 159. Retrieved from http://eric.ed.gov/?id=EJ289013

Dağhan, G., & Akkoyunlu, B. (2014). A qualitative study about performance based assesment methods used in information technologies lesson. *Educational Sciences: Theory & Practice*, *14*(1), 333–338. doi: 10.12738/estp.2014.1.2005

Davies, R., Dean, D., & Ball, N. (2013). Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course. *Educational Technology Research & Development*, *61*(4), 563–580. doi: 10.1007/s11423-013-9305-6

DiVall, M. V., Hayney, M. S., Marsh, W., Neville, M. W., O'Barr, S., Sheets, E. D., & Calhoun, L. D. (2013). Perceptions of pharmacy students, faculty members, and administrators on the use of technology in the classroom. *American Journal of Pharmaceutical Education*, *77*(4), 1–7. doi: 10.5688/ajpe77475

Edards, R.A., Kirwin, J., Gonyeau, M., Matthews, S.J., Lancaster, J., & DiVall, M. (2014). A reflective teaching challenge to motivate educational innovation. *American Journal of Pharmaceutical Education, 78*(5). 1-7. doi: 10.5688/ajpe785103

Ellington, A. J. (2006). The effects of non-CAS graphing calculators on student achievement and attitude levels in mathematics: A meta-analysis. *School Science & Mathematics*, *106*(1), 16–26. doi: 10.1111/j.1949-8594.2006.tb18067.x

Farkas, R. D. (2003). Effects of traditional versus learning-styles instructional methods on middle school students. *The Journal of Educational Research, 97*(1). 42-51. Retrieved from http://www.jstor.org/stable/27542462

Ferreri, S. P., & O'Connor, S. K. (2013). Redesign of a large lecture course into a small-group learning course. *American Journal of Pharmaceutical Education*, *77*(1), 1–9. doi: 10.5688/ajpe77113

Finkel, D. N. (2012). Social cognition in a digital world. *Cliodynamics: The Journal of Theoretical & Mathematical History*, *3*(2), 356–358. Retrieved from http://search.ebscohost.com. (Accession No. 90494927)

Floyd, K. S., Harrington, S.J., & Santiago, J. (2009). The effect of engagement and perceived course value on deep and surface learning strategies. *Informing Science: The International Journal of Emerging Transdiscipline, 12,* 181-190. Retrieved from http://www.inform.nu/Articles/Vol12/ISJv12p181-190Floyd530.pdf

Flumerfelt, S., & Green, G. (2013). Using lean in the flipped classroom for at risk students. *Journal of Educational Technology & Society*, *16*(1), 356–366. Retrieved from http://www.ifets.info/journals/16_1/31.pdf

Ford, M. B., Burns, C. E., Mitch, N., & Gomez, M. M. (2012). The effectiveness of classroom capture technology. *Active Learning in Higher Education*, *13*(3), 191–201. doi: 10.1177/1469787412452982

Friedman, L. W., & Friedman, H. H. (2013). Using social media technologies to enhance online learning. *Journal of Educators Online*, *10*(1), 1–22. Retrieved from http://www.thejeo.com/Archives/Volume10Number1/Friedman.pdf

Frisch, J. K., Jackson, P. C., & Murray, M. C. (2013). WikiED: Using web 2.0 tools to teach content and critical thinking. *Journal of College Science Teaching*, *43*(1), 70–80. Retrieved from http://search.ebscohost.com. (Accession No. 89932259)

Fulton, K. (2012). The flipped classroom: Transforming education at Byron High School. *T H E Journal*, *39*(3), 18–20. Retrieved from http://search.ebscohost.com. (Accession No. 74454477)

Gannod, G. C., Burge, J. E., & Helmick, M. T. (2008). Using the inverted classroom to teach software engineering. *Proceedings of the 30th International Conference on Software Engineering* (pp. 777–786). doi: 10.1145/1368088.1368198

Geary, D. C. (2007). An evolutionary perspective on learning disability in mathematics. *Developmental Neuropsychology*, *32*(1), 471–519. doi: 10.1080/87565640701360924

