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A Descriptive Study of High School Mathematics Teachers' Perceptions of Flipped-Mastery Learning in a High School Math Class

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College of Education

Doctorate of Education Program

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A Descriptive Study of High School Mathematics Teachers' Perceptions of
Flipped-Mastery Learning in a High School Math Class

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College of Education

Dissertation submitted to the Faculty of the College of Education
in partial fulfillment of the requirements for the degree of
Doctor of Education in Teacher Leadership

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Abstract

In this study the researcher examines high school mathematics teachers' perceptions of flipped-mastery models as an instructional strategy. The researcher investigated how high school mathematics teachers perceive the instructional practices of flipped-mastery models and their ability to increase rigor in accordance with the Common Core State Standards. While extensive research exists on the flipped classroom as an instructional strategy, to date, limited research has been conducted on flipped-mastery models. Using a sample of 26 high school mathematics teachers, with experience using both a flipped-mastery model and a traditional direct instruction/homework model, data was collected via an anonymous online survey. The findings from the research show that high school mathematics teachers think favorably of flipped-mastery models as an instructional strategy. A large majority of research participants indicated they would recommend a flipped-mastery model to a colleague. In this study, the researcher found no differences in high school mathematics teachers' perceptions of instructional practices and rigor based on gender and teaching experience. Research participants provided insight into the effectiveness and limitations of flipped-mastery models. Themes of pace/time, student ownership of learning, differentiation, and demonstrated mastery emerged as advantages of flipped-mastery learning systems. Increased planning, lack of student motivation/participation, technology access, and wide gaps in student learning emerged as themes detailing the disadvantages of flipped-mastery learning systems.

Keywords: flipped-mastery, flipped classroom

Dedication

This dissertation is dedicated to the memory of my father and grandmother. To my father, thank you for showing me the importance of higher education. To my beloved grandmother, thank you for every word of encouragement.

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Thank you to my wonderful husband for all of your support throughout this exhaustive journey. Our family hasn't missed a beat since I began this journey, and I thank God for blessing me with you as my life partner. A special thank you to my children Torrien, Jordan, and Kiersten for being patient with me throughout this tedious process. To my mother, I am forever grateful for your loving support and words of wisdom. Thank you to my family, church members, and education community for your continuous words of encouragement. Thank you to Dr. Grenier, Dr. Alba, and Dr. Gniewek for all you did to help me during this process. A very special thank you to Dr. Owusu-Ansah for stepping in when I needed you most to help me get across the finish line.

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Chapter 1: Introduction

The introduction of the Common Core State Standards for mathematics has caused a shift in the way children in the United States learn mathematics (Common Core State Standards, 2010). As student learning shifts, so too will mathematics instruction. As a result of the introduction of the Common Core State Standards, mathematics instruction will focus on fewer standards, develop topics and critical thinking skills across grade levels, and call for increased rigor (Common Core State Standards, 2010). As students matriculate through each mathematics standard, they will be expected to meet various learning outcomes. In order to meet the specific learning outcomes associated with each mathematics standard, students must demonstrate a conceptual understanding of each topic, fluently complete mathematical computations, and be able to use the knowledge gained to solve real-world problems involving mathematics (Common Core State Standards, 2010). Therefore, mathematics teachers throughout the United States will be tasked with the responsibility of implementing instructional practices that will ensure students develop knowledge and skills that can be applied in various mathematics situations. The flipped classroom and its by-product flipped-mastery learning are instructional models currently being employed by some high school mathematics teachers to address the recent shift in mathematics (Bergmann & Sams 2012).

Background, Context, History, and Conceptual Framework for the Problem

The most widely accepted record of origin names Jonathan Bergmann and Aaron Sams as pioneers of the flipped classroom (Arnold-Garza, 2014). In the spring of 2007, out of an effort to provide instruction to chronically absent students living in a rural school district, Bergmann and Sams began using screen capture software to record their live lessons (Bergmann & Sams, 2012). The recorded lessons were then posted online for students to view during or after their absence

from school. Sams eventually realized that not only were the prerecorded lectures beneficial to students who missed class, but they can also be used to free up class time to help students better understand the content being delivered within the lecture (Bergmann & Sams, 2012). Out of Sams' revelation, the flipped classroom was born. During the following school year, Bergmann and Sams began recording all of their lectures to be viewed by students as homework (2012). Bergmann and Sams experienced success with the initial implementation of their flipped classroom model. Students were completing their assignments in class with time left, and they were performing better on end of unit tests than the previous year's students (Bergmann & Sams, 2012). The results were promising. However, during student interviews, Bergmann and Sams noticed that at the end of the year, just as in the previous school year, students did not have a conceptual understanding of essential chemistry concepts (Bergmann & Sams, 2012). Bergmann and Sams (2012) began to wonder if there was a way to combine their flipped classroom model with the principles of mastery learning theory, such as self-paced learning, continuous formative assessment, and demonstrated mastery of content standards to help students truly learn chemistry. Through trial and error, Bergmann and Sams developed what they termed flipped-mastery learning (2012).

The conceptual framework for this study focuses on the concepts of mastery learning theory in combination with the instructional practices of the traditional flipped classroom. The flipped-mastery approach to learning merges the self-pacing, constant monitoring of students' levels of understanding, and demonstrated mastery components of mastery learning theory with the homework and lecture reversal of the traditional flipped classroom (Bergmann & Sams, 2014). According to Bergmann and Sams (2014), making the move from the traditional flipped classroom to flipped-mastery instructional models is beneficial to students, "flipped-mastery

places more control of learning into the hands of the students because it allows them the flexibility to create their own schedules of learning based around their own learning need and styles” (p. 64-65). The key components of mastery learning theory: self-paced learning, frequent formative assessments, and required demonstrated mastery, have been studied under mastery learning (Blessing & Olufunke, 2015; Slavin, 1990; Udo & Udofia, 2014; Sood, 2014. However, Strohmyer (2016) suggests that studies on these separate components can provide only a limited framework for a study on flipped learning cases because disjointly, they do not embody the unification of instructional practices represented with flipped-mastery. This study aims to add to the limited research on flipped learning instructional approaches through a focus on teachers’ perceptions of flipped-mastery model instructional practices.

Recent research conducted on the flipped classroom has discussed the key components of mastery learning theory: self-paced learning, frequent formative assessment, and required levels of mastery on summative assessments (Ash, 2012; Bergmann & Sams, 2012; Mok, 2014; Wiginton, 2012). In some research studies of flipped learning environments, students have been allowed to take more control of the learning process, and feedback on the shift of ownership from teacher to student was positive (Mok, 2014; Wiginton, 2013). In flipped-mastery learning environments the shift toward student ownership of learning can be seen in the level of self-pacing allowed by teachers (Bergmann & Sams, 2012). While some students in flipped-mastery learning environments have expressed appreciation for the ability to learn content at their own pace, some teachers have found a need to step in and set deadlines for students who have fallen behind (Ash, 2012). Although, self-pacing can pose an issue for some students, some teachers have found that utilizing frequent formative assessment to periodically gauge student understanding can allow for the implementation of any academic intervention needed, which

may be able to keep on pace (Bergmann & Sams, 2015). According to Bergmann and Sams (2015), the frequent formative assessment of student understanding seen in flipped-mastery learning environments, is also a way for teachers to prepare students for success on required summative assessments. Once students experience success, they begin to develop a sense of self-efficacy and build their intrinsic motivation (Mantell, 2013). This study sought to determine how high school mathematics teachers perceive the instructional practices and rigor within a flipped-mastery model.

Statement of the Problem

It is not known how high school mathematics teachers perceive the effectiveness of the instructional practices of flipped-mastery models of instruction, or its ability to aid students in meeting specific learning outcomes with the level of rigor required by the Common Core State Standards (2010).

Purpose of the Study

High school mathematics teachers in the United States have been challenged to focus instruction on the development of students' conceptual understanding, speed and accuracy, and their ability to apply content knowledge within the classroom and the real-world (Common Core State Standards, 2010). The problem many high school mathematics teachers in the U. S. may face is finding effective methods of instruction that help students meet expected learning outcomes as outlined in the CCSS. Education research may provide high school mathematics teachers with the information needed to determine the effectiveness of flipped-mastery models of instruction. Therefore, if flipped-mastery models are to be considered by high school mathematics teachers as an effective instructional method for meeting student learning outcomes, a need exists for research that evaluates its efficacy.

In the subject area of mathematics, learning outcomes addressed within the CCSS present an increase in rigor when compared to some previous state standards (Common Core State Standards, 2010). A flipped-mastery model of instruction may provide educators searching for innovative and effective instructional practices with an option to help ensure students meet expected learning outcomes. The primary focus of a flipped-mastery model of instruction is student mastery of specific learning outcomes (Bergmann & Sams, 2012). At the time of publication, high school mathematics teachers' perceptions of flipped-mastery models of instruction are not known. The purpose of this research study was to determine high school mathematics teachers' perceptions of instructional practices and rigor within flipped-mastery models of instruction, and if differences in their perceptions exist based on gender and teaching experience.

Research Questions

The following research questions were formulated for this research study:

RQ1: What are high school mathematics teachers' perceptions of instructional practices in flipped-mastery models?

Sub-questions.

1. What are the differences in high school mathematics teachers' perceptions of instructional practices in flipped-mastery models based on the gender of the teacher?
2. What are the differences in high school mathematics teachers' perceptions of instructional practices in flipped-mastery models based on the level of teaching experience?

H_{1a0}: High school mathematics teachers' perceptions of instructional practices in flipped-mastery models do not differ based on gender.

H_{1a}: High school mathematics teachers' perceptions of instructional practices in flipped-mastery models differ based on gender.

H_{1b0}: High school mathematics teachers' perceptions of instructional practices in flipped-mastery models do not differ based on level of teaching experience.

H_{1b}: High school mathematics teachers' perceptions of instructional practices in flipped-mastery models differ based on level of teaching experience.

RQ2: What are high school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models?

Sub-questions.

1. What differences exist, based on the gender of high school mathematics teachers, in their perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models?
2. What differences exist, based on the level of teaching experience of high school mathematics teachers, in their perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models?

H_{2a0}: High school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models do not differ based on gender.

H_{2a}: High school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models differ based on gender.

H_{2b0}: High school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models do not differ based on level of teaching experience.

H_{2b}: High school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models differ based on level of teaching experience.

Rationale, Relevance, and Significance of the Study

While research exists on the flipped classroom's effect on student achievement (Overmyer, 2014; Rotvold & Braathen, 2014; Saunders, 2014), the researcher of this study was able to locate only a limited amount of research on flipped-mastery and its benefits to student learning (Bergmann & Sams, 2012; Bergmann & Sams, 2013; Bergmann & Sams, 2015). K-12 teachers across the U.S. scrutinize new instructional methods and practices that may offer improvement to student learning (Marzano, Pickering, & Pollock, 2001). When new instructional practices are presented to teachers with claims of improvement to student learning, it can reasonably be presumed that most teachers want to know if these instructional practices have been verified by colleagues in their respective fields of study.

Many online shoppers read product reviews before deciding whether or not to make a purchase, and similarly high school mathematics teachers may look to others in their field to confirm the reliability of emerging instructional practices. The arrival of flipped-mastery models of instruction as viable instructional methods has sparked a mix of excitement and

apprehensiveness among several high school mathematics teachers. There is limited research on the effectiveness of flipped-mastery models of instruction in a high school mathematics classroom for educator to review. A gap in the literature is present, in relation to teachers' perceptions of the ability of a flipped-mastery models of instruction to meet student learning outcomes in a high school mathematics classroom. This research study will add to the current literature.

Definition of Terms

Flipped classroom: Learning environment that shifts the duty of the teacher from content delivery to facilitator of students' learning (Bergmann & Sams, 2012).

Flipped-mastery: Student-centered instruction that allows students to move at their own pace as they connect with course content through video instruction and other learning objects (Bergmann & Sams, 2015).

Flipped-mastery model of instruction: A successive series of video instruction, guided and/or independent practice, and assessment. Students must demonstrate mastery of lesson content before being allowed to learn new content.

