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Teachers' Support in Implementing the Standards for Mathematical Practice

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Walden University
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Abstract

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MS, Touro Graduate School of Education, 2017

BS, University of Guyana, 2007

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Teachers' support in implementing the standards for mathematical practice has been an area of study since the implementation of the Common Core state standards initiative. The research problem was a gap in the literature regarding what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. The Common Core initiative's standardized educational reform goal is to better prepare students for career and college readiness in the United States. Fidelity in implementation is essential to the success of the reform. The purpose of this qualitative research was to explore what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. The conceptual framework of this study was the interconnected model of professional growth. Twelve middle school mathematics teachers participated in semistructured interviews to provide data on their use of the standards and their perception of support needs. The data collected was analyzed using a thematic analysis approach. The results of the study indicated a reported gap in practice regarding the use of the standards from the teachers' account. They further identified the need for formal training to understand better and use the standards. The support teachers seek is to have training that can allow them to learn more about the purpose of the standards and training that can be adapted to their needs based on their current practices and experiences. The research findings can help with the fidelity of implementation, and possibly influence social change by assisting teachers in using best practices to prepare students for college and career readiness in mathematics.

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Dedication

I would like to dedicate this degree to my family. My mom, Chandrawatty Andiappen, always provided me with an abundance of love and support. My dad, Ramsammy Edward, never ceases to tell me how proud he is of my accomplishments. My siblings, Sharda Singh, Govinda Andiappen, and Diana Edward, whose personal sacrifices have paved the way for their little brother's success.

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Chapter 1: Introduction to the Study

Introduction

The Common Core initiative is a standardized educational reform in the United States of America set to ensure that all students who graduate high school are college and career ready (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010a). The initiative commenced developing academic standards for mathematics and English language arts proficiency in kindergarten to Grade 12 (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010a). Before implementing the standards, each state had its own set of standards, a measure of proficiency, and varying levels of rigor. With the new rigorous standards, mathematics proficiency at the local, national, and international level has decreased. After 10 years of implementation, teachers struggle with implementing the standards (Groth, 2019). The potential of the innovative standards for mathematical practice found within the Common Core state standards for mathematics has not been fully used. A gap in the literature exists regarding what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom.

Chapter 1 serves as an introduction to the study. It includes a summary of the literature on critical concepts related to the Common Core initiative, the Common Core standards for mathematical practice, and professional development based on the initiative. This chapter outlines the development of the problem statement, the purpose of the study, significance, and research questions. It also includes the conceptual framework

of the interconnected model of professional growth related to teachers' use of the mathematical practice standards. This chapter contains a description of the study's nature, key definitions, scope, delimitations, and limitations based on a qualitative paradigm.

Background

The Common Core state standards initiative is one of the most comprehensive and recent educational reforms to better-prepare students in the United States for college and career (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010a). The K-12 reform was initiated based on students' poor performance in national and international standardized exams (United States. National Commission on Excellence in Education, 1983). With 10 years of implementation, there are still inconsistencies among educational institutions and low performance on the state level, national level, and international level in mathematics and English language arts (National Center for Education Statistics, 2019a). The inconsistencies partially originate from the poor implementation based on findings from the Common Core Task Force (2015).

The Common Core state standards for mathematics contains a subset of standards called the Common Core state standards for mathematical practice (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010b). The standards are focused on developing students' core competencies in mathematics through best practices in the classroom (National Research Council, 2001). The mathematical practices competencies include eight standards. The standards are, make sense of problems and preserve in solving them, reason abstractly and quantitatively,

construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically, attend to precision, look for and make structure, and look for and express regularity in repeated reasoning (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010b). Based on the literature, both preservice and postservice teachers often struggle with naming the standards for mathematical practice, misinterpreting the standards, inconsistently using the practice standards in their classroom and lack proficiencies with using the standards as mathematics learners (Anhalt & Cortez, 2016; Keazer & Gerberry, 2017; Kofman & Hajra, 2016; Tunc et al., 2020).

Teachers play a crucial role in the implementation of the standards. Davis et al. (2018) claimed that teachers are not well prepared to teach the standards for mathematical practice and suggest that training needs to be done. A variety of literature supports professional development in supporting teachers in implementing the Common Core state standards (Barrett-Tatum & Smith, 2018; Stair et al., 2017). Not all professional development, however, is useful as educational institutions often have barriers. (Liang et al., 2020). Granted that professional development can be used as an effective strategy to aid in the implementation, Savage et al. (2018) claimed that other factors could prevent the successful implementation of the Common Core standards for mathematics.

Statement of Problem

There was a gap in the literature regarding what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the

classroom. Kruse et al. (2017) found a lack of observable evidence of mathematics teachers implementing the standards for mathematical practice in Grades 4 through 12. When investigating the implementation of the use of the standards for mathematical practice in middle school, Davis et al. (2018) found that one in three middle school mathematics teachers struggles in naming the eight standards for mathematical practice despite having training on the standards. The literature does not address how teachers perceive they use the standards and the supports they may need to make a shift in their practice (Kruse et al., 2017).

The Common Core standards for mathematical practice describe crucial expertise for students to develop their conceptual understandings of mathematical processes and increase their mathematical proficiency (Coomes & Lee, 2017). Since the implementation of the standards, more than 50% of New York State middle school students failed to meet the proficiency requirements (New York State Department of Education, 2019). There needs to be a change in teachers' practice to achieve the desired outcomes of the initiative (Stosich et al., 2018). The problem that was investigated in this study was a gap in the literature regarding what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom.

Purpose of Study

The purpose of this qualitative research was to explore what teachers perceive as the support needed to implement the Common Core standards for mathematical practice in the classroom. Exploring the support middle school mathematics teachers needed to use the standards of mathematical practice provides information that is useful to the

implementation of the standards. Teachers' perceptions of the issue may help develop an understanding of the support needed to overcome the barriers and challenges they are experiencing. This study had the potential to fill the gap in the literature regarding what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom.

Research Questions

The two research questions provided an overarching direction for the study. The research questions allowed for data to be collected regarding the current use of the standards and teachers' perceptions of support needs. The questions were aligned to the problem and purpose of the study. The following questions guided the study:

RQ1: How do middle school mathematics teachers perceive they implement the Common Core standards for mathematical practice?

RQ2: What supports do middle school mathematics teachers perceive they need to implement the standards for mathematical practice in the classroom?

Conceptual Framework

The framework for this study was based on the interconnected model of professional growth. The standards for mathematical practice outlined in the Common Core standard for mathematics describe the expertise that students should develop when engaging in mathematics (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010b). Each of the eight standards contains a description of what mathematically proficient students should do when engaging in problem-solving (National Governors Association Center for Best Practices, & Council

of Chief State School Officers, 2010b). The degree to which students apply these practices is based on their understanding of mathematical concepts and procedures. There must be the recursive construction of students' understandings based on their experiences to develop students' proficiencies. Mathematics teachers must adjust their instructional moves to create experiences and opportunities for students to be actively involved in the learning process.

According to Clarke and Hollingsworth (2002), the interconnected model of professional growth represents the factors that influence teachers' use of professional practice in a change environment. The factors are categorized into domains and are connected by constant reflection and enactment (Clarke & Hollingsworth, 2002). The new practice standards require a shift in teaching practice in various school environments. The model is useful to identify stimuli that are needed and barriers that can influence growth. Furthermore, the model is systematic and can identify teachers' areas of support (Bouchamma et al., 2017).

In a basic qualitative approach, the researcher seeks to understand how people interpret, construct, or make meaning of their current situation and past experiences (Merriam, 2009). With the implementation of the new standards, teachers must reflect on the process of change and growth. According to Merriam (2009), the basic qualitative research approach is used to examine processes, a series of actions, or change. The interconnected model of professional growth applies to the teacher as a change initiative to use the standards. The framework was aligned with the research questions in exploring the participants' experiences and the change process that comes with the initiative.