Geary, D. C. (2008). Whither evolutionary educational psychology? *Educational Psychologist*, *43*(4), 217–226. doi: 10.1080/00461520802392240

Gibson, K. (2013). Student teachers of technology and design into industry: A Northern Ireland case study. *International Journal of Technology & Design Education*, *23*(2), 289–311. doi: 10.1007/s10798-011-9179-z

Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *Journal of Nutrition Education and Behavior*, *47*(1), 109–114. doi: 10.1016/j.jneb.2014.08.008

Green, T. (2015). Flipped classrooms: An agenda for innovative marketing education in the digital era. *Marketing Education Review*, *25*(3), 179–191. doi: 10.1080/10528008.2015.1044851

Groenewald, T. (2004). A phenomenological research design illustrated. *International Journal of Qualitative Methods*, *3*(1), 1–26. Retrieved from https://www.ualberta.ca/~iiqm/backissues/3_1/pdf/groenewald.pdf

HaBler, B., Major, L., & Hennessy, S. (2015). Tablet use in schools: A critical review of the evidence for learning outcomes. *Journal of Computer Assisted Learning,* 2-28. Retrieved from http://wileyonlinelibrary.com/journal/jcal

Hamden, N., McKnight, P., McKnight, K., & Arfstom, K. (2013). A white paper based on the literature review titled a review of flipped learning. Retrieved from http://www.flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/41/WhitePaper_FlippedLearning.pdf

Herriott, R. E., & Firestone, W. A. (1983). Multisite qualitative policy research: Optimizing description and generalizability. *Educational Researcher*, *12*(2), 14–19. doi: 10.3102/0013189X012002014

Huang, H., Hung, C., & Cheng, K. (2012). Enhancing interactivity in geography class: Fostering critical thinking skills through technology. *Problems of Education in the 21st Century*, *50*, 32–45. Retrieved from http://search.ebscohost.com. (Accession No. 85035810)

Hutchings, M., & Quinney, A. (2015). The flipped classroom, disruptive pedagogies, enabling technologies and wicked problems: responding to 'the bomb in the basement'. *Electronic Journal of E-Learning*, *13*(2), 106–119. Retrieved from http://www.ejel.org/main.html

Kahveci, M. (2010). Students' perceptions of technology usefor learning: Measurement integrity of the modified Fennema-Sherman attitude scales. *Turkish Online Journal of Educational Technology*, *9*(1). Retrieved from http://tojet.net/articles/v9i1/9121.pdf

Kalin, J. (2012). Doing what comes naturally? Student perceptions and use of collaborative technologies. *International Journal for the Scholarship of Teaching & Learning*, *6*(1), 1–1. Retrieved from http://citation.allacademic.com/meta/p423923_index.html

Kanevsky, L. (2011). Deferential differentiation: What types of differentiation do students want? *Gifted Child Quarterly*, *55*(4), 279–299. doi: 10.1177/0016986211422098

Kaplan, A., & Maehr, M. L. (1999). Achievement goals and student well-being. *Contemporary Educational Psychology*, *24*(4), 330–358. Retrieved from http://www.sciencedirect.com/science/article/pii/S0361476X99909931

Kay, R., & Knaack, L. (2008). Investigating the use of learning objects for secondary school mathematics. *Interdisciplinary Journal of E-Learning and Learning Objects*, *4*(1), 269–289. Retrieved from http://www.editlib.org/p/44860/article_44860.pdf

Kazlauskas, A., & Robinson, K. (2012). Podcasts are not for everyone. *British Journal of Educational Technology*, *43*(2), 321–330. doi: 10.1111/j.1467-8535.2010.01164.x

Kennedy, E. J., Lawton, L., & Plumlee, L. (2002). Blissful ignorance: The problem of unrecognized incompetence and academic performance. *Journal of Higher Education, 24*(3). 243-252. doi: 10.1177/0273475302238047

Kettunen, J., Vuorinen, R., & Sampson, J. P. (2013). Career practitioners' conceptions of social media in career services. *British Journal of Guidance & Counselling*, *41*(3), 302–317. doi: 10.1080/03069885.2013.781572