Learning outcomes: Essential knowledge and skills that students must gain by the end of a unit of study or an academic course (National Institute for Learning Outcomes Assessment, n.d.).

Direct instruction/homework model of instruction: In class teacher-led instruction, which is presented to students through lecture. Students then independently practice concepts outside of the classroom as homework (Hidden Curriculum, 2014).

Assumptions

- High school mathematics teachers' perceptions of flipped-mastery models of instruction are relevant to education practitioners.

Delimitations

- The subjects are delimited to high school mathematics teachers who have used flipped-mastery models and traditional direct instruction/homework models
- The study is delimited to the content area of mathematics

Limitations

- The small sample, 26 high school mathematics teachers from various countries around the world, might not be representative of all high school mathematics teachers utilizing flipped-mastery models.

Summary

This first chapter introduced the content and overview of this descriptive research study. This study investigated teachers' perceptions of the effectiveness of a flipped-mastery models of instruction in a high school mathematics classroom. Flipped-mastery models of instruction have the potential to serve as useful instructional tools to be utilized by high school mathematics teachers as they work to ensure students meet specific learning outcomes. The research literature associated with this emerging instructional practice is reviewed in Chapter 2.

Chapter 2: Literature Review

This research study focused on high school mathematics teachers' perceptions of the instructional practice combining the flipped classroom with mastery learning theory to help students meet learning outcomes with the level of rigor prescribed by the Common Core State Standards initiative. To address the aspects of this study, the researcher attempted to research the history and descriptions of flipped classroom instruction at the high school level, mastery learning theory, the flipped-mastery model of instruction, and the survey research design. The literature for this study was compiled by searching for resources on flipped classroom, mastery learning, and survey research design using databases offered through the Concordia University-Portland Library. Several sources were found for survey research design. However, searches on the flipped classroom at the high school level yielded a limited number of sources. Each of the located research studies included a comparison of the overall effectiveness of the flipped classroom versus traditional methods of instruction. The researcher was able to locate one study that addressed flipped-mastery learning at the high school level. Current literature on the flipped classroom at the high school level, although small in quantity, also addressed the flipped classroom in areas such as academic achievement, conceptual understanding, critical thinking skills, student engagement, and student satisfaction. The researcher was also able to locate only a handful of research studies that described or included the perceptions' of teachers who were implementing the flipped classroom approach. The lack of a sufficient amount of research detailing high school teachers' perceptions of the flipped classroom and the conflicting results of research conducted on the effectiveness of flipped classroom approach, warrant a closer look at whether or not high school mathematics teachers' perceive the flipped-mastery model of

instruction as an effective instructional method for meeting student learning outcomes with the level of rigor prescribed in the Common Core State Standards Initiative (CCSS, 2010).

Conceptual/Theoretical Framework

A post-positive conceptual framework guides this study's design and methodology. The post-positive paradigm is grounded in the work of Max Weber and Karl Popper. Later philosophers such as Comte, Mill, Durkheim, Newton, and Locke recognized that knowledge gained from research is not without fallacy or bias (Creswell, 2009). Later, the writings of Phillips and Burbules (2000) established post-positivism as an expansion of the earlier positivist approach to research. Phillips and Burbules (2000) indicated post-positivism moves beyond positivist belief and that absolute knowledge can be gained exclusively from what is observed. Post-positivist research recognizes theory, prior research, and experiential knowledge and values of the researcher can influence what is being observed, therefore introducing bias into research studies (Creswell, 2009). A post-positivism paradigm for research conducted within this study will emphasize the need for researcher objectivity and acknowledgement of factors that may affect research results.

A post-positivist paradigm influences this study's main theoretical approach, mastery learning, as well as the additional experiential knowledge required to inform the study. The theoretical framework for this study combines the flipped classroom approach with mastery learning theory. According to Bergmann and Sams (2012), "A flipped-mastery classroom takes the principles of mastery learning and marries them with modern technology to make a sustainable, reproducible, and manageable environment for learning" (p. 53). The flipped-mastery classroom incorporates high quality instruction with aspects of mastery learning theory to allow students the time needed to demonstrate mastery of content standards.

Review of Research Literature and Methodological Literature

Rigor in Mathematics

The longitudinal results of the National Assessment of Educational Progress (NAEP) indicate that scores for high school students in the United States has shown have shown minimal growth since 1973 (Schneider, 2009). The U.S. has lagged behind other countries in the area mathematics education (Kremers & Nolen, 2016). One attempt to address this issue involved introduction of the Common State Standards (Common Core State Standards, 2010). Before the Common State Standards were implemented, many mathematics standards focused on breadth rather than depth (Schmidt, Geary, & Henion, 2013). However, embedded within these new standards is a need for a shift in the way students learn mathematics and mathematics instruction. According to Hull, Balka, & Miles (2013), “Leaders and teachers must promote mathematical rigor in every classroom in every state for every student (p. 55).

In mathematics, the key cognitive strategies of problem formulation, research, interpretation, communication, and precision/accuracy are generally expressed using action verbs such as understand, use, perform, and solve (Conley, 2013). According to Conley (2013), the emphasis in the standards themselves is...primarily on the understanding, use, and application of a series of mathematical concepts, principles, and techniques (p. 180). Students are expected to gain an understanding of the mathematics standards and demonstrate mastery of these standards through practice and utilization. However, the Common Core State Standards also calls for the use of more complex action verbs such as include, construct, compare, model, visualize, summarize, and interpret (Conley, 2013). Action verbs such as these are embedded within the Standards for Mathematical Practice: making sense of problems and persevering, reasoning abstractly and quantitatively, constructing arguments and critiquing reasoning, modeling, using

tools strategically, attending to precision, looking for and making use of structure, and looking for regularity in repeated reasoning (Conley, 2013). The key cognitive strategies described by Conley (2013) aligned with the Standards for Mathematical Practice characterize a needed shift in the level of rigor in mathematics.

There has long been a call for increased rigor in mathematics (Bell, 1934; Schaaf, 1951). According Bell (1934), “The place of rigor in mathematics is in mathematics (p. 599). However, all mathematics educators have not agreed with the need for more rigor. Kemeny (1961) stated, “...although a degree of rigor is important in teaching because a student should be able to understand what a proof is, it is vastly more important to emphasize basic ideas and to build up the intuition possessed by the student” (p. 70). The Common Core State Standards aim to address the need for elevated rigor by focusing on conceptual understanding, procedural fluency, and application of knowledge (Common Core State Standards, 2010; Gaddy et. al, 2014). Previous trends in mathematics education employed teaching techniques that focused on recitation in which “the teacher leads the class of students through the lesson material by asking questions that can be answered with brief responses, often one word” (Hull, Balka, & Miles, 2013, p. 54). New teaching strategies will need to focus on the development of mathematics concepts over time, so that students are able to apply their knowledge and make connections (Silva, 2014). The flipped classroom is one such teaching strategy that has the potential to address the need for a shift in rigor in mathematics courses (Bergmann & Sams, 2012).

Historical Aspects of the Flipped Classroom

Although the idea of reversing lecture and homework is not revolutionary, the descriptive term “flipped classroom” was brought to the attention of the education community by Jon Bergmann and Aaron Sams (Logan, 2015). Bergmann and Sams (2013) realized the potential of

the flipped classroom after making video lectures for students who missed their classes. Bergmann and Sams (2013) realized by moving lectures outside of the classroom, they could use class time more efficiently. The movement of homework to class time gives educators the opportunity to help students understand lecture content during class (Sams, 2011). Since the pioneering efforts of Bergmann and Sams, other educators have implemented the flipped classroom instructional model in both high school and post-high school classrooms.

In 2009 in a response to budgetary concerns over the purchase of textbooks to match new state standards, math teachers within the Bryon School District decided to implement the flipped classroom approach as a way to eliminate a need for the use of textbooks (Fulton, 2012). By 2010, math teachers at Byron High School had begun using the FCM as their primary method of instruction. Once fully implemented, math teachers at Byron High School began to see the flipped classroom not only as a different way to deliver instruction to students, but as a self-reflective tool for their own teaching practice (Fulton, 2012). Throughout the inaugural school year of the FCM use at Byron High School, math teachers monitored and analyzed student academic progress. The results of the initial implementation were promising, and teachers reported an increase in student mathematical scores on the Minnesota Comprehensive Assessment (MCA). When compared to scores of students previously taught using traditional methods of instruction, and after teachers successfully aligned the curriculum with state standards, results indicated Byron High School students' scores on the mathematics portion of the MCA rose 8.2% (Fulton, 2012).

Other studies followed the Fulton (2012) study. In a study to determine the effectiveness of flipped instruction on student self-efficacy and achievement, Wiginton (2013) turned to the flipped classroom as a way to address concerns over students meeting expectations of newly

implemented College and Career Readiness standards. Wiginton (2013) recognized the traditional lecture-based method of delivering instruction was failing to prepare students to meet college and career readiness standards. After collecting and analyzing data related to student achievement and self-efficacy, the determination was student achievement and student self-efficacy were significantly higher for students receiving flipped mathematics instruction versus traditional mathematics instruction (Wiginton, 2013).

Although the research design utilized by the Wiginton (2013) study does not directly influence the methodology for this study, the results declare flipped-mastery learning as a viable instructional approach for improving student achievement. More recently, Bell (2015) also conducted research using a quasi-experimental design to determine the effectiveness of the flipped classroom as an instructional strategy to increase student comprehension, while simultaneously addressing the demands of different student learning styles. Bell (2015) understood the traditional method of instructional delivery often left students with a superficial level of understanding, which dissipated once students were left to complete homework assignments on their own. After implementing the flipped classroom model during three units of study in a high school Physics with Technology course, data collected and analyzed indicated “students in the flipped physics class performed equally well as students in the traditional inquiry-based class” (Bell, 2015, p. 38). However, Bell (2015) noted the traditional method of instruction compared with the flipped classroom model included guided inquiry methods, and students in each experimental group were taught using the same course materials.

Technology Integration in Flipped Classrooms

Brame (2013) identifies the key elements of the flipped classroom: provide an opportunity for students to gain first exposure prior to class, provide an incentive for students to

prepare for class, provide a mechanism to assess student understanding, and provide in-class activities that focus on higher level cognitive activities. The flipped classroom approach to learning goes beyond simply reversing the roles of classwork and homework seen within the traditional classroom (Wang, 2017). Zamzami & Halili (2016) detail how learning within a flipped classroom encompasses the six levels of learning provided in Bloom's revised taxonomy of cognitive domain:

1. Remembering: in this stage, the students try to recognize and recall the information they receive; they also try to understand the basic concepts and principles of the content they have learned.
2. Understanding: the students try to demonstrate their understanding, interpret the information and summarize what they have learned.
3. Applying: the students practice what they have learned or apply knowledge to the actual situation.
4. Analyzing: the students use their critical thinking in solving the problem, debate with friends, compare the answer with peers, and produce a summary. The students obtain new knowledge and ideas after implementing critical thinking or a debate in group activities. In this level of learning, the students also produce creative thinking.
5. Evaluating: assessment or established peer-review knowledge, judge in relational terms; in this stage, students are evaluating the whole learning concepts and they could evaluate or make judgement on how far they successfully learned.

6. Creating: the students are able to design, construct, and produce something new from what they have learned. (p. 315)

Wang (2017) asserts that within the flipped classroom the lower levels of remembering and understanding are done at home. While the levels of applying, analyzing, evaluating, and creating are completed by students in class. It is the use of class time that may be used to determine the overall effectiveness of the flipped classroom (Bergmann & Sams, 2015).