Nature of Study

A basic qualitative research design was used for this study. The basic qualitative research design helps people to make sense of their experiences (Merriam, 2009). According to Babbie (2014), basic qualitative research is a direct study of the interrelationship between the phenomenon from the participants' account. The inquiry process was based on exploring what middle school mathematics teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. The research design was used to explore the teachers' perceptions of supports needed to implement the Common Core standards for mathematical practice in the classroom. The research design further explored the support teachers were given and any unmet needs to enhance their practice. The research approach was appropriate as it focused on teachers' experiences, views, and reality of the phenomenon.

In this study, data was collected by interviewing participants. Audio interviews were recorded. The format of in-depth, one-on-one interviews played a key role in collecting rich and detailed data. The semistructured interview provided the opportunity to ask questions aligned to the research questions, therefore allowing some degree of freedom to ask follow-up questions based on participants' responses (see Rubin & Rubin, 2012). Interviews are appropriate for this basic qualitative research design with some constraints, based on the participants' availability and time (see Burkholder et al., 2016). A benefit of interviewing; was that during the interview, the participants could ask clarifying questions to help them better understand the questions (Babbie, 2014).

For this research study, 12 middle school mathematics teachers were interviewed. The criteria for choosing these participants included location, experience, grade level, and subject discipline. The goal was to interview teachers in the United States who adopted the Common Core standards, had exposure to the mathematical practice, and currently taught middle school mathematics at the time of the interview. Recruitment targeted participants from various stages in their careers, representing a wide range of perceptions. The sampling strategy that supported the goals with the desired criteria was purposeful sampling. This nonprobability sampling allowed for identifying participants who can provide the widest variety of answers to represent the population (Babbie, 2014). Throughout the data collection and analysis process, a reflexive journal was kept adding transparency in the research process (see Ortlipp, 2008).

Once the data was collected through audio recordings, the interviews were transcribed with the use of Microsoft Word voice dictation. For accuracy, the recordings were played to assess the accuracy of the transcripts by the researcher. NVivo qualitative data analysis software was used to code the participants' answers. The coding was done in cycles. The first cycle allowed for the coding of keywords and phrases. These words and phrases were used to determine the second level of coding. From the codes, I developed categories and themes to represent the answers from the participants. To ensure validity, I kept detailed notes of the data collection process. A summary of the results was sent to the participants to check for accuracy and to ensure credibility.

Definitions

This section contains definitions of key concepts used in the study. There are two important phrases that are recurring and crucial to the foundation of this research. These phrases were mathematical practice and support needs.

Mathematical practices: Mathematical practices are programs, activities, or strategies that have empirical evidence that, if replicated, will produce desirable results to increase student's proficiency in mathematics (Spencer et al., 2013).

Support Needs: Support needs are a requirement arising from some view of incompleteness (Jones et al., 1989, p. 38)

Assumptions

There were three assumptions for the study. The first assumption was that teachers received some form of training and had some understanding of the Common Core standards for mathematical practice. There was no guarantee that the teachers had been trained or supported on the use of the standards. The second assumption was that teachers were not consistently using the Common Core standards for mathematical practice. Although previous studies have indicated a lack of consistent use of the standards, it was not necessarily representative of the large population since generalizability was impossible given the criteria used in those studies. Another assumption was that novice teachers might have a different perception of the Common Core standards for mathematical practice since they were more likely to receive preservice training based on the timeline of implementation.

Scope and Delimitations

The study was confined to middle school teachers within states or schools that have adopted the Common Core state standards. The scope was aligned with a qualitative study to uncover stakeholders' perceptions within schools as a functioning system. The delimitations did not affect the transferability of the results. A purposive sampling strategy was used to target a wide variety of teachers and backgrounds within each system where the phenomenon of the Common Core state standards for mathematical practice was investigated. The study's feasibility was considered when the chosen method of interviews was selected as the primary mode of data collection. Time was another factor that was considered.

Limitations

The study results cannot be generalized; however, the study allowed for an insight into teachers' perceptions of the concept and promoted transferability. The school as a system played a crucial role in the study, and its uniqueness and influence on teachers' experiences and perceptions. Other factors in the school system, such as resources, leadership styles, and coach's ability, influenced teachers' experiences with the phenomenon. Although the goal of the study was to collect enough data to the point of saturation, the sample size did not guarantee that this goal was met.

Significance

This study was aimed at filling the literature gap by exploring the supports middle school teachers perceive they need to use the Common Core standards for mathematical practice. The study addressed the local problem of a decline in mathematics achievement

since the implementation of the Common Core state standards for mathematics. Since the launch of the Common Core state initiative, researchers have been extensively researching gaps to ensure effective implementation based on the stakeholders' needs (see Cookson, 2017; Davis et al., 2018; Filippi & Hackmann, 2019; Sobolewski-McMahon, 2017). This study contributes to the existing literature on the Common Core initiative to prepare students for college and career readiness. The results provide much-needed insights into the barriers and challenges preventing teachers from implementing the standards for mathematical practice, and as implementers of the standards, the support they may need. The teachers' perceived need and support provide crucial information to school administrators who are responsible for teachers' training on the use of the standards and can enact a change in professional practice. Teachers are major stakeholders in the implementation of the Common Core state initiative, and their role is influential in determining the success or failure of the initiative (Kruse et al., 2017).

This study has potential relevance to society and can add to a positive social change on college readiness and students' access to college. There is a negative effect of teachers not using the standards on the goal of the Common Core state initiative to preparing students for college readiness. According to Er (2018), a lack of mathematics college readiness has been highlighted as a social problem that affects students accessing college and or needing remediation mathematics classes while in college. The fact that mathematics students are not proficient in mathematics affects college attainment, college attrition, and to a broader context, job opportunity since mathematics proficiency is a common eligibility requirement for most colleges (Donnell, 2010).

Summary

In Chapter 1, I outlined the major elements of the study. The problem that was investigated by this study was a gap in the literature regarding what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. The purpose was to explore what teachers perceive as the support needed to implement the Common Core standards for mathematical practice in the classroom. Based on the research purpose, two research questions were developed. These questions were constructed to explore how middle school teachers perceive they implement the Common Core standards for mathematical practice and the supports they may need to fulfill the gap in their practice. The research was based on the interconnected model of professional growth framework, which considers the change factors that influence teachers' growth in using a practice or strategy.

The qualitative research approach best suited the research as it relates to the experience and process of implementation of the standards by teachers. The research design chosen for the research was a basic qualitative research design. Interviews from 12 middles school mathematics teachers were recorded and coded. These teachers were recruited through purposeful sampling to ensure that they met the criteria of experience and knowledge of the standards. The assumptions were that teachers had knowledge and or training on the use of the standards. The study scope included teachers from states or schools that have adopted the standards and who taught mathematics at the time of the study. The study was limited by the teachers' experiences and could not be generalized. This study adds to the literature and contribution to filling the gap in the literature by

exploring what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. This study has potential relevance to society and can add to a positive social change on college readiness and students' access to college.

In Chapter 2, I organized the key literature that I reviewed. I started with the study's conceptual foundation and a justification of the alignment with the interconnected model of professional growth. Although the Common Core state standards are relatively new, the foundations and framework are embedded in researched concepts. In the literature, I examined the implementation of the standards and shift of the nationwide adoption. There was a particular focus on the Common Core state standards for mathematics and the substandards, the mathematical practice standards. Each substandard was research in detail based on the most recent literature. In the chapter, I also researched teachers' role in the implementation and support that schools and districts provided to teachers.