Khan, M. B. (2009). Effects of information technology usage on student learning - An empirical study in the United States. *International Journal of Management*, *26*(3), 354–364, 487. Retrieved from http://search.ebscohost.com. (Accession No. 44768321)

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education*, *193*(3), 13–19. Retrieved from http://www.citejournal.org/articles/v9i1general1.pdf

Kolikant, Y. B. (2009). Digital students in a book-oriented school: Students' perceptions of school and the usability of digital technology in schools. *Educational Technology & Society*, *12*(2), 131–143. Retrieved from http://ifets.info/journals/12_2/10.pdf

Kong, S. C. (2015). An experience of a three-year study on the development of critical thinking skills in flipped secondary classrooms with pedagogical and technological support. *Computers & Education*, *89*, 16–31. doi: 10.1016/j.compedu.2015.08.017

Kuhn, K., & Rundle-Thiele, S. R. (2009). Curriculum alignment: Exploring student perception of learning achievement measure. *International Journal of Teaching and Learning in Higher Education, 21*(3). 351-361. Retrieved from http://www.isetl.org/ijtlhe/

Kulik, J. (2003). Effects of using instructional technology in elementary and secondary school: What controlled evaluation studies say. Arlington, VA: SRI International. Retrieved from http://www.sri.com/policy/csted/reports/sandt/it/Kulik_ITinK-12_Main_Report.pdf

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *Journal of Economic Education*, *31*(1), 30–43. doi: 10.2307/1183338

Love, B., Hodge, A., Grandgenett, N., & Swift, A. W. (2014). Student learning and perceptions in a flipped linear algebra course. *International Journal of Mathematical Education in Science and Technology*, *45*(3), 317–324. doi: 10.1080/0020739X.2013.822582

Malterud, K. (2001). Qualitative research: Standards, challenges, and guidelines. *The Lancet*, *358*(9280), 483–488. doi: 10.1016/S0140-6736(01)05627-6

Maypole, J., & Davies, T. G. (2001). Students' perceptions of constructivist learning in a community college American History II course. *Community College Review*, *29*(2), 54. doi: 10.1177/009155210102900205

McCulloch, A. W. (2009). Insights into graphing calculator use: Methods for capturing activity and affect. *International Journal for Technology in Mathematics Education*, *16*(2), 75–82. Retrieved from http://search.ebscohost.com. (Accession No. 42407578)

McLeod, K., Waites, T., Benavides, S., Pittard, D., & Pickens, K. (2012). Virtual learning influences on education: Technology reforming the learning experience. *Journal of Technology Integration in the Classroom*, *4*(3), 61–69. Retrieved from http://search.ebscohost.com. (Accession No. 98040219)

McVee, M. B., Dunsmore, K., & Gavelek, J. R. (2005). Schema theory revisited. *Review of Educational Research*, *75*(4), 531–566. doi: 10.3102/00346543075004531

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, *63*(2), 81–97. doi: 10.1037/h0043158

Moreno, R. (2006). Learning in high-tech and multimedia environments. *Current Directions in Psychological Science*, *15*(2), 63–67. doi: 10.1111/j.0963-7214.2006.00408.x

Morgan, D. L. (1996). Focus groups. *Annual Review of Sociology*, *22*, 129–152. Retrieved from http://www.jstor.org/stable/2083427

Moustakas, C. (1994). *Phenomenological research methods* (1st ed.). Thousand Oaks, CA: SAGE Publications, Inc.

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

Musallam, R. (2013). A pedagogy-first approach to the flipped-classroom. *OnCUE*, *35*(1), 6–8. Retrieved from http://cue.org/sites/cue.org/files/images/Spring13OnCUE.pdf

Nielsen, L. (2012). Five reasons I'm not flipping over the flipped classroom. *Technology & Learning*, *32*(10), 46–46. Retrieved from http://www.techlearning.com/default.aspx?tabid=100&entryid=3360

November, A. C. (2001). *Empowering students with technology* (2nd ed.. Thousand Oaks, CA: Corwin.