Advances in technology offer teachers a better use of face-to-face class time with students. The promise of technology in education is described by Stewart (2012):

Many people see technology's biggest promise as the ability to go beyond one-size-fits-all education to genuinely individualize learning and make it more student centered, as befits the 21st century learner who has grown up surrounded by technologies. This does not mean just letting students do what they want. (We all know that projects that are not in a larger curriculum framework of learning goals are just that - projects) Instead, it means the teacher's role changes from transmitter of knowledge to one who guides and scaffolds student progress toward the achievement of broad, deep, and ambitious learning goals. (p. 163)

Recent innovations in technology, allow for the remembering and understanding levels of student learning to no longer be addressed only by the delivery of content through video lectures. According to Zainuddin and Halili (2016), "...living in a digital age demands the learners to work independently and collaboratively before coming to the classroom using various technology tools" (p. 314). Technology now allows teachers to use interactive tools and simulations to replace the use of lectures as direct instruction. Students can work independently and collaboratively to complete simulations and guided activities using software and tools such

as Geogebra, Desmos, and Explore Learning Gizmos (Bergmann & Sams, 2015). Digital learning resources can also be used to aid students through the higher learning levels of applying, analyzing, evaluating, and creating (Wang, 2017). The completion of classroom activities, projects, and presentations can be made easier with the appropriate implementation of technology.

Teachers' Perceptions of Flipped Classroom

In 1996, two professors, one female with 10 years of teaching experience and one male with 6 years of teaching experience, implemented what Lage et. al. (2000) described as an inverted classroom during a fall semester microeconomics course. According to Lage et. al. (2000), "Inverting the classroom means that events that have traditionally taken place *inside* the classroom now take place *outside* the classroom and vice versa (p. 32). Within the inverted classroom, research participants reported increased student motivation and student collaboration. The inverted classroom was perceived to provide more in-class opportunities for one-on-one interaction, and one professor stated, therefore leading to a more stimulating teaching experience (Lage et. al, 2000). Similar perceptions of the use of class time were discussed in a different higher education study.

During the fall semester of 2000, lectures within Computer Science 310 courses were replaced twice per week with video presentations (Foertsch et. al, 2002). The class time that was previously spent lecturing, was now referred to as "Team Labs" where students worked in groups to solve a problem, and the professor and one teaching assistant facilitated student learning (Foertsch et. al, 2002). The professors involved in the research study noted that face-to-face class time was "...used for more pedagogically powerful interactive exercises in which the

students attempt to apply their knowledge under the watchful eye and helpful tutelage of their professor” ((Foertsch et. al, 2002, p. 273).

In 2012, 453 flipped educators, 95% of whom were secondary school teachers, were asked about the impact of flipping their classrooms on students and themselves (). Of the flipped educators surveyed, 67% reported test score improvement for students and 80% reported an improvement in students’ attitudes. The participants in this study also reported on how flipping their classrooms impacted their level of job satisfaction. Of the flipped educators surveyed, 88% reported a level of job satisfaction improvement, with 46% reported the improvement as significant. Although 91% of those surveyed had only been flipping their classrooms for less than two years, 99% of flipped educators reported they would be flip their classrooms again next year. Positive perceptions of the flipped classroom were reported in a similar survey research study.

The research survey asked 309 higher education faculty members about their motivation for adoption of the flipped classroom (Center for Digital Education, 2013). Research participants were specifically asked about the areas of adoption based on classroom type and size, success measures and outcomes, unmet needs and challenges, and technology investment. Of those surveyed, 56% reported they were currently utilizing or plan to implement a flipped classroom model. Over half (57%) of the research participants already implementing a flipped classroom model rated it as either successful or extremely successful as an instructional strategy. While 81% reported an improved mastery of information as a significant/very significant benefit of the flipped classroom, and 83% reported that their attitude towards teaching improved.

Mastery Learning Theory

Mastery learning is not a new concept. Introduced by Bloom (1968) as a learning theory which focuses on time and learning conditions, mastery learning theory asserts a large majority of students can meet a predetermined level of mastery for course content when time and learning conditions are ideal. In 1968, Bloom described procedures for implementing mastery learning:

The operating procedures we have used are intended to provide detailed feedback to teachers and students and to provide specific supplementary instructional resources as needed. These procedures are devised to insure mastery of each learning unit in such a way as to reduce the time required while directly affecting both quality of instruction and the ability of the student to understand the instruction. (p. 9)

After the introduction of mastery learning, researchers conducted studies using mastery learning's strategies. Proponents of mastery learning argued, "When well implemented, the process helps teachers improve student learning in a broad range of learning goals from basic skills to highly complex cognitive processes" (Guskey, 2009, para. 18). Abakpa and Iji (2015) examined the effectiveness of the Mastery Learning Approach on Geometry students' achievement scores based on ability levels and gender. Students were issued a Geometry Achievement Test (GAT) as a pre-test and post-test. The results from the GAT indicate that regardless of ability level or gender, scores of students in the experiment group showed greater improvement than those of students in the control group (Abakpa and Iji, 2015). In a similar study, Udo and Udofia (2014) determined students taught using mastery learning strategy outperformed students taught using a lecture method of instruction.

The theoretical framework for this research study is centered on the use of strategies associated with mastery learning theory. Within this study, mastery learning will encompass demonstrated student mastery of Common Core mathematics standards using the flipped classroom model and frequent formative assessments. This research study focused on a combination of the ‘flipped classroom’ instructional strategy with mastery learning theory, defined as flipped-mastery models.

Flipped-Mastery Models

Mastery learning strategies form the core of the flipped-mastery models. Using a scientific approach to the collection and analysis of data from the frequent assessments required by mastery learning instructional strategies. Flipped-mastery models combine the essential components of mastery learning with the recently introduced instructional approach of the flipped classroom. The flipped classroom model incorporates the use of video lectures for the delivery of instruction (Overmeyer, 2012). Overmeyer (2012) described the basic form of the flipped classroom, “In its simplest form, what used to be classwork (the lecture) is done at home via teacher-created videos, and what used to be homework (assigned problems) is now done in class” (p. 46). According to Moore, Gillett, and Steele (2014), “The flipped classroom model has great potential for improving students’ mathematical knowledge and providing time to engage in high cognitive demand tasks that embody the recommendations of the Common Core Standards for Mathematical Practice” (p. 425).

Flipped-mastery models move well beyond the basic reversal of flipping lecture and homework by incorporating the flexible pacing, ownership of learning, and demonstration of mastery present in mastery learning theory (Bloom, 1968). The efficient use of instructional time is an important component of flipped-mastery models. Bergmann and Sams (2013)

contended when students are able to work at their own pace, they are able to learn content in the amount of time they need. Flipped-mastery models also incorporate high quality instruction, frequent formative assessments, corrective assignments or activities, and a second opportunity for students to demonstrate mastery of content standards. A need exists to accept or reject that flipped-mastery models offer high school mathematics teachers an instructional approach to addresses the needs of each individual learner, and allows students to master content standards leading to college and career readiness. Students who are college and career-ready have:

...the ability to engage in formal learning in any of a wide range of settings: university and college classrooms, community college two-year certificate programs, apprenticeships that require formal classroom instruction as one component, and military training that is technical in nature and necessitates the ability to process information through a variety of modes developed academically, such as reading, writing, and mathematics. (Conley, 2010, p. 9)

According to Conley (2013) it is important that students have “the ability to employ a range of skills and techniques essential to the learning process” (p. 71). Flipped-mastery models allow students to take ownership of their learning, which may allow help students develop these abilities. Flipped-mastery models have the potential to transform students from dependent learners that “struggle when asked to work independently” to students who are better able to take ownership of their own learning (Conley, 2013, p. 72).

Flipped-Mastery Models as a Learning-Centered Teaching Approach

Learning-centered teaching is an instructional approach “in which teaching methods are chosen to match, as well as possible, the kinds of learning expected of students and to cater for their different preferred learning styles” (Sparkes, 1999, p. 188). According to Maier (2013),

"Learning-centered teaching begins with the assumption that the student is at the central nexus of education" (p. 4). In a learning-centered teaching environment "students take greater responsibility for their own learning because the instructor's role changes from disseminator of information to facilitator of learning" (Mostrom and Blumberg, 2012, p.399). According to Mostrom and Blumberg (2012), "Learning-centered teaching, is in part, characterized by the three essential behaviors: a shift in responsibility for learning towards students and away from the instructor, active student engagement in the course material, and formative assessment opportunities for students" (p. 399). The flipped-mastery model of education is a learning-centered teaching approach that encompasses these three behaviors.

The flipped-mastery model of education is an instructional approach that requires students to take a more influential role in the learning process. One mathematics prototype of this model takes students through a progressive cycle of activities, as they work to demonstrate mastery of content standards (Bean, Brust, Kelly, and Sullivan, n.d). During the cycle students watch a short video on the lesson content, complete practice problems and check their answers, follow with application problems, and take a short quiz to determine mastery of learning content (Bean et al., n.d). At the end of this cycle, students must demonstrate 80% mastery of the preceding content before being allowed to move on to learn new content. Student learning is at the center of this learning-centered teaching approach, because mastery of learning content is contingent upon students' ability to demonstrate understanding of expected learning outcomes (Bergmann and Sams, 2013).

The mathematics version of the flipped-mastery model accommodates both self-paced learning and small group work, which align with learning-centered teaching practices (Maier, 2013). Just as with traditional flipped classrooms, "pacing is more flexible and allows better use

of both students' and teachers' time" (Rotvold and Braathen, 2014, p. 2). According to Moore, Gillett, and Steele (2014), "The flipped classroom model has great potential for improving students' mathematical knowledge and providing time to engage in high cognitive demand tasks that embody the recommendations of the Common Core Standards for Mathematical Practice (CCSSI 2010)" (p. 425). However, some critics may argue that the flexible pacing of the flipped mastery model of education may pose a problem for teachers, if they are not able to manage the pacing of students (Bergmann and Sams, 2013). The mathematics version of the flipped-mastery model addresses this issue by providing students with a minimum pacing guide needed to successfully master required learning content within the time allocated for a course of study. In addition to the concern regarding student pacing, Slavin (1990) pointed out that based on past research experiments "mastery learning procedures hold teachers more narrowly to the mastery objectives (p. 301). Nonetheless, the flipped-mastery model is one of several learning-centered teaching approaches that can be implemented by teachers to increase student engagement and achievement. Mathematics teachers have the option to combine the flipped-mastery model with other learning-centered teaching approaches such as "student-centered learning, active and problem-based learning and the use of IT, as well as instruction and demonstration by a teacher, wherever they are appropriate" (Sparkes, 1999, p. 183).

Assessment in Flipped-Mastery Models

Assessment in education has been traditionally used for diagnosing students' strengths and weaknesses, monitoring students' progress, assigning grades, and determining instructional effectiveness (Popham, 2013). However, in recent years, as the field of education has pursued excellence in assessment, the use of assessment in education has expanded to include influencing public perceptions of educational effectiveness, helping to evaluate teachers, and clarifying

teachers' instructional intentions (Popham, 2013). While all of these uses of assessment are widely practiced in schools across America. The true excellence of assessment in education lies in the ability of educators to use assessment for student learning.

In education, assessment is usually described as either formative or summative. Formative assessment is defined as “a planned process in which assessment-elicited evidence of students' status is used by teachers to adjust their ongoing instructional procedures or by students to adjust their current learning tactics” (Popham, 2014, p. 290). Whereas, summative assessment “takes place when educators collect test-based evidence to inform decisions about already completed instructional activities” (Popham, 2014, p. 291). The key differences between formative and summative assessment is that “formative assessment is a process rather than a test” (Popham, 2014, p. 290). Also, summative assessment is used “as a means to gauge, at a particular point in time, student learning relative to content standards” (Garrison & Ehringhaus, 2007, p. 1). Successful assessment programs use both formative and summative assessments to determine students' status with respect to content standards (Popham, 2014).

Flipped-mastery models “provides students opportunities for advanced preparation and time to identify knowledge gaps needing clarification” (Hawks, 2014, p. 265). The innovativeness of the flipped-mastery model lies in the idea that “students take responsibility for their learning and are actively engaged rather than passive recipients of lecture content” (Hawks, 2014, p. 265). Teachers serve as facilitators and “stand back and watch the learning process going on” within their classrooms (Sang-Hong, Nam-Hun, & Kil-Hong, 2014, p. 70). Great care is taken by teachers to only interject when students need guidance or to provoke more thoughts about the lesson content (Sang-Hong, Nam-Hun, & Kil-Hong, 2014). Within flipped-mastery

models teachers have the freedom to complete assessments “of student learning” and “for student learning” using both formative and summative assessments.