Chapter 2: Literature Review

Introduction

There was a gap in the literature regarding what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. The purpose of the study was to explore what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. The Common Core state standards initiative is an educational reform aimed at standardizing the educational system in the United States to increase the kindergarten through Grade 12 education program's competency in preparing students for college and career readiness. Since the adoption, however, there has been a decline in students' achievement in mathematics in New York State (New York State Department of Education, 2019). According to the literature, one major contributing factor to the decline in students' achievement is the lack of proper implementation of the standards and fidelity in using the standards. Filippi and Hackmann (2019) claimed that in order to achieve the desired results of the Common Core state standards initiatives, schools and districts must identify the challenges in implementation and work to overcome those challenges.

Even though the standardization reform of the Common Core State initiative is relatively new, the concepts processes, practices, and frameworks embedded are drawn from a variety of literature that has been researched before the initiative (Aud et al., 2013; Cipriani, 2015; Hughes et al., 2013). One such concept is the Common Core standards for mathematical practice. The Common Core standards for mathematical practice align with the conventional practices of learning and the constructivist theory of learning.

Literature Search Strategy

I conducted a search strategy using phrases and key concepts in several databases. I used Walden University's Library portal as the main database. I also used the Journal for Research in Mathematics Education. My search strategy started out with unpacking keywords in the dissertation title. I searched for articles that highlighted the Common Core standards for mathematical practice. Since the standards for mathematical practice was a relatively new concept, the emerging articles were few. I searched for related terms such as *sense-making of problems, preserving through problems, modeling in mathematics, mathematical discourse, abstract reasoning in mathematics,* and *mathematical structure*. I was able to uncover the basis for the standards and used search terms from the original standards, practice, and process standards. Central to the practice, I noticed that the teachers' role in implementing the standards were aligned to the interconnected model of professional growth. I searched seminal articles for the interconnected model of professional growth to support the observation.

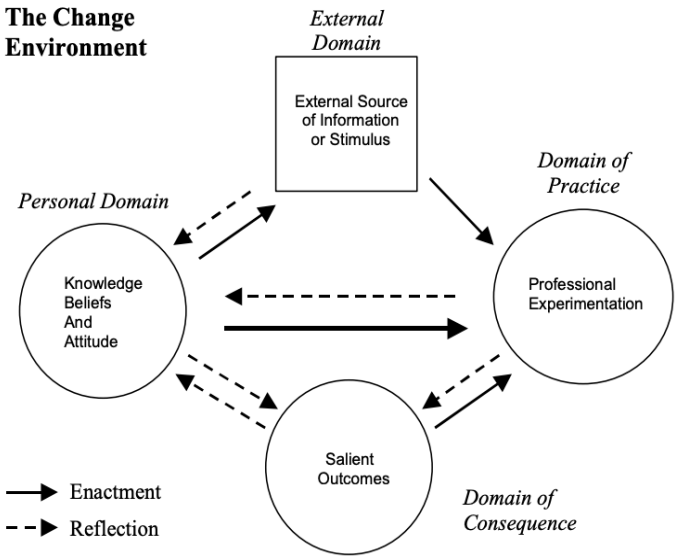
Conceptual Foundation

The conceptual framework for this study was based on Clarke and Hollingsworth's (2002) interconnected model of professional growth. The inclusion of the Common Core state standards for mathematical practice aims to foster students' mathematical skills by developing their conceptual understandings and approaches to solving mathematical problems (National Research Council, 2001). The standards require mathematics educators to take a pedagogical approach that will foster the integration of the standards for mathematical practice into the K-12 mathematics classrooms. A shift in

pedagogical practices will require teachers to grow professionally. The interconnected model of professional growth plays a central role in teachers' development and the use of the mathematical practice standards. Figure 1 shows the interconnected model of professional growth.

Figure 1

The Interconnected Model of Professional Growth



Teachers' use of the Common Core standards for mathematical practices and their support needs are dependent on a change in practice that is facilitated by teachers' growth. Clarke and Hollingsworth's interconnected model of professional growth considers the different factors that influence growth in the changing environment. Clarke and Hollingsworth claimed that a change in practice is dependent on constant reflection and enactment between four domains: the personal domain, the practice domain, the consequence domain, and the external domain. The cyclic model represented the complex

nature of change and originated from empirical work on key factors in the change environment.

The interconnected model of professional growth was derived from Guskey's (1986) model for teacher change framework (Clarke & Hollingsworth, 2002). Guskey claimed that professional development provided to teachers facilitates a change in teachers' classroom practices; a change in practice will influence a change in students learning outcomes, with the result affecting a change in teachers' attitudes and beliefs. Clarke and Hollingsworth's model considers the dynamic nature of change and represents the interconnectedness of the analytic domains rather than the linear sequence of Guskey's model. Another key factor in the interconnected model is change sequence as opposed to growth. According to Clarke and Hollingsworth, change sequence is not transformative, and for teachers to truly change their practice, they must experience growth. Growth is long term, cyclic, intrinsic, and adaptive (Clarke & Hollingsworth, 2002). Two mediating processes between the domains are enactment and reflection. Enactment refers to putting into action a new practice based on an interaction with a change in the environment, whereas reflection referrers to the careful considerations of a new idea, new belief, or new practice (Clarke & Hollingsworth, 2002). Guskey's model include four domains that are connected.

The personal domain, the external domain, the domain of practices, and the domain of consequences are key concepts within the model. The personal domain describes three subfactors that influences the growth and change of a teacher's practice. Teachers' knowledge, beliefs, and attitudes are personal to the teacher and consider the

individualistic nature of the domain. (Clarke & Hollingsworth, 2002). According to Shulman (1986), teachers' knowledge affects students' outcomes, and as such, teachers' must have knowledge of their content, pedagogical content knowledge, and knowledge of the curricular. The external domain is based on outside stimuli that are not a part of the teachers' world (Clarke & Hollingsworth, 2002). Although this domain is analogous to professional development in Guskey's model, it includes other stimuli such as new information, coaching, observations, workshops, or policies that can enact professional growth (Lomas & Mathematics Education research group of Australasia, 2018). Within the domain of professional practice is professional experimentation. Professional experimentation allows for teachers to put into practice the strategies or new ideas they learned through the external domain which may influence the personal domain (Milewski et al., 2018). The domain of consequences contains salient outcomes. The salient outcomes are important outcomes that can be either positive or negative based on the relationship of the personal domain and domain of practice (Hamza et al., 2018).

Over the years, there has been a suggestive modification to the domains. According to Lomas and Mathematics Education research group of Australasia (2018), reflection and enactment should not be restricted between the domains but can be found within the personal domain for change to occur. An increase in knowledge does not necessarily mean that teachers will change their beliefs and attitude (Lomas & Mathematics Education Research Group of Australasia, 2018). Beliefs are subjective with a higher degree of cognition, whereas attitudes are less cognitive (Lomas & Mathematics Education Research Group of Australasia, 2018). Akuma and Callaghan (2019) added

that teachers' choice of teaching practice is individualistic and should be placed in the personal domain. Milewski et al. (2018) claimed difficulties in working with the interconnected model of professional growth, particularly when it comes to categorizing certain simulated activities within a particular domain. The modifications were recent in relation to the time of this study and have limited literature supporting the change.

The interconnected model of professional growth has been applied in recent literature regarding teacher's growth with professional practice (Piqueras, & Achiam, 2019; Rillero, 2016; Widjaja et al., 2017). Akuma and Callaghan (2019) used the interconnected model of professional growth to study teachers' use of an inquiry-based teaching model. The findings of the study showed that teachers' implementation was inconsistent, and the inconsistent practices were as a result of low-level implementation (Akuma & Callaghan, 2019). I used the interconnected model of professional growth as a framework to identify the needs of middle school mathematics teachers in the implementation of the Common Core standards for mathematical practice. Similarly, to Akuma and Callaghan's study, there was inconsistent use of the Common Core standards for mathematical practice. Enactment is a crucial factor in the implementation of teaching practices and is a crucial factor in teachers' growth (Coenders & Verhoef, 2019). The enactment of the standards for mathematical practice will require teachers to use the practice in order to grow professionally. According to Bouchamma et al. (2017), teachers depend on the external stimuli of their supervisors or coach to continuously provide resources to and feedback to support the change process. Depending on the change environment, this level of support might not be possible to enact change.