O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education*, *25*, 85–95. doi: 10.1016/j.iheduc.2015.02.002

Ollerton, M. (2014). Differentiation in mathematics classrooms. *Mathematics Teaching*, (240), 43–46. Retrieved from http://www.atm.org.uk/Mathematics-Teaching-Journal-Archive/15344

Osgerby, J. (2013). Students' perceptions of the introduction of a blended learning environment: An exploratory case study. *Accounting Education*, *22*(1), 85–99. doi: 10.1080/09639284.2012.729341

Overmyer, G. (2012). *The flipped classroom model for college algebra: Effects on student achievement* (Doctoral dissertation, Colorado State University). Retrieved from http://flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/41/Dissertation%20Overmyer.pdf

Paas, F. G. W. C., & Van Merriënboer, J. J. G. (1994). Instructional control of cognitive load in the training of complex cognitive tasks. *Educational Psychology Review*, *6*(4), 351–371. doi: 10.1007/BF02213420

Paas, F., Tuovinen, J. E., Tabbers, H., & Van Gerven, P. W. M. (2003). Cognitive load measurement as a means to advance cognitive load theory. *Educational Psychologist*, *38*(1), 63–71. doi: 10.1207/S15326985EP3801_8

Piaget, J. (1959). *The language and thought of the child*. London, England: Routledge.

Pink, D. (2011). Think tank: Flip-thinking-the new buzz word sweeping the U.S. Retrieved from http://www.edcoe.org/departments/curriculum_instruction/documents/101310CILC_ThinkTank.pdf

Plass, J. L., Moreno, R., & Brunken, R. (2010). *Cognitive load theory* (1st ed.). Cambridge, England; New York, NY: Cambridge University Press.

Poellhuber, B., & Anderson, T. (2011). Distance students' readiness for social media and collaboration. *International Review of Research in Open & Distance Learning*, *12*(6), 102–125. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1018/1960

Prober, C. G., & Heath, C. (2012). Lecture halls without lectures: A proposal for medical education. *New England Journal of Medicine*, *366*(18), 1657–1658. Retrieved from http://njms.rutgers.edu/education/office_education/faculty/documents/Lecturehallswithoutlectures-Prober-May2012.pdf

Richardson, W. (2010). *Blogs, wikis, podcasts, and other powerful web tools for classrooms* (3rd ed.). Thousand Oaks, CA: Corwin.

Roblyer, M. D., McDaniel, M., Webb, M., Herman, J., & Witty, J. V. (2010). Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites. *The Internet and Higher Education*, *13*(3), 134–140. doi: 10.1016/j.iheduc.2010.03.002

Rosenberg, J. L., Lorenzo, M., & Mazur, E. (2006). CHAPTER 8: Peer Instruction: Making science engaging. In *Handbook of College Science Teaching* (pp. 77–85). National Science Teachers Association. Retrieved from http://mazur.harvard.edu/sentFiles/Mazur_274536.pdf

Sahin, A., Cavlazoglu, B., & Zeytuncu, Y. E. (2015). Flipping a college calculus course: A case study. *Journal of Educational Technology & Society*, *18*(3), 142–152. Retrieved from http://www.ifets.info/journals/18_3/11.pdf

Samo, N. B. (2010). Decision-making practices of head teachers in public secondary schools of Dadu District. *Journal of Educational Research (1027-9776)*, *13*(2), 63–83. Retrieved from http://www.iub.edu.pk/jer/JOURNAL/JER_Vol13_No2.pdf

Schloss, P. J., & Smith, M. (1999). *Conducting research* (1st ed.). Upper Saddle River, NJ: Prentice Hall.