How teachers implement flipped-mastery models within their classroom varies. However, flipped-mastery models require that teachers frequently assess student learning of lesson content. Students are assessed after the completion of required lesson content. A predetermined level of mastery must be achieved before a student is allowed to move on to the new lesson content. If a student does not reach the predetermined level of mastery, remediation occurs then students are allowed to retake the assessment. The flipped mastery learning model offers students more than one opportunity to “demonstrate understanding of a topic if they’re unhappy with their prior performance. It also helps remove some of the competitive and punitive components of assessment and of education in general” (Sams & Bergmann, 2013, p. 18).

Flipped-mastery models allow educators to employ various formative and summative assessments to assess student learning. The assessments used can be teacher-made or reproducible. The purpose of each assessment used should be to help ensure that students gain generalizable mastery of the content being taught throughout each course (Popham, 2014). When used appropriately, assessment can “motivate students, provide models for high-quality work,” and “lead students to discovery” (Berger, Rugen, & Woodbin, 2014, p. 5).

Methodological Literature

Conducting true experimental research in education settings has proved to be a difficult undertaking for researchers (Campbell & Stanley, 2015). Historically, education researchers sought to control “nonexperimental factors” in research environments, such as classrooms (Engelhart, 1930, p.58). However, the inability to control the unpredictable environment of the classroom setting, prompted education researchers to look for a new research procedure.

Descriptive research allows education practitioners the opportunity to study and describe current trends in education, while accommodating for circumstances unique to education research (Campbell & Stanley, 2015). Therefore, descriptive research qualifies as nonexperimental research (Cook & Cook, 2008). According to Borg & Gall (1989), “Descriptive studies are aimed at finding out “what is,” so observational and survey methods are frequently used to collect descriptive data (as cited in Knupfer & McLellan, 1996, p. 1197). The research study employed survey research methods.

Survey research encompasses quantitative research procedures “in which investigators administer a survey to a sample or to the entire population of people to describe the attitudes, opinions, behaviors, or characteristics of the population” (Creswell, 2008, p. 388). Research surveys are either cross-sectional or longitudinal. This research study uses a cross-sectional survey design. The cross-sectional survey design provides researchers with a small glimpse of the research participants’ opinion of a topic of interest (Gay, Mills, Airasian, 2012). These opinions may then be generalized to the entire population. Yet, as with any other research design, the cross-sectional survey design has its issues.

Review of Methodological Issues

Low response rates have historically been a significant area of concern with survey research. According to Rogelberg et al. (2003), survey research is affected by low response rates in the following ways:

First, lower response rates mean fewer participants, which reduces statistical power and prevents the use of certain statistical procedures. Second, low response rates can reduce the perceived credibility of the study’s findings. In general, when faced with unfavorable results, survey sponsors cite low response rates as “the

issue” instead of plausible alternatives. Third, low response rates can generate biased samples where study participants are systematically different from nonrespondents. (As cited in Reio, 2007, p. 48)

Knupfer & McLellan (1996) suggest that further analysis be conducted to determine the differences between respondents and nonrespondents.

The cross-sectional survey design also presents problems for survey research. According to Gay, Mills, & Airasian (2012), “Cross-sectional studies are not effective if the researcher’s goal is to understand trends or development or development over time” (p. 185). The attitudes, beliefs, and opinions of research participants may change over time. In the field of education, educators may be fond of a new instructional strategy during its implementation and vice versa. Therefore, if an education researcher is interested in the continuing perceptions of an instructional strategy, a longitudinal survey design should be utilized (Creswell, 2008).

Synthesis of Research Findings

Current literature presented evidence of studies to determine the efficiency of the flipped-classroom. Various research designs have been employed by education researchers to investigate the areas of academic achievement, engagement, and satisfaction. In recent studies, researchers sought to determine the effectiveness of the flipped classroom on students’ academic performance. Cilli-Turner (2015) found course grades were slightly higher and final exam scores were significantly higher for students receiving instruction in the flipped classroom. Peterson (2016) learned the average exam score in a flipped classroom was a full letter grade higher than the traditional classroom. In contrast to these results, Clark (2015) found no significant difference between the mean averages of students’ scores on a teacher-created unit test in either classroom. Similarly, DeSantis, Van Curen, Putsch, and Metzger (2015) reported

no difference in the amount of improvement by student from a unit pretest to posttest.

Contrasting views were also present in the literature regarding the area of student satisfaction with the flipped classroom model.

Student opinions of the flipped classroom varied across studies. In a course survey administered by Peterson (2016), all students in the flipped classroom gave a rating of excellent or good in response to questions about course quality and teacher effectiveness. In a similar study, Clark (2015) reported students thought positively of the flipped classroom. While in another study, student perception of the flipped classroom was the polar opposite. Students reported an overall dislike of the flipped classroom (DeSantis et al., 2015). Although current literature reports conflicting student perceptions, students' attitudes toward the flipped classroom may reflect a reluctance to change (Cilli-Turner, 2015).

Critique of Previous Research

During the time this literature review was conducted, one research study on flipped-mastery learning was located (Wiginton, 2013). Therefore, the flipped classroom and mastery learning theory were the focus of the literature review. Research on the flipped classroom has centered around its impact on student learning (Cilli-Turner, 2015; DeSantis et al., 2015; Kirvan, Rakes, & Zamora, 2015; Peterson, 2016; Saunders, 2014). Due to the limited number of studies, the results from these studies offer only a provisional outline of the benefits, limitations, and shortcomings of the flipped classroom at the high school level. Research highlighting the potential benefits of the flipped classroom has failed to examine whether improvements in student achievement were reflected in areas other than academic achievement and student perception. Only a handful of recent studies have moved beyond the focus of past research

studies on the impact of the flipped classroom on student achievement and perception to include a concentration on conceptual understanding, critical thinking skills, and engagement.

Kirvan et al. (2015) reported seventh and eighth grade Algebra I students in flipped and traditional classrooms showed significant gains in their levels of understanding for solving systems of equations. However, students in the flipped classroom demonstrated a more proficient ability to solve systems of equations (Kirvan et al., 2015). In another study, Saunders (2014) reported no significant difference in the mathematics critical thinking skills of students in flipped and traditional classrooms. The results of these two studies offer minimal evidence of the flipped classroom's ability or inability to improve student learning in the areas of conceptual understanding and critical thinking.

Summary

A review of the literature regarding the flipped classroom and mastery learning theory has demonstrated an urgency for more research on flipped-mastery models. Flipped-mastery models can best be described as still in infancy stage. Bergmann and Sams (2013) argued flipped-mastery models offer educators and students benefits such as extended time to master learning content and increased engagement. However, the researcher was unable to find sufficient research to support their claims. In order to validate the claims of Bergmann and Sams (2013), extensive research needs to be conducted of the effectiveness of flipped-mastery models.

Chapter 3: The Methodology

The increase in mathematics rigor that accompanied the introduction of the Common Core State Standards (CCSS) has many education practitioners surveying the field for emerging instructional strategies that offer the promise of effectively helping high school mathematics students meet expected learning outcomes. Flipped-mastery models are one such instructional strategy that has risen out of the recent flipped classroom movement. Student mastery of expected learning outcomes is the focus of a flipped-mastery models. Flipped-mastery models take students on a sequential path towards mastery through video instruction, practice, application, and assessment. High school mathematics teachers utilizing flipped-mastery models require students to demonstrate mastery of the expected learning outcome for one lesson before they are allowed to move on to the next lesson. While the promise of results may be encouraging for some education practitioners, the conductor of this study was unable to locate academic research that would confirm or reject the effectiveness of flipped-mastery models as an effective instructional strategy.

Purpose and Design of the Study

This descriptive study focuses on teachers' perceptions of a flipped-mastery model in high school math courses. The researcher was particularly interested in determining how high school mathematics teachers perceive the effectiveness of the instructional practices of a flipped-mastery model, and how flipped-mastery models address the call for increased rigor outlined within the Common Core State Standards Initiative. In order to determine any group differences, the researcher chose to take a closer look at the perceptions of high school mathematics teachers based on gender and teaching experience. Through the use of survey research methods, it was hoped that the quantitative results of this study would provide education practitioners whom are

considering or currently implementing a flipped-mastery model with a consumer review regarding educators' attitudes about its effectiveness in a high school mathematics classroom. This chapter describes the quantitative methods and instruments used to investigate the research questions for this study, the rationale for their selection, and a detailed description of the procedures used to collect and analyze the data.

Research Questions

The following research questions were formulated for this research study:

The following research questions were formulated for this research study:

RQ1: What are high school mathematics teachers' perceptions of instructional practices in flipped-mastery models?

Sub-questions.

3. What are the differences in high school mathematics teachers' perceptions of instructional practices in flipped-mastery models based on the gender of the teacher?
4. What are the differences in high school mathematics teachers' perceptions of instructional practices in flipped-mastery models based on the level of teaching experience?

H_{1a0}: High school mathematics teachers' perceptions of instructional practices in flipped-mastery models do not differ based on gender.

H_{1a}: High school mathematics teachers' perceptions of instructional practices in flipped-mastery models differ based on gender.

H_{1b0}: High school mathematics teachers' perceptions of instructional practices in flipped-mastery models do not differ based on level of teaching experience.

H_{1b}: High school mathematics teachers' perceptions of instructional practices in flipped-mastery models differ based on level of teaching experience.

RQ2: What are high school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models?

Sub-questions.

3. What differences exist, based on the gender of high school mathematics teachers, in their perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models?
4. What differences exist, based on the level of teaching experience of high school mathematics teachers, in their perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models?

H_{2a0}: High school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models do not differ based on gender.

H_{2a}: High school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models differ based on gender.

H_{2b0}: High school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models do not differ based on level of teaching experience.

H_{2b}: High school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models differ based on level of teaching experience.

Basis of Quantitative Data Component of the Study

According to Creswell (2003), a quantitative research approach "...is one in which the investigator primarily uses post positivist claims for developing knowledge (i.e., cause and effect thinking, reduction to specific variables and hypotheses and questions, use of measurement and observation, and the test of theories), employs strategies of inquiry such as experiments and surveys, and collects data on predetermined instruments that yield statistical data" (p. 18). According to Creswell (2008) "...the problems studied by post positivists reflect the need to identify and assess the causes that influence outcomes" (p. 7). Therefore, a quantitative research design will be used in this research study to identify and describe the current conditions of high school mathematics instruction in the flipped-mastery learning community.

Basis of Qualitative Data Component of the Study

Due to its vast number of methodological approaches, qualitative research is difficult to define. However, some authors have been able to characterize research as qualitative due the study's "...concern with 'what' 'why' and 'how' questions rather than 'how many'" (Ormston, Spencer, Barnard, & Snape, 2014, p. 3). Creswell (2003) provides a more in depth look at what qualitative research looks like from beginning to end of the research process:

The procedures of qualitative research, or its methodology, are characterized as inductive, emerging, and shaped by the researcher's experience in collecting and analyzing the data. The logic that the qualitative researcher follows is inductive, from the ground up, rather than handed down entirely from a theory or from the perspectives of the inquirer.

Sometimes the research questions change in the middle of the study to reflect better the types of questions needed to understand the research problem. In response, 'the data collection strategy, planned before the study, needs to be modified to accompany the new questions. During the data analysis, the researcher follows a path of analyzing the data to develop an increasingly detailed knowledge of the topic being studied. (p. 13)

Creswell's views help researchers realize the importance of research questions and the need for flexibility during the research process. The types of questions researchers ask during the research process influence their understanding of the research problem (Creswell, 2003).

Research Design

This study utilized a descriptive research design. According to Pollard & Duignan (2011), "Descriptive research...involves the use of such tools as surveys and questionnaires, interviews, observations, and objective tests to describe behaviors and characteristics (p. 24). Descriptive research uses these tools to collect both quantitative and qualitative data (Knupfer & McLellan, 1996). The quantitative data reports on frequencies and percentages, while the qualitative data reports on behaviors and characteristics (Pollard & Duignan, 2011). Williams (2007) states, "The descriptive research approach is a basic research method that examines the situation, as it exists in its current state" (p. 66).