The interconnected model of professional growth was beneficial to this study since it considers the dynamic nature of change over time and the key factors that influence growth. According to Akuma and Callaghan (2019), the interconnected model of professional growth allows for educators to assess the everyday use of instructional practices and use a systematic approach to determine the factors that influence the use of the practice. Based on the area of need, the appropriate supports can be provided (Bouchamma et al., 2017). Not only does the framework consider the relationship between teacher and the change initiative, it considers the uniqueness of the change environment and the influence it has on the desirable outcome. The interconnected model is foundational to this study in exploring teachers use and support needs of the standards for mathematical practice.

Common Core State Standards

The nationwide movement to adopt a common set of standards to assist students in preparing them for college and career readiness began in 2019 with the development of the Common Core state standards (Common Core State Standards Initiative, 2010). Each state in the United States has had its own set of standards prior to the implementation of the Common Core state standards for math and English language arts. In 2013, 45 states, the Department of Defense Education Activity, Washington DC., Guam, the Northern Mariana Islands, and U.S. Virgin Island adopted the Common Core State Standards (Common Core State Standards Initiative, 2010). Even though most states had adopted the standards, only 41 states, the District of Colombia, four territories, and the

Department of Defense Education Activity are currently using the standards (Common Core State Standards Initiative, 2010).

The first nationwide call for standardized education in the United States was highlighted in *A Nation at Risk* (1983) report as a critical next step to improve the educational quality in American K-12 schools. The report cited several indicators of the quality of the educational system. Among the indicators identified, two alarming indicators related to math were (United States. National Commission on Excellence in Education, 1983):

- Scores consistently declined in the verbal, mathematics, physics, and English areas measured by the Scholastic Aptitude Test (SAT). (p. 9)
- Between 1975 and 1980, remedial mathematics courses in public 4-year colleges increased by 72 percent and now constitute one-quarter of all mathematics courses taught in those institutions. (p. 9)

The decline in math scores and increase in remedial college course became a concern in the U.S. education system.

In early 2000, each state had adopted some level of standardization to address the concerns of the decline in educational quality; however, the level of proficiency at each state differs (Common Core State Standards Initiative, 2010). The Common Core curriculum reform was then launched to address the lack of standardization among the states. National and international assessments are used as a measurement the educational achievements and status in the United States. The National Assessment of Educational Progress (NAEP), the Program for International Students Assessment (PISA), and the

Trends in International Mathematics and Science Study (TIMSS) are the three major assessments that are used to measure students' achievement in various subjects. The NEAP assesses students' achievement across schools in the states on multiple subjects, including mathematics. Over a 10 year period from 2009 and 2019 as comparative measures of pre- and post-Common Core, only 13 states/jurisdictions had an increase in Grade 4 mathematics. (National Center for Education Statistics, 2019a). On the Grade 8 mathematics assessments, five states/jurisdictions out of the 52 states/jurisdictions who took the assessment had an increase (National Center for Education Statistics, 2019a). PISA is an international assessment administered every 3 years. On the most recent assessment in mathematics in 2018, the United States scored lower than 30 education system and higher than 39 education systems (National Center for Education Statistics, 2019b). Compared to the scores in 2003 during the early release of the Common Core, the average score between 2018 and 2003 was lower (National Center for Education Statistics, 2019b). The results of the TIMSS assessment after the implementation of the Common Core state standards indicated eighth graders in the United States experienced smaller growth than other countries who took the assessment (Hwanggyu & Sireci, 2017). The Common Core state standards are closely aligned to the TIMSS international standards, with a certain area needing development (Khaliqi, 2016). According to Khaliqi (2016), most areas are aligned, however there needs to be improvements in algebraic problems and a more rigorous problem in the Common Core state standards for mathematics. The shift to the Common Core state standards were made due to the lack of

consistency in proficiency across the state but created some unintended consequences during the implementation stage.

The reactions to the implementation of Common Core state standards have been mixed; however, there have been more negative comments about the Common Core state standards than positive comments (Wang & Fikis, 2019). One factor contributing to the negativity is the significant decline in students' achievement once the standards have been adopted (Davis, 2019). Based on findings from the Common Core Task Force in New York, the implementation of the standards was rushed with little time for stakeholder input; teachers had little time to develop curriculum aligned to the Common Core, and teachers had inadequate training prior to the implementing the standards (Common Core Task Force, 2015). According to Abadie and Bista (2018), public school teachers' experiences with the implementation of the Common Core state standards were overall negative due to unsupportive professional development. Most states currently use the standards despite the challenges and is continuing to support its implementation.

Common Core State Standards for Mathematics

The Common Core state standards for mathematics contains two sets of standards: the standards for mathematical content and standards for mathematical practice (Common Core State Standards Initiative, 2010). The standards for mathematical content outline the core concepts and procedures that students should learn at each grade level. The standards of mathematical practice outline the processes and proficiencies that mathematic students should engage in regardless of the grade level and are meant to be used with the content standards. According to Kamin (2016), despite the varying opinions

of what it means to be college-ready, the Common Core state standards for mathematics are aligned to the rigor and fundamental understanding that high school students need to be successful in the college of the program of study. Akkus (2016) claimed that the challenges of the Common Core state standards for mathematics lie with the implementation and not with the standards themselves. The implementation of standards for mathematical practice and the standards for mathematical content are both crucial to developing students' mathematical proficiencies.

One of the goals of the Common Core state standards for mathematics is to better prepare students for college and career. Kamin (2016) investigated the alignment of the Common Core state standards and what university mathematics expects students to know upon entry into college. Kamin found that there was a strong alignment between the two and affirmed that faithful Common Core instruction can promote college readiness. With an increased rigor, there has been criticism questioning whether the standards are developmentally appropriate for young children. Based on child development theories, Otalora (2016) argued that the standards are developmentally appropriate for young children. Furthermore, the Common Core state standards for mathematics do not dictate how the standards are covered, so teachers do have the flexibility to use several engaging instructional practices to foster active learning and social interaction (Otalora, 2016).

Common Core State Standards for Mathematical Practice

The literature indicated that the standards for mathematical practice have the potential to increase students' conceptual understanding. Conceptual understandings can lead to an increase in student achievement and is an important goal in the implementation

of the Common Core state standards for mathematics (Coomes & Lee, 2017). In the implementation of the standards, schools and districts are obligated to provide supports to develop teachers' capacity to use the standards. According to Toropova et al. (2019), a teacher's capacity has a linear relationship with student performance in mathematics, where low-capacity results in low performance.

The Common Core state standards for mathematical practice promote a constructivist learning approach. According to Bada and Olusegun (2015), constructivism is both an approach to teaching and learning and is based on the refinement of knowledge over time. The constructivist learning theory is based on three principles; learning is an active experience, students form new knowledge based on their experience of the subject or topic, and learning is socially and culturally rooted (Fernando & Marikar, 2017). Constructivism has no single founder, but the work of theorist Piaget, Dewey, and Vygotsky played an instrumental role in the development of the theory and shaped the constructivist learning theory (McLeod, 2019). Based on the nature of constructivist learning, traditional teaching is often compared. Piaget, Dewey, and Vygotsky all opposed the traditional teaching method, where the teacher disseminates information to students, and students are passive learners (Pardjono, 2016). Piaget (1936) contribution focused on the cognitive development of children whose knowledge is constructed based on their experience, whereas Dewey (1938) believed that learners learn best when they are actively participating in the learning process. Vygotsky (1978) later emphasizes the importance of social interaction as a way of gaining new knowledge. The term student-

centered is often associated with the constructivist learning theory based on the active role of the learner.