Schwandt, T. A., Lincoln, Y. S., & Guba, E. G. (2007). Judging interpretations: But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Evaluation*, *2007*(114), 11–25. doi: 10.1002/ev.223

Seaman, M. (2011). Bloom's taxonomy: It's evolution, revision, and use in the field of education. *Curriculum and Teaching Dialogue*, *13*(1/2), 29–131A. Retrieved from http://search.ebscohost.com. (Accession No. 92898125)

Shell, A. E. (2002). The Thayer method of instruction at the United States Military Academy: A modest history and a modern personal account. *Problems, Resources, and Issues in Mathematics Undergraduate Studies*, *12*(1), 27–38. doi: 10.1080/10511970208984015

Shulman, L. S., & Shulman, J. H. (2008). How and what teachers learn: A shifting perspective. *Journal of Education*, *189*(1/2), 1–8. doi: 10.1080/00220270320000148298

Sorden, S. D., & Munene, I. I. (2013). Constructs related to community college student satisfaction in blended learning. *Journal of Information Technology Education*, *12*, 251–270. Retrieved from http://www.jite.org/documents/Vol12/JITEv12ResearchP251-270Sorden1206.pdf

Stitt-Gohdes, W. L. (2001). Business education students' preferred learning styles and their teachers' preferred instructional styles: Do the match. *Delta Pi Epsilon Journal, 43*(3). 137-151. Retrieved from http://eric.ed.gov/?id=EJ638597

Strayer, J. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environments Research*, *15*(2), 171–193. doi: 10.1007/s10984-012-9108-4

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, The Ohio State University). Retrieved from http://etd.ohiolink.edu/send-pdf.cgi/Strayer%20Jeremy.pdf?osu1189523914&dl=y

Sugar, W., Brown, A., & Luterbach, K. (2010). Examining the anatomy of a screencast: Uncovering common elements and instructional strategies. *International Review of Research in Open and Distance Learning*, *11*(3), 1–20. Retrieved from http://www.irrodl.org/index.php/irrodl/article/viewArticle/851

Sungur, S., & Tekkaya, C. (2006). The relationship between teacher discipline and students' learning motivation in school. *Journal of Primary and Secondary Education Research, 18,* 165-193. doi: 10.3200/JOER.99.5.307-320.

Sweet, M., & Pelton-Sweet, L. M. (2008). The social foundation of team-based learning: Students accountable to students. *New Directions for Teaching & Learning,* (116), 29–40. doi: 10.1002/tl.331

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, *12*(2), 257–285. doi: 10.1016/0364-0213(88)90023-7

Sweller, J. (1993). Some cognitive processes and their consequences for the organisation and presentation of information. *Australian Journal of Psychology*, *45*(1), 1–8. doi: 10.1080/00049539308259112

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. New York, NY: Springer.

Talley, C. P., & Scherer, S. (2013). The enhanced flipped classroom: Increasing academic performance with student-recorded lectures and practice testing in a "Flipped" STEM course. *Journal of Negro Education*, *82*(3), 339–347. doi: 10.7709/jnegroeducation.82.3.0339

Tapscott, D. (2008). *Grown up digital: How the net generation is changing your world* (1st ed.). New York, NY: McGraw-Hill.

Taylor, L., McGrath-Champ, S., & Clarkeburn, H. (2012). Supporting student self-study: The educational design of podcasts in a collaborative learning context. *Active Learning in Higher Education*, *13*(1), 77–90. doi: 10.1177/1469787411429186

Toto, R., & Nguyen, H. (2009). Flipping the work design in an industrial engineering course. In *Frontiers in Education Conference, 2009. FIE'09. 39th IEEE* (pp. 1–4). IEEE. Retrieved from http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5350529

Tyack, D. B., & Cuban, L. (1995). *Tinkering toward utopia: A century of public school reform*. Cambridge, MA: Harvard University Press.

U.S. Department of Education. (2010). Evaluation of evidence-based practices in online learning. Retrieved from https://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf

Van Merriënboer, J. J. G., & Ayres, P. (2005). Research on cognitive load theory and its design implications for e-learning. *Educational Technology Research & Development*, *53*(3), 5–13. doi: 10.1007/BF02504793

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

Weaver, A., Walker, H., & Marx, A. (2012). Student and faculty perceptions regarding the use of technology in sport management coursework. *Journal of Technology Integration in the Classroom*, *4*(3), 25–36. Retrieved from http://search.ebscohost.com. (Accession No. 98040215)

Yin, R. K. (2011). *Qualitative research from start to finish*. New York, NY: Guilford Press.