Descriptive research has been used to describe current trends in education (Knupfer & McLellan, 1996). In this research study, the researcher sought to identify high school mathematics teachers' current perceptions of flipped-mastery learning. The descriptive research design was utilized to help the researcher analyze and make sense of these perceptions. However, like any other research design, descriptive research has its pros and cons. In education research, the descriptive design may be used to "...provide a more accurate and complete picture

of reality” (Pollard & Duignan, 2011, p. 27). Yet, the “findings are not generalizable; in classroom-based studies, sample sizes are too small” (Pollard & Duignan, 2011, p. 27).

Although the results of descriptive research conducted in educational settings may not be used to disprove or validate the effectiveness of teaching strategies, it can “lay the groundwork for development of such strategies” (Carnine & Gersten, 2000, p. 139).

Research Population and Sampling Method

The target population for this research study consists of high school mathematics teachers who have taught courses using both flipped mastery models and traditional lecture/homework models of instruction. Specifically, the researcher used nonprobability convenience sampling procedures to recruit research participants among the subscribers of the Flipped Learning Network (FLN) and the Flipped Learning Global Initiative. A nonprobability sampling of convenience was used in this research study because of the ease of accessibility for the researcher to potential research participants (Kothari, 2004). According to Creswell (2008), when using convenience sampling “...the researcher cannot say with confidence that the individuals are representative of the population. However, the sample can provide useful information for answering questions and hypotheses” (p. 155). For this research study, subscribers of the Flipped Learning Network (FLN) and the Flipped Learning Global Initiative made up target population. From this population, 55 high school mathematics indicated they met the requirements for participation in the research study. However, only 26 of these respondents completed the survey.

Instrumentation and Materials

This descriptive study utilized survey research methods which encompassed both quantitative and qualitative survey questions. According to Fowler (2014), “the purpose of the

survey is to produce statistics, that is, quantitative or numerical descriptions about some aspects of the study population” (p. 1). The origins of survey research can be traced to the social surveys conducted by social reformers in Victorian Britain (Kelley, Clark, Brown, & Sitzia, 2003).

Although survey research has become more disciplined since its origins, the essential use of the survey hasn’t changed. According to Kelley, Clark, Brown, & Sitzia (2003):

The term ‘survey’ is used in a variety of ways, but generally refers to the selection of a relatively large sample of people from a pre-determined population (the ‘population of interest’; this is the wider group of people in whom the researcher is interested in a particular study), followed by the collection of a relatively small amount of data from those individuals. The researcher therefore uses information from a sample of individuals to make some inference about the wider population. (p. 261)

Sample surveys that are used to “collect data about current attitudes, opinions, or beliefs” fall under the cross-sectional survey design (Creswell, 2008). A cross-sectional survey is used in “stand-alone” studies that provide a “...snapshot of the current behaviors, attitudes, and beliefs in a population” (Gay, Mills, & Airasian, 2012, p. 185). This research study incorporated a cross-sectional survey design to sample and compile data about the current perceptions of high school mathematics teachers regarding instructional practices and rigor within flipped-mastery models.

Concordia University’s Qualtrics system was used to create a web-based survey. Before the survey was officially released, a panel of experts were asked to complete the survey to ensure content validity. This panel of experts consisted of the Algebros and Graham Johnson, pioneers in the flipped-mastery learning community. The views of this expert panel were used to make

minor changes to the research survey. Once all revisions were made to the questionnaire it become accessible to all research participants.

Research participants were asked to answer demographics related questions in the first section of the survey such as, years of teaching experience and gender. Responses to demographic items were used to “make comparisons between different subgroups” (Gay, Mills, & Airasian, 2012, p. 187). In the next section research participants answered questions regarding their perceptions of the instructional practices in flipped mastery models and their students’ ability to meet learning outcomes with the appropriate level of rigor required by the Common Core State Standards in flipped mastery models. No print materials were needed for this proposed research study, since the research questionnaire will be web-based.

Data Collection

After submitting a dissertation proposal to the institutional review board for Concordia University - Portland and gaining approval, the researcher executed the research. Data collection occurred during the 2016-2017 school year. Research participants accessed the Informed Consent Letter (see Appendix A) on the home screen of the web-based survey. By beginning the survey, research participants indicated that they read the attached consent form and consented to participate in the survey. The survey entitled “High School Mathematics Teachers' Perceptions of Flipped-Mastery Learning” was utilized in this research study (see Appendix B). The research survey was modeled after the survey entitled “Student Perceptions of the Flipped Classroom” (Johnson, 2013). Permission was granted to make revisions to the survey for use in this research study (see Appendix C).

Operationalization of Variables

The independent variables for this research study are gender and teaching experience. High school mathematics teachers' perceptions of flipped-mastery models in relation to instructional practices and rigor are the dependent variables of this proposed study. A flipped-mastery model is defined in this study as an instructional approach in which students can progress through course material at their own pace (Bergmann & Sams, 2012). Flipped-mastery models require students to complete a cycle of notetaking with the assistance of video lectures, practice problems, application problems, and mastery checks for each lesson within the unit. The traditional instructional approach includes direct instruction with in class lecture and independent practice problems given as homework assignments.

Data Analysis

The survey instrument for this proposed research study employs Likert-type items. Descriptive statistics for each Likert-type item were analyzed for frequency, mean, and standard deviation. The Likert-type items were then grouped together to measure two separate dependent variables. A significance level of $p < 0.05$ was utilized and a Cronbach alpha test was conducted to "provide evidence that the components of the scale are sufficiently intercorrelated and that the grouped items measure the underlying variable (Sullivan and Artino, 2013, p. 542). A Likert scale encompasses "a series of four or more Likert-type items that are combined into a single composite score/variable during the data analysis process (Boone & Boone, 2012, para. 6).

Parametric tests may be used to analyze data from surveys and make inferences about a target population (Sullivan & Artino, 2013). However, nonparametric tests can be used if data is ordinal or "when a parametric assumption has been greatly violated" (Gay, Mills, & Airasian, 2012, p. 351). The Likert-scale data collected using the survey instrument for this research study

takes on an ordinal nature. Therefore, a Mann-Whitney U Test was used to analyze the data collected related to research participants' gender and teaching experience. Data analyzed using a Mann-Whitney U Test falls under four assumptions regarding research design and data characteristics: the dependent variable is continuous or ordinal; one categorical independent variable with two groups; independence of observation; shape of distribution scores are similar or different (Laerd Statistics, 2015).

Limitations and Delimitations of the Research Design

This research study utilized a descriptive design, and therefore limitations related to this particular quantitative research design will influence this study. The use a nonprobability convenience sample resulted in a sample size that may not be representative of the target population of high school mathematics teachers (Creswell, 2008). This research study was also limited by the use of a cross-sectional survey. The results of this research study provided the current views of high school mathematics teachers, which will not provide education practitioners with longitudinal results that measure changes in the perceptions of a sample population over a period of time (Creswell, 2008).

The delimitations of this research study include the generalizability of research results to other subject areas other than high school mathematics. The researcher chose to focus only on the perceptions of high school mathematics teachers. Therefore, research results may not be applicable to the perceptions of high school teachers of other subject areas. Another delimitation of this research study is related to the limited use of open-ended responses in the survey instrument. The researcher chose to primarily use close-ended Likert-type questions in the survey to improve the response rate and strengthen the external validity of the research study

Internal and External Validity

The threats to internal validity for this research study were directly related to the survey instrument. Once IRB approval was granted for this research study, a pilot test of the research survey was administered. The Algebras were asked to complete the questionnaire to determine content validity. The results of the pilot test were used to make any necessary changes to the questionnaire, such as question wording or sequence.

The threats to external validity for this research study were directly related to the sampling method utilized. Although the sampling method used for this study is one of convenience, the researcher invited approximately 1,680 members of the target population to participate in this research study. It was hoped that the number of research participants for this study would represent a large enough portion of the target population. In order to ensure external validity, the right sample size is needed to generalize research results to the entire target population (Creswell, 2008).

Expected Findings

The introduction of Common Core State Standards (CCSS) has changed the way high school mathematics teachers must approach the instruction of students (2010). CCSS for mathematics require students to not only demonstrate proficiency of rigorous mathematics content standards through recall and basic reasoning questions, but they must also be able to demonstrate application of these standards through higher-order thinking questions (Louisiana Department of Education, 2013). Based on previous research, the researcher expected high school mathematics teachers would perceive that the mastery learning techniques associated with flipped-mastery models would provide more of the increase in rigor emphasized in the CCSS (Bergmann & Sams, 2014). The researcher also expected that factors of gender and teaching

experience would not produce differences in the perceptions of high school mathematics teachers' perceptions of flipped-mastery models.

Ethical Issues

The researcher anticipated ethical considerations for the research study in the following areas: data collection, data analysis and interpretation, and writing and disseminating the research (Creswell, 2009). In an effort to address ethical concerns regarding data collection, the researcher developed and issued to research participants an informed consent form (see Appendix A). The informed consent form divulges to research participants the purpose, benefits, and risks associated with participation in the proposed research study (Creswell, 2009). A guarantee of confidentiality and release without penalty is included within the informed consent form.

The ethical concerns regarding data analysis and interpretation and writing and disseminating the research were addressed solely by the researcher, and did not directly involve research participants. In order to maintain anonymity, the identity of research participants was not revealed during the data collection and analysis or reporting phases of this research study. The researcher ensured that language used within the research study did not include “words that are biased against persons because of gender, sexual orientation, racial or ethnic group, disability, or age” (Creswell, 2009, p. 92).

Summary

This chapter described the methods and procedures that were utilized to provide insight into high school mathematics teachers' perceptions of the instructional practices, achievement, rigor, and overall satisfaction regarding flipped-mastery models. The purpose, research design, research questions, sample population, and instrumentation were introduced in the chapter. This

chapter also discussed how the data for this research study was collected. The analysis of this data will be discussed in Chapter 4.

Chapter 4: Results

Introduction

The purpose of this study was to determine high school mathematics teachers' perceptions of a flipped-mastery system of learning, in relation to instructional practices and rigor. The data for this study was collected utilizing a survey. After IRB approval was received, the study was conducted during April and May of 2017. Participants consisted of 26 high school mathematics teachers who submitted anonymous responses to a Likert survey using Qualtrics software. The link for the anonymous survey was accessed by email subscribers of the Flipped Learning Network and of the Flipped Learning Global Initiative. Participants responded to either strongly disagree (1), disagree (2), somewhat disagree (3), neither agree nor disagree (4), somewhat agree (5), agree (6), or strongly agree (7) to 14 questions. Participants also responded to 3 open-ended survey questions. The data collected from each of the 17 questions was used to answer the following research questions:

RQ1: What are high school mathematics teachers' perceptions of instructional practices in flipped-mastery models?

Sub-questions.

1. What are the differences in high school mathematics teachers' perceptions of instructional practices in flipped-mastery models based on the gender of the teacher?
2. What are the differences in high school mathematics teachers' perceptions of instructional practices in flipped-mastery models based on the level of teaching experience?

RQ2: What are high school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models?

Sub-questions.

1. What differences exist, based on the gender of high school mathematics teachers, in their perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models?
2. What differences exist, based on the level of teaching experience of high school mathematics teachers, in their perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped-mastery models?

Description of the Sample

The sample for the study includes 26 email subscribers of the Flipped Learning Network and Flipped Learning Global Initiative who accessed the link for the anonymous survey, which was contained in the blog recruitment post (see Appendix D). The current enrollment of email subscribers for both the Flipped Learning Network and Flipped Learning Global Initiative totals 1,680. It is not known how many of these email subscribers are high school mathematics teachers utilizing a flipped-mastery learning system. Of the 68 email subscribers that accessed the survey, 55 indicated that they met the criteria for this study of having taught either Algebra I, Geometry, Algebra II, or Fourth Courses (Precalculus, Calculus or AP Statistics, Advanced Statistics, Discrete Mathematics) using both a flipped-mastery system of learning and a traditional direct instruction/homework model. Of these 55 respondents, 26 individuals completed the survey, resulting in a response rate of 47%. Table 1 reflects the frequency and percent of these 26 participants' gender and years of teaching experience.