In a constructivist classroom, students can brainstorm ideas, participate in group discussions, role-play, conduct case studies, conduct educational visits, and debate their views on a topic or subject (Fernando & Marikar, 2017). The transition from teaching traditional mathematics to a student-centered approach will require enormous efforts by teachers (Jacobs et al., 2006). According to Selling (2016), many mathematics teachers have not experienced learning with mathematical practice and, as such, will require training to develop their knowledge and pedagogy to teach the mathematical practice. Polly et al. (2015) claimed schools should support teachers with the integration of the Common Core state standards by providing standards-based pedagogies aligned with the curriculum. The learner-centered approach of support to teachers supplements the findings that this approach may increase teachers' knowledge of the curriculum, content, and students' achievement (Polly et al., 2015). There is an alignment between the practices used to promote a constructivist classroom and the standards for mathematical practice.

The Common Core state standards for mathematics contains eight standards for mathematical practice. Although the term standards for mathematical practice is new, the concepts behind the mathematical practice have been long-standing. The origin of the standards for mathematical practice can be traced back to the strands of mathematical proficiency developed by the National Research Council to describe proficiency and the process standards developed by the National Council of Teachers of Mathematics.

According to the National Research Council (2001), mathematical proficiency includes conceptual understandings, procedural fluency, strategic competence, adaptative reasoning, and productive disposition. Groth (2017) claimed that even though assessment measures students' knowledge, the measurement of proficiency is a far more challenging task but is crucial in developing students' achievement. The process standards developed by the National Council of Teachers of Mathematics (1989 & 2000) include problem-solving, reasoning and proof, communication, connection, and representation as processes that students should be able to do. The eight Common Core state standards for mathematical practice are (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010a):

- MP1: Make sense of problems and persevere in solving them
- MP2: Reason abstractly and quantitatively
- MP3: Construct viable arguments and critique the reasoning of others
- MP4: Model with mathematics
- MP5: Use appropriate tools strategically
- MP6: Attend to precision
- MP7: Look for and make structure
- MP8: Look for and express regularity in repeated reasoning

MP1: Making Sense of Problems and Persevering in Solving them. The first mathematical practice of making sense of the problems and preserving through them is directly related to students' problem-solving abilities. According to Keazer and Gerberry (2017), teachers play a role in helping students to develop their ability to make sense of

mathematical problems. The standard is to help develop students' thought processes when faced with non-routine and challenging problems (Keazer & Gerberry, 2017). One-third of prospective teachers correctly identify the standards of developing students' thought processes, whereas the remaining two-thirds identify the standards as using procedures or scaffold to solve the problem. Although scaffolds can be provided, it is intended to help students preserve through the problem by teachers providing opportunities for students to productively struggle through the problem and noticing when to appropriate scaffolds along the way to prevent students from giving up (Betts & Rosenberg, 2016).

MP2: Reason Abstractly and Quantitatively

Fosters students' ability to decontextualize situations by representing them with numbers, symbols, and/or equations and the inverse with developing students' ability to contextualize numbers, symbols, and/or equations by representing them with mathematical situations (Kamin, 2016). This skill is essential for mathematics learners at all levels. According to Kofman and Hajra (2016), pre-service mathematics teachers struggle to decontextualize word problems. Traditionally mathematical learners who work with word problems through routines develop imitation reasoning thinking and, when faced with a non-routine task, struggle to reason abstractly and quantitatively (Mumu & Tanujaya, 2019). Students must be able to work through non-routine mathematical tasks to develop their creative reasoning skills (Mumu & Tanujaya, 2019). In addition, Ersoy and Bal-Incebacak (2017) also found a lack of reasoning abilities in mathematics students and similarly express the need for teaching to shift away from procedural understandings to overcome this barrier.

MP3: Construct Viable Arguments and Critique the Reasoning of Others. To construct viable arguments and to critique the reasoning of others, students need to be given the opportunity to interact with their work and the work of other students beyond problem-solving. Student discourse in the mathematics classroom is aligned to the constructivist-based learning theory and aimed to improve students' mathematical reasoning and problem-solving performance (Xin, et al., 2020). According to Max and Welder (2020), this standard was selected by pre-service teachers as the most addressed in their classes compared to the other mathematical practice standards.

MP4: Model with Mathematics. According to Anhalt and Cortez (2016), well-designed modeling activities allow students to solve problems that can be applied to the real world. Students should be able to justify their assumptions, make predictions, and iterate their solutions for reasonableness (Anhalt & Cortez, 2016). Pre-service teachers perceive using concrete models as a positive instructional move for teaching students about mathematics (Tunç et al., 2020). As much as modeling has its benefits of having students applying critical thinking and connecting their learning of mathematics to the real world, it can be time-consuming and requires teachers to create materials due to insufficient materials available (Bora & Ahmed, 2019). Opfer et al. (2016) claimed that teachers often misinterpret the model with mathematics within the mathematical practice standards. Anhalt and Cortez (2016) had similar findings with prospective teachers who misinterpret the standard and fail to make a connection to the application of this standard to the real world as a crucial part of the standard.

MP5: Use Appropriate Tools Strategically. In mathematics, tools can vary. In the younger grades, students can use a variety of manipulatives to develop their conceptual understandings of mathematics, whereas in the higher-grades, students can use more sophisticated tools such as graphing calculators and computer simulations (Boote, 2016; Kharuddin & Ismail, 2017). In the math classroom, students should be afforded the opportunity to use available technology to solve real-world problems (Kharuddin & Ismail, 2017). The student's choice of tools is dependent on what is available.

MP6: Attend to Precision. The standard for mathematical practice ''Attend to precision'' calls for students to ''calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context'' (Common Core State Standards Initiative (CCSSI) 2010, p. 7). Otten et al. (2019) found that mathematics teachers interpret the standards to go beyond calculations and symbols but extend the practice to the use of precise vocabulary. However, the use of vocabulary was not mentioned on the Common Core standards for mathematical practice definition (Otten et al., 2019).

MP7: Look For and Make Structure. According to Davis et al. (2018), this mathematical practice is the least mentioned by middle school mathematics teachers. The Common Core state standards lack the full scope of structure in mathematics in their explanation of the standard (Harel, 2017). According to Moguel et al. (2019), for teachers to develop this reasoning and regularity, they need to be proficient.

MP8: Look For and Express Regularity in Repeated Reasoning. According to the Common Core State Standards Initiative (2010), proficient mathematics students should recognize repetition and assess the reasonableness of their work. This skill can develop over time and requires a conceptual understanding of mathematical concepts. In an investigation carried out by Kruse et al. (2017), mathematics teachers acknowledge they need more support in differentiating between the mathematical practices; look for and make structure and look for and express regularity in repeated reasoning.

Teachers Role in Implementing the Standards

The Common Core state standards for mathematical practice demands a shift in teachers' practice to integrate the content standards with the practice standards. According to Johns (2016), teachers must have a conceptual understanding of the content and pedagogical knowledge to help students develop proficiency in mathematics. This concept is strongly aligned with Shulman's (1986) pedagogical content knowledge framework that a teacher's content knowledge should not be mutually exclusive from their pedagogical knowledge.