Ziegelmeier, L. B., & Topaz, C. M. (2015). Flipped calculus: A study of student performance and perceptions. *PRIMUS*, *25*(9-10), 847–860. doi: 10.1080/10511970.2015.1031305

Appendix A – Parent Email Invitation

Parent Email of Invitation

Hello, my name is Dan Strohmyer and I am doing my dissertation research to learn about student perceptions of the flipped classroom. You are receiving this email because your school identified your son or daughter as a student in a flipped math class. I would like to invite your child who has been in flipped math classes to be in my research study so I may learn about his or her perceptions and experiences about learning in a flipped class. However, because your child is a minor, I want you to learn about the project before you decide if your child should be invited to participate. Attached to this email is a parental consent form for you. I am also attaching the student assent form for you to review. You will find more thorough information about the study in the attached forms, including who I am, information about the study itself, sample questions, options for participation, privacy, and contact information.

If you consent to your child participating in this study, please sign the parental consent form electronically by typing your name on the printed line, your email on the signature line, and the date on the date line, and save the document. Please attach the signed consent forms in a return email to me. If you prefer printed copies for signature, please email me and I will provide them for your child to pick up and return at the school office. Once I receive your consent, I will contact the student using the email address you provide, and invite them to participate, and will have them fill out the assent form then.

Once I have students willing to be part of my study I will ask each student to take a 5-question survey that will help me to select students based on varying levels of experience with flipped learning. Three students from your child's school will be chosen for individual face-to-face interviews, and additional students will be invited to a face-to-face focus group. It is possible that you consent for your child to participate, but it does not necessarily mean he or she will be needed for participation in the study.

If you prefer for your child not to participate, please respond to this email indicating that you do not want him or her to participate so that you do not receive follow up emails.

If you have any questions, please feel free to contact me at any time by responding to this email.

Thank you, I look forward to hearing from you soon.

Sincerely,

Dan Strohmyer
Walden University

PhD Education - Learning, Instruction, and Innovation Program

Appendix B – Reminder Emails

Parent Reminder Email

Date

Dear Parent,

My name is Dan Strohmyer and I am a doctoral student from Walden University and a week ago, I sent you an email letter introducing you to my research study. The topic of the study is student perceptions of flipped learning in a high school math classroom. I would like to invite your child who has been in flipped math classes to be in my research study so I may learn about his or her perceptions and experiences about learning in a flipped class. Please refer to the email I sent on _____ and if you would, reply to this email with whether or not you intend to allow your child to be invited to participate in the study.

Sincerely,

Dan Strohmyer
Walden University
PhD Education - Learning, Instruction, and Innovation Program

Student over 18 Reminder Email

Dear (student name),

My name is Dan Strohmyer and I am a doctoral student from Walden University and a week ago, I sent you an email letter introducing you to my research study. The topic of the study is student perceptions of flipped learning in a high school math classroom. I would like you to consider consenting to be part of my study. Because you have been in flipped math class, I am interested in learning about your perceptions and experiences in a flipped math class. Please refer to the email I sent on _____ and if you would, reply to this email with whether or not you intend to consent to participate in the study.

Sincerely,

Dan Strohmyer

Walden University
PhD Education - Learning, Instruction, and Innovation Program

Appendix C – Letters of Invitation

Email Letter of Invitation
For Students 18 and Over

Hello, my name is Dan Strohmyer and I am doing a research project to learn about student perceptions of the flipped classroom. You are receiving this email because your school identified you as a student in a flipped math class. I am inviting students who have been in flipped math classes to be in a research study about their perceptions and experiences. I want you to learn about the project before you decide if you would like to participate in it. Attached to this email is a consent form for you to review and sign if you elect to participate. You will find more thorough information about the study in the attached form, including who I am, information about the study itself, sample questions, options for participation, privacy, and contact information.

If you consent to participate in this study, please sign the consent form electronically by typing your name on the printed line, your email on the signature line, and the date on the date line. Please save the file and attach the signed consent form in a reply email to me. If you prefer a printed copy for signature, please email me and I will provide them for you to pick up and return at the school office.