Table 1

Demographic Characteristics of Teachers Represented by Frequency and Percentage

	Frequency	%
<i>Gender</i>		
Male	11	42
Female	15	58
<i>Years of Teaching Experience</i>		
1-5	6	23.1
6-10	2	7.7
11-15	9	34.6
16-20	6	23.1
21 or longer	3	11.5

Female participants were the 58% majority in this study. The least amount of teaching experience was presented as 6-10 years while 11-15 years was presented as the maximum. The majority of the participants in the study have at least 10 years of teaching experience, 69.2% (18). The largest percentage of research participants had experience teaching Geometry courses using flipped-mastery and traditional lecture/homework models.

Research Methodology and Analysis

Permission was granted to use and make adjustments to the survey utilized within this study (see Appendix C). A 7-point Likert scale was utilized to rate participants' responses to 14 statements. The reliability of the survey instrument utilized within this study was measured using Cronbach alpha. The survey was found to be internally consistent with a Cronbach alpha of 0.814 (Laerd Statistics, 2015). The online survey was distributed using an anonymous link through Qualtrics. Participants were recruited from the email subscribers of the Flipped Learning Network and of the Flipped Learning Global Initiative. Research participants' information was kept confidential, and was only used for data analysis related to the independent

variables gender and teaching experience and the dependent variables instructional practices and rigor.

During data analysis, Likert scale data for each question measuring a specific dependent variable were summarized using the median of all items to create two distinct dependent variables. Content analysis coding was used to locate themes found in participants' responses to open-ended survey questions. The Data Management Plan shown in Table 2 summarizes the data analysis for each research question.

Table 2

Data Management Plan

Research Question	Measure(s)	Independent Variables	Dependent Variable	Analysis Method/Statistical Test
1	Survey Items: 1, 2, 3, 4, 5, 6, 7, 8, 12, 13	Gender Teaching Experience	Median of responses for each Likert item of instructional practices	Descriptive Statistics Mann-Whitney U test Content Analysis Coding
2	Survey Items: 9, 10, 11	Gender Teaching Experience	Median of responses for each Likert item of rigor	Descriptive Statistics Mann-Whitney U test Content Analysis Coding

Overall Results

The descriptive results for each survey item, including the percentages of response, means, and standard deviations, are presented in Table 3. In regards to learning progress monitoring and feedback, the vast majority (96.2%) of high school mathematics teachers agree that the use of frequent formative assessment within a flipped-mastery model of instruction allows them to adequately monitor and assess student progress, and every high school mathematics teacher believes that a flipped-mastery model allows greater opportunities to provide feedback to students about their learning progress.

Table 3

Percentages of Teachers' Responses, Medians for Items Appearing on High School Mathematics

Teachers' Perceptions of Flipped-Mastery Learning (n = 26)

Item	Frequencies (Percentages) of Responses							Media n
	1 SD	2 D	3 SWD	4 NAD	5 SWA	6 A	7 SA	
1. A flipped-mastery model of instruction offers greater opportunities for me to provide feedback to students about their learning progress.					2 (7.7%)	9 (34.6%)	15 (57.7%)	7
2. The use of frequent formative assessment within a flipped-mastery model of instruction allows me to adequately monitor and assess student progress.				1 (3.8%)	2 (7.7%)	11 (42.3%)	12 (46.2%)	6
3. The students in my flipped-mastery classes move at the same pace.	4 (15.4%)	8 (30.8%)	6 (23.1%)	3 (11.5%)	2 (7.7%)	3 (11.5%)		3
4. Students in my flipped-mastery classes easily pace themselves through the course content.	2 (7.7%)	1 (3.8%)	2 (7.7%)	4 (15.4%)	7 (26.9%)	10 (38.5%)		5
5. While using a flipped-mastery model of instruction, I spend less class time delivering content to students than with a direct instruction/homework model of instruction.				1 (3.8%)	3 (11.5%)	8 (30.8%)	14 (53.8%)	7

Table 3 contd. Item	1 SD	2 D	3 SWD	4 NAD	5 SWA	6 A	7 SA	Media n
6. A flipped-mastery model of instruction gives my students more time to practice math than a direct instruction/homework model of instruction.			1 (3.8%)		3 (11.5%)	8 (30.8%)	14 (53.8%)	7
7. The students I have taught using a flipped-mastery model of instruction are more motivated to learn mathematics, than students I have taught using a direct instruction/homework model of instruction.	2 (7.7%)		1 (3.8%)	3 (11.5%)	4 (15.4%)	12 (46.2%)	4 (15.4%)	6
8. Students in my flipped-mastery classes enjoy watching video lessons.	2 (7.7%)		1 (3.8%)	3 (11.5%)	7 (26.9%)	6 (23.1%)	6 (23.1%)	5
9. My students have gained a better conceptual understanding of mathematics under a flipped-mastery model of instruction.					7 (26.9%)	13 (50%)	6 (23.1%)	6
10. The mastery learning component of a flipped-mastery model of instruction has improved my students' procedural skills and fluency.					5 (19.2%)	14 (53.8%)	7 (26.9%)	6

Table 3 contd. Item	1 SD	2 D	3 SWD	4 NAD	5 SWA	6 A	7 SA	Media n
11. The students I have taught using a flipped-mastery model of instruction are better able to correctly apply the mathematical knowledge they have gained during the course, than students I have taught using a direct instruction/homework model of instruction.				1 (3.8%)	8 (30.8%)	11 (42.3%)	6 (23.1%)	6
12. Grades on summative assessments are higher for students I have taught using a flipped-mastery model of instruction than those of students I taught using a direct instruction/homework model of instruction.				2 (7.7%)	6 (23.1%)	11 (42.3%)	7 (26.9%)	6
13. Scores on standardized tests are higher for students I have taught using a flipped-mastery model of instruction than those of students taught using a direct instruction/homework model of instruction.		1 (3.8%)		5 (19.2%)	4 (15.4%)	10 (38.5%)	6 (23.1%)	6
14. I would recommend a flipped-mastery model of instruction to a colleague.	1 (3.8%)				2 (7.7%)	8 (30.8%)	15 (57.7%)	7

Over half (69.3%) of high school mathematics teachers believe that students in their flipped-mastery classes do not move at the same pace. While over half (65.4%) of high school mathematics teachers believe that students in their flipped-mastery classes easily pace

themselves through the course content. In regards to the use of class time, nearly all (96.2%) high school mathematics teachers agree that while using a flipped-mastery model of instruction, they spend less class time delivering content to students than with a direct instruction/homework model of instruction. Nearly all (96.2%) high school mathematics teachers believe that a flipped-mastery model of instruction gives their students more time to practice math than a direct instruction/homework model of instruction. Almost three-fourths of high school mathematics teachers agree that students in their flipped-mastery classes enjoy watching video lessons. With respect to the Common Core State Standards components of rigor, every high school mathematics teacher believes that their students have gained a better conceptual understanding of mathematics under a flipped-mastery model of instruction, and that the mastery learning component of a flipped-mastery model of instruction has improved their students' procedural skills and fluency. While nearly all (96.2%) high school mathematics teachers believe that the students they have taught using a flipped-mastery model of instruction are better able to correctly apply the mathematical knowledge they have gained during the course, than students they have taught using a direct instruction/homework model of instruction. With respect to student performance on various assessments, almost every teacher (93.2%) agree that grades on summative assessments are higher for students they have taught using a flipped-mastery model of instruction than those of students they taught using a direct instruction/homework model of instruction. More than three-fourths (77%) of high school mathematics teachers agree that scores on standardized tests are higher for students they have taught using a flipped-mastery model of instruction than those of students taught using a direct instruction/homework model of instruction. Nearly all (96.2%) high school mathematics teachers would recommend a flipped-mastery model of instruction to a colleague.

The descriptive statistics for the dependent variables, instructional practices and rigor, are included in Table 4. The mean of high school mathematics teachers' perception of the instructional practices of a flipped-mastery model is 5.88. The median is 6, and the mode is 6. High school mathematics teachers' perception of the instructional practices of a flipped-mastery model had a standard deviation of .97. The mean of high school mathematics teachers' perception of rigor in a flipped-mastery model is 6.04. The median is 6, and the mode is 6. High school mathematics teachers' perception of rigor in a flipped-mastery model had a standard deviation of .66.

Table 4

Descriptive Statistics

Variables	<i>Mean</i>	<i>Median</i>	<i>Mode</i>	<i>SD</i>	<i>Range</i>	<i>IQR</i>
Sex	5.88	6	6	.973	4.5	1.13
Dist. Intol.	6.04	6	6	.662	2	.25

Instructional Practices

A Mann-Whitney U test was conducted to determine if there were differences in high school mathematics teachers' perceptions of the instructional practices within a flipped-mastery model between males and females. Distributions of high school mathematics teachers' perceptions of the instructional practices within a flipped-mastery model for males and females were similar, as assessed by visual inspection. High school mathematics teachers' perceptions of the instructional practices within a flipped-mastery model was not found to be statistically significantly different between males ($Mdn = 6$) and females ($Mdn = 6$), $U = 96$, $z = .729$, $p = .507$.

A Mann-Whitney U test was conducted to determine if there were differences in high school mathematics teachers' perceptions of the instructional practices within a flipped-mastery model between groups of participants with levels of teaching experience: 1-10 years and 11-21 or longer. Distributions of high school mathematics teachers' perceptions of the instructional practices within a flipped-mastery model for both groups of teaching experience were similar, as assessed by visual inspection. High school mathematics teachers' perceptions of the instructional practices within a flipped-mastery model was not found to be statistically significantly different between participants with 1-10 years of teaching experience ($Mdn = 6$) and participants with 11-21 or longer years of teaching experience ($Mdn = 6$), $U = 86$, $z = .809$, $p = .461$.

Rigor

A Mann-Whitney U test was conducted to determine if there were differences in high school mathematics teachers' perceptions of rigor within a flipped-mastery model between males and females. Distributions of high school mathematics teachers' perceptions of the rigor within a flipped-mastery model for males and females were similar, as assessed by visual inspection. High school mathematics teachers' perceptions of the rigor within a flipped-mastery model was not found to be statistically significantly different between males ($Mdn = 6$) and females ($Mdn = 6$), $U = 87$, $z = .263$, $p = .838$.

A Mann-Whitney U test was conducted to determine if there were differences in high school mathematics teachers' perceptions of rigor within a flipped-mastery model between groups of participants with levels of teaching experience: 1-10 years and 11-21 or longer. Distributions of high school mathematics teachers' perceptions of rigor within a flipped-mastery model for both groups of teaching experience were similar, as assessed by visual inspection.

High school mathematics teachers' perceptions of rigor within a flipped-mastery model was not found to be statistically significantly different between participants with 1-10 years of teaching experience ($Mdn = 6$) and participants with 11-21 or longer years of teaching experience ($Mdn = 6$), $U = 88.5$, $z = .844$, $p = .461$.

Summary of Quantitative Findings

Research Question 1: What are high school mathematics teachers' perceptions of instructional practices in flipped mastery versus traditional lecture/homework models? Teachers' perceptions of the instructional practices of a flipped-mastery model ranged from 2.5 to 7 on the Likert-scale, representing perceptions from between "disagree" and "somewhat agree" to "strongly agree". With a mean of 5.88, median of 6, and mode of 6, teachers' perceptions of the instructional practices of a flipped-mastery model support a favorable opinion of this instructional method. The range (4.5) and interquartile range (1.13) indicate that most teachers' perceptions of the instructional practices of a flipped-mastery model were grouped closely together, representing a negatively skewed distribution. The spread of teachers' perceptions of the instructional practices of a flipped-mastery model indicated that there were high school mathematics teachers who did not think favorably of the instructional practices of a flipped-mastery model. A closer look at the data indicated that teachers' perceptions of the instructional practices of a flipped-mastery model do not differ based on gender nor level of teaching experience. Therefore, failing to reject the null hypothesis.