Students and teachers of mathematics need to engage with the mathematical practice daily actively. According to Davis et al. (2018), middle mathematics teachers' knowledge and understandings of the standards for mathematical practice are limited and will require more training regarding the use of the standards. The selection of appropriate curricular resources can enhance teachers' knowledge of the standard and affect its use (Davis et al., 2017). To use the standards for mathematical practice, mathematics teachers

must shift their instructional practice and not be so dependent on traditional curricular practices (Harel, 2017).

Teacher preparation programs are one of the major factors that can support teachers' knowledge and use of the standards for mathematical practice. Olson (2016) argued that there is a lack of purposely aligned materials presented in the coursework offered to pre-service teachers to engage and prepare them to teach the Common Core state standards for mathematics. Although the coursework may not have explicitly connected what pre-service teachers are learning with the Common Core state standards for mathematics, Wood et al. (2015) found that there is a wide variety of activities embedded in the coursework related to the standards. Teacher preparation programs must provide pre-service teachers the experience learning that they would create in their classroom related to the Common Core state standards for mathematics (Johns, 2016). Without appropriate training, schools and districts must take on the burden of providing additional support to teachers.

Teachers play a central role in the implementation of the Common Core state standards for mathematics. In a recent study by Barrett-Tatum and Smith (2018), the majority of teachers surveyed believed that they were underprepared to teach the Common Core state standards for mathematics even with support from their school-based mathematics support programs. Barrett-Tatum and Smith (2018) claimed that in an effort to ensure equality in educational opportunities for students in the United States through the standardized Common Core state standards, there needs to be fidelity in implementation with teachers receiving adequate support to meet their needs. The shift in

practices that are required for the implementation of the standards places emphasis on the teachers role.

Professional Development

Filippi and Hackmann (2019) identified professional development as a crucial factor in the successful implementation of the Common Core state standards. Literature supports the use of professional development in successfully implementing the Common Core state standards for mathematics (Barrett-Tatum & Smith, 2018; Stair et al., 2017). Professional development encompasses "all activities that help education professionals develop the skills and knowledge required to achieve their school's educational goals and meet the needs of students" (Chambers et al., 2008, p.4). Professional development allows pre-service teachers to continually develop their areas of expertise (Garcés & Granada, 2016).

Even though the literature supports the use of professional development in the implementation of new practices, Liang et al. (2020) argued that many organizations struggle to implement a comprehensive plan due to resources, competing priorities, and organizational structures. Savage et al. (2018) found that professional development alone cannot support the implementation of the Common Core standards for mathematics. Not all professional developments are successful. Jacob et al. (2017) found limited evidence of positive change in mathematics teachers' practice over a three-year period with professional development supports. According to Aldahmash et al. (2019), professional development for in-service teachers needs to be continuous and use the inquiry-based approach to what is happening at the school. Osamwonyi (2016) claimed that

professional development allows teachers to update their knowledge and skills, and the supports must be well developed, and the objective is driven to be successful.

Coaching is a form of professional development that is commonly used to support in-service teachers to develop and or enhance new skills. Coaching can be leveraged to build teachers' capacity to implement the Common Core state standards for mathematics by providing instructional moves to teachers and using the observation-feedback framework to support teachers' growth (Woulfin & Rigby, 2017). Administrators, teachers, and coaches need to share a common vision for mathematics coaching and to identify desired outcomes in order to maximize this type of support (Luebeck & Burroughs, 2017). Coaching has been highlighted as a key strategy in supporting teachers in schools that have successfully implemented the Common Core state standards (Filippi & Hackmann, 2019). Knowledgeable teachers can be leveraged to support struggling teachers by serving as coaches in schools where there are unequal knowledge and practice of the Common Core state standards (Supovitz et al., 2016). Although peers or experts in the field can provide coaching, Lowman (2016) claimed that expert coaching is more effective due to expert coaches' availability, flexibility, and access to resources.

Another form of support for in-service teachers' professional growth is workshops. The workshop-model of professional development is a popular method that schools, and districts use to support teachers in increasing their knowledge about a topic or practice (Ngaewkoodrua, & Yuenyong, 2018; Verdon, 2020). Workshops can be short-term, long-term and can be provided in school or at a separate location. Nichol et al. (2018) found that a year-long workshop-model professional development did not have significant

effects on student achievement compared to teachers who did not receive training. In the subsequent year, however, students' achievement did increase, prompting the researchers to suggest that it takes time for teachers to develop the skills provided by training (Nichol et al., 2018). Hennessy et al. (2018) claimed that, even though workshop-based professional development can be used to increase teachers' knowledge, continuous support is necessary. Strategic use of professional development can support the implementation of the standards.

Summary and Conclusions

The Common Core state standards are a set of standards that were developed with the aim of better preparing students in the United States of America for college and careers (Common Core State Standards Initiative, 2019). The standards were developed based on the poor performance of the nation's students when compared to international students (United States. National Commission on Excellence in Education, 1983). Even though there an increase in proficiency since the implementation, international students continue to outperform students in the states (Hwanggyu & Sireci, 2017). The standards and the implementation have been criticized, and some States have even opted out of their initial agreement to use the standards (Common Core State Standards Initiative, 2019; Davis, 2019; Wang & Fikis, 2019).

The Common Core state standards for mathematics consist of the content standards as well as a set of substandards called the Common Core standards for mathematical practice. The standards for mathematical practice outlined the processes and proficiencies that mathematics students should engage with when interacting with

mathematical concepts (National Council of Teachers of Mathematics, 1989 & 2000). Akkus (2016) claimed that the standards had not been implemented with fidelity. Toropova et al. (2019) argued that teachers play a central role in the implementation and have the biggest effects on students' performance.

From the literature, professional development was highlighted as a means of supporting teachers with the implementation of the Common Core state standards (Barrett-Tatum & Smith, 2018; Stair et al., 2017). Professional development, however, is a broad concept and varies in form, frequency, style, execution, and purpose. These factors are crucial to consider when developing a support plan for teachers. When these factors are not taken into consideration, along with teachers' perceptions, the initiative can have negative consequences and have little to no effects (Jacob et al., 2017). From the literature reviewed, there was gap in the literature regarding what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. Chapter 3 includes a detailed description of the research design on how I investigated the gap using a qualitative approach.

Chapter 3: Research Method

Introduction

In this chapter, I will discuss the research design and methodology. The purpose of this qualitative study was to explore what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. My research design was a qualitative research design. Qualitative studies provide an opportunity for researchers to understand the experiences and perspectives of the participants (Patton, 2015). My research approach within the qualitative research design was the basic qualitative research approach. The research method was semistructured interviews of middle school mathematics teachers. The interview questions were based on my two research questions. The participants for the research study were middle school mathematics teachers who shared what they perceived as the supports they need to implement the Common Core standards for mathematical practice. The data were collected through semistructured interviews and analyzed with the use of the thematic approach.

Research Design and Rationale

The purpose of this qualitative study was to explore what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. There were two research questions based on the purpose of the research. These questions were:

RQ1: How do middle school mathematics teachers perceive they implement the Common Core standards for mathematical practice?

RQ2: What supports do middle school mathematics teachers perceive they need to implement the standards for mathematical practice in the classroom?