Once I have students willing to be part of my study I will ask each student to take a 5-question survey that will help me to select students based on varying levels of experience with flipped learning. Three students from your school will be chosen for individual face-to-face interviews, and additional students will be invited to a face-to-face focus group. It is possible that you consent to participate, but it does not necessarily mean you will be needed for participation in the study.If you prefer not to participate, please respond to this email indicating that you do not want to participate so that you do not receive follow up emails.

If you have any questions, please feel free to contact me at any time by responding to this email.

Thank you, I look forward to hearing from you soon.

Sincerely,

Dan Strohmyer
Walden University
PhD Education - Learning, Instruction, and Innovation Program

Email Letter of Invitation
For Student Minors (under 18)

Hello, my name is Dan Strohmyer and I am doing a research project to learn about student perceptions of the flipped classroom. You are receiving this email because your school identified you as a student in a flipped math class. I am inviting students who have been in flipped math classes to be in a research study about their perceptions and experiences. I want you to learn about the project before you decide if you would like to participate in it. Attached to this email is an assent form for you to review and sign if you elect to participate. You will find more thorough information about the study in the attached form, including who I am, information about the study itself, sample questions, options for participation, privacy, and contact information.

If you decide to participate in this study, please sign the assent form electronically by typing your name on the printed line, your email on the signature line, and the date on the date line. Please save the file and attach the signed consent form in a reply email to me. If you prefer a printed copy for signature, please email me and I will provide them for you to pick up and return at the school office.

Once I have students willing to be part of my study I will ask each student to take a 5-question survey that will help me to select students based on varying levels of experience with flipped learning. Three students from your school will be chosen for individual face-to-face interviews, and additional students will be invited to a face-to-face focus group. It is possible that you consent to participate, but it does not necessarily mean you will be needed for participation in the study. If you prefer not to participate, please respond to this email indicating that you do not want to participate so that you do not receive follow up emails.

If you have any questions, please feel free to contact me at any time by responding to this email.

Thank you, I look forward to hearing from you soon.

Sincerely,

Dan Strohmyer
Walden University
PhD Education - Learning, Instruction, and Innovation Program

Appendix D: Letters of Cooperation

[redacted]

February 20, 2015

Dear Mr. Strohmyer,

Based on my review of your research proposal, I give permission for you to conduct the study entitled "Student Perceptions of Flipped Learning in a High School Math Classroom" within the [redacted]rict. As part of this study, I authorize you to conduct your experience survey, interviews, and focus group to gather data for the project. Individuals' participation will be voluntary and at their own discretion.

We understand that our organization's responsibilities include: providing a quiet room for interviews and then again for a focus group discussion. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University IRB.

Sincerely,

[redacted]

Walden University policy on electronic signatures: An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically. Electronic signatures are regulated by the Uniform Electronic Transactions Act. Electronic signatures are only valid when the signer is either (a) the sender of the email, or (b) copied on the email containing the signed document. Legally an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. Walden

University staff verify any electronic signatures that do not originate from a password-protected source (i.e., an email address officially on file with Walden).

[redacted]

February 20, 2015

Dear Mr. Strohmyer,

Based on my review of your research proposal, I give permission for you to conduct the study entitled Student Perceptions of the Flipped teaching model in the high school mathematics classroom within the [redacted]. As part of this study, I authorize you to conduct your experience survey, interviews, and focus group to gather data for the project. Individuals' participation will be voluntary and at their own discretion.

We understand that our organization's responsibilities include: providing a quiet room for interviews and then again for a focus group discussion. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University IRB.

Sincerely,

[redacted]

Walden University policy on electronic signatures: An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically. Electronic signatures are regulated by the Uniform Electronic Transactions Act. Electronic signatures are only valid when the signer is either (a) the sender of the email, or (b) copied on the email containing the signed document. Legally an "electronic signature"

can be the person's typed name, their email address, or any other identifying marker. Walden University staff verify any electronic signatures that do not originate from a password-protected source (i.e., an email address officially on file with Walden).