Research Question 2: What are high school mathematics teachers' perceptions of their students' ability to meet learning outcomes with the appropriate level of rigor in flipped mastery versus traditional lecture/homework models? Teachers' perceptions of rigor in a flipped-mastery model ranged from 5 to 7 on the Likert-scale, representing perceptions from "somewhat agree"

to “strongly agree”. With a mean of 6.04, median of 6, and mode of 6, teachers’ perceptions of rigor in a flipped-mastery model support a favorable opinion of this instructional method. The range (2) and interquartile range (.25) indicate that most teachers’ perceptions of rigor in a flipped-mastery model were grouped closely together, representing a negatively skewed distribution. The spread of teachers’ perceptions of rigor in a flipped-mastery model indicated an absence of high school mathematics teachers who did not think favorably of the rigor in a flipped-mastery model. A closer look at the data indicated that teachers’ perceptions of rigor in a flipped-mastery model do not differ based on gender nor level of teaching experience. Therefore, failing to reject the null hypothesis.

Qualitative Results

In the first of three open-ended survey questions, research participants were asked to provide their perceptions of the advantages of a flipped-mastery system of learning. Four themes were discovered amongst participants’ responses to the advantages of a flipped-mastery learning system: pace/time, student ownership of learning, differentiation, and demonstrated mastery. Eight respondents suggested that a flipped-mastery model allows better use of class for both students and teachers time and more control of the pace of learning:

“Flipped learning allows students to work at an individualized pace.”

“More one-on one time with my students. More time to "go deeper" into a topic.”

“Often the pace of the class is managed by the median ability level, and skill learning is inefficient or ineffective when taught at a standard pace.”

“Individually paced.”

“More time helping students at all levels and allows time for deeper discussions.”

“Allows for better utilization of face time in class with the instructor as guide on the side, floating to provide assistance and input where needed to various students”.

“It allows for a student to have various amounts of time when learning Mathematics concepts.”

“Students have time to learn.”

“More time is spent on one-to-one learning with the teacher and other students.”

The responses of six research participants exemplify the theme of student ownership of learning as an advantage of a flipped-mastery model:

“Students are in charge of their learning.”

“Gives students more control of the pace of learning and choice of optimum time to study for them.”

“Students take ownership of their part on learning.”

“Students have control over how fast they learn the content.”

“Students can exchange ideas and knowledge and discuss in a group.”

“Students learn from THEIR mistakes. Students reflect on their learning.”

Five respondents designated demonstrated mastery of learned concepts as an advantage of a flipped-mastery model:

“Students must master a lesson before moving on to another lesson.”

“...mastery on a concept before advancing with the topic.”

“Students can work on a skill until they master it. There’s no more snowballing of misconceptions upon each other.”

“The ability for students to watch videos a number of times to fully understand the content of the topic.”

“Students like that they are given many chances to pass material, as the system makes it easier to try again, removing some of the stigma of failure.”

The second open-ended survey question asked research participants to provide their perceptions of the disadvantages of a flipped-mastery system of learning. Four themes were discovered amongst participants’ responses to the disadvantages of a flipped-mastery learning system: increased planning, lack of student motivation, technology access, and wide gaps in student learning. Six respondents indicated increased planning time needed to create resources:

“Start-up --- a lot of time and effort is needed for recording videos, creating notes, etc.”

“Much more time-consuming for the teacher.”

“Massive amount of teacher time involved in creating resources.”

“Time required to produce videos, guided notes, and practice components if you do not have a teaching partner to work with.”

“Lots of preparation to get lessons and videos going.”

“Time”

Seven respondents characterized lack of student motivation/participation as a disadvantage of a flipped-mastery model:

“Students are in charge of their own learning, which can be great, but for some kids they just don’t care.”

“Not all students motivated to watch videos in their own time. Some students watch the videos but are not actively engaging in the activities.”

“Student motivation (not any different than a ‘traditional’ classroom).”

“My students were not motivated to work ahead, or stay in pace. At one point, they spanned 3 units (10 sections).”

“Some students do not engage, do not listen to the videos.”

“Some students do not participate or talk about other things rather than topic discuss in group.”

“Students can become complacent and not take full responsibility for their learning.”

One respondent described gaps in student learning as a disadvantage of a flipped-mastery model:

“When dealing with a population of students who have low skills in mathematics and reading often the flipped course lays bare the student’s gaps and inabilities in Mathematics. This can be really stressful to the student and prevent them from progressing.”

Two respondents defined technology access as a disadvantage of a flipped-mastery model:

“technology access”

“In our community several houses are without internet service...”

The third and final open-ended survey question asked research participants to provide their recommendation for the improvement of learning within a flipped-mastery high school math class. Six themes were detected amongst respondents’ recommendations for improving learning within a flipped-mastery high school math class: true mastery learning system, teacher collaboration, increased student activities/resources, administrative support, detailed pacing, and dynamic grouping. Six respondents characterized increased student activities/resources as a recommendation for improving learning within a flipped-mastery high school math class:

“Need to find more activities/enrichment for my students.”

“Might allow kids to watch more than one option of content. Khan, my videos, etc.”

“My highest recommendation, hands down, is the learning software “MathSpace” which incorporates video options, differentiated practice problems, and “hints” for wherever a student is currently stuck on a problem.”

“Mashing the videos with an interactive site like edpuzzle providing instant feedback on students understanding of the material.”

“do varieties of interesting activities”

Three respondents identified detailed pacing requirements as a recommendation for improving learning within a flipped-mastery high school math class:

“Allow students to truly work at their own pace and don’t force them to get through 100% of a state curriculum if they can’t handle it.”

“A detailed schedule that students follow so they can pace themselves...”

“have flexible scheduling so those students than need more time can have it”

Three respondents outlined collaboration and administrative support as recommendations for improving learning within a flipped-mastery high school math class:

“more people do it so I don’t have to teach students all about it from the start of the year.”

“Support for staff facilitating this way of learning. Teachers/administrators should be able to invest the time to spend more than a glance at the method. It is difficult to get a true appreciation for the value of mastery learning without spending time in the classroom.”

“This is our second year with the flipped classroom and next year I am going to attempt some dynamic grouping to help student progress faster by working with students on the same lesson or unit.”

Two respondents identifies increased time as a recommendation for improving learning within a flipped-mastery high school math class:

“Put more hours in a day!!!”

“Providing more time for that would be an improvement.”

Summary

This chapter discussed the research methods and procedures used during the study. The sample for this study was described, and the results of the data analysis was presented. Research findings were summarized in relation to each research question. The next chapter will discuss the importance of these research findings.

Chapter 5: Discussion and Conclusion

This study modeled high school mathematics teachers' perceptions of a flipped-mastery model in relation to instruction practices and rigor. This chapter includes a summary and discussion of the results for this study. The results of this study are also discussed in relation to the literature. The limitations and implications of the results of this study are presented, and recommendations for further research are discussed.

Summary of the Results

Research question one addressed high school mathematics teachers' perceptions of the instructional practices of a flipped-mastery model. The results of this study indicate that high school mathematics teachers' perceptions of the instructional practices of a flipped-mastery model do not differ based on gender and teaching experience. Research question two focused on high school mathematics teachers' perceptions of the ability of a flipped-mastery model to increase rigor. The variables of gender and teaching experience were found to have no effect on high school mathematics teachers' perceptions of a flipped-mastery model's ability to increase rigor. The results of this study indicate that high school mathematics teachers' perceptions of rigor in a flipped-mastery model do not differ based on gender and teaching experience.

Research participants' answers to open-ended survey questions provided insight into high school mathematics teachers' opinions of what's right and wrong with flipped-mastery models. Themes of pace/time, student ownership of learning, differentiation, and demonstrated mastery were identified as advantages of flipped-mastery models. While themes of increased planning, lack of student motivation, technology access, and wide gaps in student learning were identified as disadvantages of flipped-mastery models. Research participants provided ideas for improvement in flipped-mastery models. Increased student activities, detailed pacing, true mastery learning

system, teacher collaboration, administrative support, and dynamic grouping were offered as possible improvements to flipped-mastery models.

Discussion of the Results in Relation to the Literature

While the results of this study found no differences in high school mathematics teachers' perceptions of instructional practices and rigor bases on gender and teaching experience, these results do provide insight into what these educators are saying about flipped-mastery models. Born out of the flipped classroom movement, flipped-mastery learning emerged as an instructional method that combined the introverted nature of the flipped classroom with the core principles of mastery learning theory (Bergmann & Sams, 2012). At the time of publication, the researcher was able to locate one research study directly related to flipped-mastery learning, in which flipped-mastery learning was recommended as an instructional approach that could be used to promote student responsibility, self-regulation, and ownership of the learning process (Wiginton, 2013). A limited amount of research has been conducted on the effectiveness of the flipped classroom at the high school level. While an extensive amount of research has been conducted on the effects of mastery learning theory since its introduction by Bloom (1968).

Teachers at Byron High School found the flipped classroom to be an effective instructional method for increasing students' math scores on the Minnesota Comprehensive Assessment (MCA) (Fulton, 2012). Wiginton (2013) found that student achievement and self-efficacy was slightly higher for students receiving instruction in a flipped classroom than those receiving instruction in a traditional classroom. In 2009, Guskey suggested that mastery learning theory improves student learning. Abakpa and Iji (2015) found that the achievement scores of students taught using the mastery learning approach showed greater improvement on the Geometry Achievement Test than those of students taught using a traditional method of

instruction. Udo and Udofia (2014) credited mastery learning theory with students' superior academic performance compared to those of their peers taught using lecture instruction. The results of these research studies suggest that a combination of the flipped classroom with mastery learning theory can make a similar impact on student learning.

The limited amount of research on the flipped classroom at the high school level influenced the decision of Gough, DeJong, Grundmeyer, and Baron (2017) to study teachers' perceptions of the flipped classroom based on grade level and content area taught. The conductor of this research study felt that providing the education community with the perceptions of high school mathematics teachers who have taught courses using a flipped-mastery learning system would open the discussion of its effectiveness. The results of this study attest that a large percentage of research participants perceived that a flipped-mastery learning system frees up class time for students to practice and study mathematics. An even higher percentage of research participants perceive that a flipped-mastery learning system allows students to take more ownership of their learning in a high school math class.

Limitations

Limitations are defined as "potential weakness or problems with the study identified by the researcher" (Creswell, 2008, p. 207). The small sample size of this research study presents a Type II sampling error, and the results of this study may not be generalized to the target population (Faber, 2014). The researcher was not able to determine if many members of the target population were qualified to participate in this research study. Therefore, the innovativeness of flipped-mastery models may account for the low number of participants.

Implications of the Results for Practice, Policy, and Theory

The results of this study indicate high school mathematics teachers' perceptions of the best practices of a flipped-mastery learning system. In a response to the implementation of the Common Core State Standards (CCSS) for mathematics, teachers are in search of instructional methods that adequately attend to the shift in which students are learning mathematics. The shift in the teaching of mathematics, caused by the introduction of the CCSS, specifically calls for an increase in rigor. Rigor as addressed by the CCSS demands that students demonstrate a conceptual understanding of mathematics topics, complete mathematical computations with speed and accuracy, and use mathematics concepts to solve real-world problems (Common Core State Standards, 2010).

The results of this study allow high school mathematics teachers to discern the benefits and disadvantages of a flipped-mastery learning system. If you are a teacher considering whether or not to implement flipped-mastery learning in your classroom, and you already struggle in the areas of lesson planning, time management, or classroom management, then according to the testimony of research participants, flipped-mastery is not for you. For high school mathematics teachers considering flipped-mastery models as an instructional approach to address to meet the demands set by CCSS implementation, the results of this study provide evidence that can be provided to reluctant or unknowledgeable administrators to advocate its usage. Professional development can also be provided to educate administrators about potential impact and pitfalls of implementing a flipped-mastery model to improve student learning.

Recommendations for Further Research

The small sample size of this research study, limits generalizability of the results to the target population. Therefore, the researcher suggests a need for further research using a larger

sample size to evaluate the perceptions of high school mathematics teachers utilizing flipped-mastery models. With the minute amount of research regarding flipped-mastery learning, both qualitative and quantitative research is needed to support the validity of its effectiveness. The researcher suggests that both phenomenological studies and quasi-experimental studies be conducted to assess a flipped-mastery learning system's effect on student achievement.