The research design was basic qualitative research. According to Merriam (2009), basic qualitative research originated from constructionism, phenomenology, and symbolic interaction. Each of these concepts played a crucial role in the research design and rationale. From the teachers' accounts, I investigated their current views on the implementation of the standards. Constructionism is knowledge based on the perspective of the individual (Denzin & Lincoln, 2002), and as such, I inquired about teachers' perception regarding the use of the standards and the supports they may need to use those standards. The qualitative approach and design allowed the researcher to interpret and make meaning of the phenomenon on a personal level (Patton, 2015). Regarding the factor of symbolic interaction, the school environment is a social community with various interactions for teachers as learners. The environment can shape and influence their thinking as practitioners. Pascale (2010) claimed that symbolic interaction is how the participants see themselves in the social environment. Teachers perceptions as implementors of the standards with a specific social environment can affect the desired outcome

Through semistructured interviews, my goal was to uncover a variety of truths of the phenomena where my concerns as a researcher are *what* and *how* from the participants (Cassell et al., 2018; Holstein & Gubrium, 2008). As the primary implementers of the Common Core state standards for mathematical practice, teachers' perceptions and truths are based on their individuality. My goal was to interview multiple

mathematics teachers from various experiences, school settings, and background for the research. Another rationale for my research design was attributed to the element of phenomenology, where the basic qualitative research was originated (Merriam, 2009). According to Husserl and Gibson (1962), phenomenology investigates the participants' unprocessed experiences. As much as phenomenology was considered based on the element of teachers' experiences, the ultimate choice of the basic qualitative study was made based on the teachers' experiences in the process of implementing the standards. Alternative approaches, such as grounded theory and narrative approach, were not chosen simply because they were not aligned with the purpose of the study. The basic qualitative study allowed the participants to become deeply present in their thinking about their current practice on the standards, barriers, and supports needed if necessary.

Based on the individualistic and constructivist limitation of a quantitative study, the quantitative approach was not chosen. Quantitative research is carried out with the intention to measure and quantify the phenomena as a way of explaining the phenomena (Aliaga & Gunderson, 2002). In education, both approaches are important. When education systems require change, the implication for change can have both unintended and intended consequences, and at times these implications cannot be quantified (Freebody, 2003). Exploration of human experiences of the phenomenon through the change process is valuable and aligned with the research purpose.

Role of the Researcher

My role in the research was to attempt to access the how middle school mathematics teachers perceive they implement the Common Core state standards for mathematical practice in the classroom and their support needs. I did not have any personal or professional relationship with any of the participants, nor did I have any relationship involving power over the participants. During the recruitment process, no relationships were discovered. In the data collection stage, I conducted semistructured interviews to elicit what was middle school mathematics teachers' perceptions regarding the use of Common Core standards for mathematical practice and what supports they need to develop their professional growth in using the standards. As an interviewer, my role required skills, objectivity, and deep reflection of biases that were raised based on my philosophy of teaching and role as an educator. My skills as an interviewer are ever evolving. I have participated in numerous interviews and received formal training. I took basic and advanced graduate research courses in qualitative research, which taught interviewing as a data collection method. As an assistant principal in an independent charter middle school, I am invested in the social effects of this initiative. The advantage of this was that I am knowledgeable about the Common Core initiative and specifically the standards for mathematical practice. My knowledge provided an advantage in the semistructured interview process since I was able to recognize keywords and phrases that stood out and required additional probing.

Methodology

Participant Selection Logic

For this qualitative study, I collected data from interviewing middle school mathematics teachers. There were certain criteria for the selection. The participants needed to be active middle school mathematics teachers who was teaching in a school or state that had adopted the Common Core state standards for mathematics. Additionally, the teachers must have had awareness of the Common Core standards for mathematical practice. The participants involved in the study did not have any affiliation with my place of employment.

The sampling strategy for this study was purposeful sampling. According to Patton (2002), the goal of purposeful sampling is to obtain rich information. The research questions were based on teachers' perceptions and experiences; hence it was important to seek out individuals who have had some exposure to the Common Core standards for mathematical practice. In qualitative studies, saturation occurs when there was no new information, and the data becomes repetitive (Guest et al., 2006). The plan was to recruit 10 to 15 teachers to participate in this study. This goal was met with 12 teachers who volunteered to participate in the study and met the criteria. Francis et al. (2010) recommended a sample size of 10 to 15 participants in qualitative studies.

Participants were screened with the use of a questionnaire that was attached to the invitation to participate flyer (see Appendix B). For the selection process, all participants who met the primary criteria were shortlisted. From the smaller list, the secondary criterion was added. To ensure that there were a variety of perspectives, the criterion of

experience was used to categorized teachers. Participants were categorized as novice teachers (0-5 years of teaching experience) or experienced teachers (6 or more years of teaching experience). An equal number of participants were selected in each category. Participants who did not meet the criteria were excluded from the study.

Instrumentation

The instrumentation was aligned with Merriam's (2009) basic qualitative research design. The primary data collection instrument was the researcher using an interview protocol (see Appendix C). Preliminary data was collected using a questionnaire in sampling participants; however, the interview guide was the main data collection tool. As the data collector, I used the guide to conduct the semistructured interviews through a Zoom digital platform. The sample size was 12 participants. Interviews of small sample size are characteristics of basic qualitative research (Merriam, 2009). The questions in the interview guide were aligned with the research questions. As shown in Table 1, RQ1 is aligned to all the interview questions whereas RQ2 is aligned to Interview Questions 4, 5, 6, and 7.

Table 1

Alignment of Interview Questions to Research Questions and Standards for Mathematical Practice

Interview Questions	Research Questions
1. Think back to the past 3-4 weeks, in what ways have you specifically plan for and use the standards for mathematical practice in your classroom?	RQ1
2. If I am observing your classroom within the past week, what should I look for if I want to see students engaging with the standards?	RQ1
3. Why do you think the CCSM include the standards for mathematical practice in addition to the content standards?	RQ1
4. Describe type of formal trainings (in college or institutional professional you have had development) on using the standards.	RQ1 and RQ2
5. Would you rate yourself as proficient in understanding and using the standards? Why or why not?	RQ1 and RQ2
6. How have you been trained in using the standards?	RQ1 and RQ2
7. Based on teacher knowledge of standards: What standard are you most and least comfortable with using?	RQ1 and RQ2

An interview is a data collection method that is part of a social process where there is an interaction between the interviewer and the respondent or respondents (Cowles & Nelson, 2015). Interviews are more commonly used in qualitative research as it is more aligned to the naturalistic paradigm (Rubin & Rubin, 2012). According to Rubin and Rubin, interviews allow the responders to elaborate on answers and even raise new ideas that the researcher might not have considered. Interviews can provide the researcher with additional information with observations on the respondents' body language and tone (Opdenakker, 2006). Observations made during the interview can add to data collected in

qualitative research. According to Rubin and Rubin, interviews can be structured or unstructured, can be done in person or digitally, or can involve a single person or a group of people. Each mode carries its own advantages and disadvantages. A disadvantage of interviews is that they can be more subjective and can be affected by the interviewer's personality (Rubin & Rubin, 2012). An interview was chosen based on the many benefits and alignment to the research purpose.

Procedures for Recruitment, Participation, and Data Collection

Data was collected by semistructured interviews of middle school mathematics teachers who had some knowledge of the Common Core standards for mathematical practice. I conducted the interviews as the primary researcher. The interviews lasted for no more than one hour, with an average time of 20-30 minutes. The date and time of the interviews were dependent on the participants' availability. The interviews were conducted digitally through the Zoom web conferencing platform.

Once Walden University's Institutional Review Board (IRB) approved my study (IRB #10-16-20-0757733), I invited participants from online social media groups and the Walden participant pool. The social media platforms included Facebook, LinkedIn, and Twitter. In addition to the invitation, teachers completed a short questionnaire (see Appendix B). The purpose of the questionnaire was to determine eligibility.

An informed consent form, including the criteria, was attached to the questionnaire on the recruitment post. Participants were required to sign the informed consent by completing a google questionnaire with the option to type in words "I consent." The purpose of the informed consent was for the participants to acknowledge

their willingness to participate in the study. Participants who consented were emailed with a request to provide a date and time preference that was convenient to them. There was a back-up plan if there were too few participants. The plan was to extend my search by searching and adding more social media education groups and extending the invitation. This plan was not used.