Conclusion

The results of this study suggest that gender and teaching experience have no impact on high school mathematics teachers' perceptions of a flipped-mastery learning system. Although these results may not be generalized to the entire population of high school mathematics teachers who have or currently utilize a flipped-mastery learning system, they enlighten education practitioners of its best practices and benefits. The level of overall satisfaction presented by research participants led to the deeper investigation of the themes directly related to the experiences felt by these participants within their own classrooms. High school mathematics teachers' perceptions in relation to the themes of pace/time, student ownership of learning, differentiation, demonstrated mastery, increased planning, lack of student motivation, technology access, wide gaps in student learning, true mastery learning system, teacher collaboration, increased student activities/resources, administrative support, detailed pacing, and dynamic grouping can be used to guide further research on the disadvantages and benefits of flipped-mastery models within high school mathematics classes.

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Appendix A: Informed Consent Form

CONSENT FORM

Research Study Title: A Descriptive Study of High School Mathematics Teachers' Perceptions of Flipped-Mastery Learning

Principal Investigator: Adriane Howard

Research Institution: Concordia University - Portland

Faculty Advisor: Dr. Connie Greiner

Purpose and what you will be doing:

The purpose of this survey is to use high school mathematics teachers' perceptions to assess the efficiency of Flipped-Mastery Learning as an instructional method to meet student learning outcomes. We expect approximately 60 volunteers. No one will be paid to be in the study. We will begin enrollment on April 14, 2017 and end enrollment on May 5, 2017. To be in the study, you will be asked to complete a survey using Concordia University's Qualtrics system. Completing this survey should take less than 15 minutes of your time.

Risks:

There are no risks to participating in this study other than providing your information. However, we will protect your information. Any personal information you provide will be coded so it cannot be linked to you. Any name or identifying information you give will be kept securely via electronic encryption. When we or any of our investigators look at the data, none of the data will have your name or identifying information. We will refer to your data with a code that only the principal investigator knows links to you. This way, your identifiable information will not be stored with the data. We will not identify you in any publication or report. Your information will be kept private at all times and then all study documents will be destroyed 3 years after we conclude this study.

Benefits:

Information you provide will help participation in this study could add to the limited amount of research on Flipped-Mastery learning. Study results may also provide a wider audience with insight into teachers' views of the benefits of Flipped-Mastery learning. You could benefit these study results by having academic research that may support your choice of instructional strategy, or influence your decision to choose a different instructional strategy.

Confidentiality:

This information will not be distributed to any other agency and will be kept private and confidential. The only exception to this is if you tell us abuse or neglect that makes us seriously concerned for your immediate health and safety.

Right to Withdraw:

Your participation is greatly appreciated, but we acknowledge that the questions we are asking are personal in nature. You are free at any point to choose not to engage with or stop the study. You may skip any questions you do not wish to answer. This study is not required and there is no penalty for not participating. If at any time you experience a negative emotion from answering the questions, we will stop asking you questions.

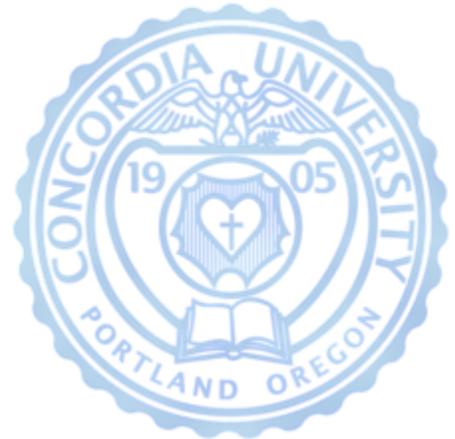
Contact Information:

You will receive a copy of this consent form. If you have questions you can talk to or write the principal investigator, Adriane Howard at [Researcher email redacted]. If you want to talk with a participant advocate other than the investigator, you can write or call the director of our institutional review board, Dr. OraLee Branch (email obranche@cu-portland.edu or call 503-493-6390).

Your Statement of Consent:

I have read the above information. I asked questions if I had them, and my questions were answered. I volunteer my consent for this study.

_____	_____
Participant Name	Date
_____	_____
Participant Signature	Date
_____	_____
Investigator Name	Date
_____	_____
Investigator Signature	Date



Investigator: Adriane Howard; email: adrianeh16@gmail.com
c/o: Professor Connie Greiner; Concordia
University – Portland
2811 NE Holman Street
Portland, Oregon 97221

Appendix B: Research Survey

High School Mathematics Teachers' Perceptions of Flipped-Mastery Learning

For the purpose of this research study, flipped-mastery model of instruction and direct instruction/homework model of instruction are defined as follows: Flipped-mastery model of instruction – A successive series of video instruction, guided and/or independent practice, and assessment. Students must demonstrate mastery of lesson content before being allowed to learn new content. Direct instruction/homework model of instruction - In class teacher-led instruction, which is presented to students through lecture. Students then independently practice concepts outside of the classroom as homework. Have you taught high school mathematics courses using both models of instruction?

- Yes (1)
- No (2)

Condition: No Is Selected. Skip To: End of Survey.

Clicking the "Next" button below indicates that you have read the attached consent form, and indicates your consent to participate in this survey.

Q1 What is your age?

- 21-24 (1)
- 25-34 (2)
- 35-44 (3)
- 45-54 (4)
- 55-64 (5)
- 65 or older (6)

Q2 What is your gender?

- Male (1)
- Female (2)

Q3 By the end of the current school year, how many years will you have been teaching high school mathematics courses?

- 1-5 (1)
- 6-10 (2)
- 11-15 (3)
- 16-20 (4)
- 21 or longer (5)

Q4 Which high school mathematics courses do you have experience teaching using a traditional direct instruction/homework model? Choose all that apply.

- Algebra I (1)
- Geometry (2)
- Algebra II (3)
- Fourth Courses (Precalculus, Calculus or AP Statistics, Advanced Statistics, Discrete Mathematics) (4)

Q5 Which high school mathematics courses do you have experience teaching using a flipped-mastery learning model? Choose all that apply.

- Algebra I (1)
- Geometry (2)
- Algebra II (3)
- Fourth Courses (Precalculus, Calculus or AP Statistics, Advanced Statistics, Discrete Mathematics) (4)

Q6 Rate each item on the scale provided to indicate your agreement.

	Strongly Disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
A flipped-mastery model of instruction offers greater opportunities for me to provide feedback to students about their learning progress. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The use of frequent formative assessment within a flipped-mastery model of instruction allows me to adequately monitor and assess student progress. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The students in my flipped-mastery classes move at the same pace. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students in my flipped-mastery classes easily pace themselves through the course content. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
While using a flipped-mastery model of instruction, I spend less class time delivering content to students than with a direct instruction/homework model of instruction. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<p>A flipped-mastery model of instruction gives my students more time to practice math than a direct instruction/homework model of instruction. (6)</p>	<input type="radio"/>						
<p>The students I have taught using a flipped-mastery model of instruction are more motivated to learn mathematics, than students I have taught using a direct instruction/homework model of instruction. (7)</p>	<input type="radio"/>						
<p>Students in my flipped-mastery classes enjoy watching video lessons. (8)</p>	<input type="radio"/>						
<p>My students have gained a better conceptual understanding of mathematics under a flipped-mastery model of instruction. (9)</p>	<input type="radio"/>						
<p>The mastery learning component of a flipped-mastery model of instruction has improved my students' procedural skills and fluency. (10)</p>	<input type="radio"/>						

<p>The students I have taught using a flipped-mastery model of instruction are better able to correctly apply the mathematical knowledge they have gained during the course, than students I have taught using a direct instruction/homework model of instruction. (11)</p>	<input type="radio"/>						
<p>Grades on summative assessments are higher for students I have taught using a flipped-mastery model of instruction than those of students I taught using a direct instruction/homework model of instruction. (12)</p>	<input type="radio"/>						
<p>Scores on standardized tests are higher for students I have taught using a flipped-mastery model of instruction than those of students taught using a direct instruction/homework model of instruction. (13)</p>	<input type="radio"/>						
<p>I would recommend a flipped-mastery model of instruction to a colleague. (14)</p>	<input type="radio"/>						

Q12 What are some of the advantages of a flipped-mastery system of learning?

Q13 What are some of the disadvantages of a flipped-mastery system of learning?

Q14 What improvements would you recommend to improve learning within a flipped-mastery high school math class?

Q15 If you are interested in participating in an additional interview [by phone or email], please provide your contact information. Your survey responses may no longer be anonymous to the researcher. However, no names or identifying information would be included in any publications or presentations based on these data, and your responses to this survey will remain confidential.

Name (1)

Email Address (2)

Postal code (6)

Country (7)

Appendix C: Authorized Usage Correspondence

Good afternoon,

My name is Adriane Howard, and I am a wife and mother to three beautiful children. I have been teaching high school mathematics in the U.S. for the past eleven years. Along with juggling the responsibilities that go along with being a wife, mother, and teacher, I am also a doctoral student at Concordia University – Portland. My dissertation will focus on high school mathematics teachers' perceptions of Flipped-Mastery learning in a high school math class. I would like permission to use your survey "Students Perceptions of the Flipped Classroom" in my research. Please let me know if I may utilize your survey in my research.

Sincerely,

Adriane Howard

Absolutely, best wishes!

Graham Johnson

Technology Consultant / Instructional Leadership Team

School District #23

[Phone number redacted]

Appendix D: Survey Recruitment Letter

Be part of an important flipped-mastery learning research study

- Are you a high school math teacher?
- Do you have experience teaching high school math courses (Algebra I, Geometry, Algebra II, Fourth Courses: Precalculus, Calculus or AP Calculus, Advanced Statistics, Discrete Mathematics) using both a flipped-mastery system of learning and the traditional direct instruction/homework model of instruction?

If you answered YES to these questions, you may be eligible to participate in a flipped-mastery learning study.

The purpose of this survey is to use high school mathematics teachers' perceptions to assess the efficiency of flipped-mastery learning as an instructional method to meet student learning outcomes, when compared to the traditional direct instruction/homework model of instruction.

There are no risks to participating in this study other than providing your information. To be in the study, you will be asked to complete a survey using Concordia University's Qualtrics system.

Completing this survey should take less than 15 minutes of your time.

Follow this link to the survey: [URL Redacted]

Appendix E: Statement of Original Work

The Concordia University Doctorate of Education Program is a collaborative community of scholar-practitioners, who seek to transform society by pursuing ethically-informed, rigorously-researched, inquiry-based projects that benefit professional, institutional, and local educational contexts. Each member of the community affirms throughout their program of study, adherence to the principles and standards outlined in the Concordia University Academic Integrity Policy. This policy states the following:

Statement of academic integrity.

As a member of the Concordia University community, I will neither engage in fraudulent or unauthorized behaviors in the presentation and completion of my work, nor will I provide unauthorized assistance to others.

Explanations:

What does “fraudulent” mean?

“Fraudulent” work is any material submitted for evaluation that is falsely or improperly presented as one’s own. This includes, but is not limited to texts, graphics and other multi-media files appropriated from any source, including another individual, that are intentionally presented as all or part of a candidate’s final work without full and complete documentation.

What is “unauthorized” assistance?

“Unauthorized assistance” refers to any support candidates solicit in the completion of their work, that has not been either explicitly specified as appropriate by the instructor, or any assistance that is understood in the class context as inappropriate. This can include, but is not limited to:

- Use of unauthorized notes or another’s work during an online test
- Use of unauthorized notes or personal assistance in an online exam setting
- Inappropriate collaboration in preparation and/or completion of a project
- Unauthorized solicitation of professional resources for the completion of the work.

Statement of Original Work

I attest that:

1. I have read, understood, and complied with all aspects of the Concordia University Portland Academic Integrity Policy during the development and writing of this dissertation.
2. Where information and/or materials from outside sources has been used in the production of this dissertation, all information and/or materials from outside sources has been properly referenced and all permissions required for use of the information and/or materials have been obtained, in accordance with research standards outlined in the *Publication Manual of The American Psychological Association*

Digital Signature

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Name (Typed)

Date