For each interview, I conducted the interview and recorded the data. I used the Zoom platform to conduct the interviews digitally. I interviewed one participant at a time in a semistructured interview format. The interviews lasted for approximately 20-35 minutes. Zoom records both audio and video; however, I only recorded the audio of the interviewees. The Zoom recordings were done using my personal computer, and all recordings were stored on my personal iCloud for safety and security. Each interview was saved under a participant ID in chronological order of the interview. Handwritten notes were taken during the time of the interview; however, an analytic memo and field notes were written after each interview. The memo included information about the process, participants, and phenomena, whereas the filed notes included observations and reflections of the social interaction between the interviewees and I (Saldana, 2013).

Once the interviews were concluded, I thanked the participants and debrief the participants to follow up procedures (Appendix C). After the data were transcribed and analyzed, I emailed a copy results to the participants and my committee. The data analysis was sent to the participants to verify accuracy and for credibility. There were no further action steps or commitments on behalf of the participants once member checking was completed.

Data Analysis Plan

In this qualitative study, the data analysis plan was to analyze data from middle school mathematics teachers regarding their perceived use of the Common Core standards for mathematical practice and the supports they need to develop their professional growth. The first step in the data analysis process was to compile, organize, and prepare the data for analysis. The audio files from the interviews were transcribed into transcripts. Microsoft Word dictate tool was used to complete the transcription. Once the audio files were transcribed, I played the recordings and followed the transcripts to ensure the accuracy for each interview. Following the transcription process, the data were formatted to separate questions and responses. I then uploaded the transcripts to a qualitative software called NVivo. In NVivo, I coded the data using the thematic analysis approach that was cited in the literature as a strategy to extract relevant data in qualitative studies (Saldana, 2013). The conceptual framework was used to guide the development of the themes. The framework was not used to construct priori codes but were considered as I was coding. In the coding process, I made mental connections to the four domains within the framework and thought about the relationship to the participants' responses.

The first step in the thematic data analysis approach was to identify codes. The coding process included reading through each data set and underlining keywords, phrases, and sentences. The first phase of coding was reading the participants' answers and identifying low inference codes and descriptions of ideas. According to Davis (2019), the codes should be appropriate and easy to read. Iterations of this open coding process allowed me to identify patterns in the data. I then used the broad generalized ideas to

label and index the data (Saldana, 2013). At the end of the coding process, I compiled a list of open codes from the open-coding process.

In the second phase of coding, called axial coding, I attempted to link or connect the data based on their relationships. I developed categories and subcategories that brought together several codes that were related to a broader term (Saldana, 2013). From the generated categories, I developed themes by looking at the patterns. Finally, I synthesized the information gathered to answer the research questions.

I reviewed the data, categories, subcategories, and themes several times to ensure that I reached saturation. Finally, I used my memo data to corroborate my findings and to triangulate my data. I also looked for and identified outliers from the data that might be contradictory to the emergent themes. The results of my findings were sent to the participants for member checking.

Issues of Trustworthiness

The trustworthiness of qualitative research was based on the validity and reliability of the research (Shenton, 2004). In developing the research design, I used peer-reviewed research guides on qualitative research and feedback from experts in the field to develop the research plan. My role in the research, instrumentation, and data collection were all linked to ensuring the reliability of the research (Burkholder et al., 2016). According to Ravitch and Carl (2016), validity is another crucial factor as it relates to the way the researcher can affirm that the data are faithful to the participants' experiences.

Credibility was an important part of the research design, and even though there is no checklist for ensuring credible research, there are strategies a researcher can use to

ensure that the research is credible (Ravitch & Carl, 2016). In my research, I used member checking to explore credible results. A summary of the results was sent to the participants to check for accuracy and to ensure that there was a resonance with their experience shared during the interview. For transferability, thick description was used by which there were specific descriptions of the subjects' years of experiences, prior and current training, and knowledge in exploring the use of the standards for mathematical practice. The context of the experiences provided information to outsiders to evaluate transferability (Korstjens, & Moser, 2018). To ensure dependability and conformability, I used the strategy of an audit trail. An audit trail keeps records of the research and describes the process from the start to the end (Korstjens, & Moser, 2018). The analysis section of this paper included details of the process of collecting and coding data.

Ethical Procedures

An application was filed with Walden's IRB to ensure that the methodology and procedure outlined did not infringe on the rights and welfare of the participants or organizations. Once the application was filed and approved, only then did my data collection commenced. The IRB number for the study is 10-16-20-0757733. All participants who agreed to participate did so on a voluntary basis and could have withdrawn from the study at any time. Participants' consent emails were stored. All information collected were kept confidential, and participants' identities were masked by a numbering system. Data collected were stored on my personal cloud space and is password protected. This information will be deleted after five years from the research publication.

Conclusions and Summary

The purpose of this qualitative study was to explore what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. The proposed research design was basic qualitative research. As the primary researcher, my role in the research included designing and conducting the research. Middle school mathematics teachers participated in an interview to share their perception of the use of the standards for mathematical practice and what supports they need, if any. The 12 participants were recruited through purposeful sampling. The data were captured by recordings of the interview and later transcribed. Coding was done by the use of a qualitative software called NVivo. Based on my role in the research, there were considerations on credibility, dependability, and ethical procedures. Member checking, audit trails, and an IRB review addressed the issues in trustworthiness. In Chapter 4, the results are presented along with an analysis and findings.

Chapter 4: Results

The purpose of this qualitative research was to explore what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. Data were collected from 12 middle school mathematics teachers through semistructured interviews. In this chapter, information on the settings, demographics, and data analysis will be presented. Also, I will present evidence of trustworthiness and the research results to answer the research questions. The research questions were as follows:

RQ1: How do middle school mathematics teachers perceive they implement the Common Core standards for mathematical practice?

RQ2: What supports do middle school mathematics teachers perceive they need to implement the standards for mathematical practice in the classroom?

Setting

I conducted the semistructured interviews through Zoom, a web-based conferencing platform. The platform allows for both video and audio recordings. Some participants chose to have their videos on, and others decided to have their videos off. Only the audio feature was used to record the interviews for each of the participants. Participants were recruited on social media platforms and Walden's participant pool. Sixteen participants responded to the questionnaire; however, only 12 met the criteria and were selected for the study. Participants were given the option to choose a time and date that was the most convenient to them. All of the participants decided to have Zoom interviews outside of their work environment. Eleven of the participants had their

interviews at home, whereas one had the interview conducted elsewhere. The interviews were conducted from my home office, where there were no distractions. Due to the Covid19 global pandemic, traveling restrictions may have affected where the participants chose to conduct the interview as it influenced my decision. Two of the participants' locations had minor distractions; however, it did not affect the quality of the interview. One participant chose to wear headphones to avoid the distraction. The recruitment and interview process were conducted over four weeks.

Demographics

Twelve participants were interviewed for this study. As shown in Table 2, the participants' years of experience ranged from 2 to 14 years. Based on my research criterion, participants were categorized as a novice (1-5 years of teaching experience) or experienced (6 or more years of teaching experience) to ensure a variety of perspectives. Five teachers were categorized as a novice whereas seven were categorized as an experienced based on their years of experience. The majority of participants taught in the northeastern region of the United States. The participants were teachers from both public district and public charter schools. The grades that the teachers taught ranged from Grades 59. The majority of teachers taught one grade level.

Table 2

Research Participants' Demographics

Pseudonym	Years of Experience	Category	Current Grade Level Teaching
P1	2	Novice	7
P2	5	Novice	7
P3	7	Experienced	8
P4	11	Experienced	7,8,9
P5	6	Experienced	7,8
P6	11	Experienced	7
P7	3	Novice	7
P8	6	Experienced	6
P9	14	Experienced	8
P10	3	Novice	7,8
P11	5	Novice	5,6
P12	6	Experienced	5

Data Collection

The research study included 12 middle school mathematics teachers who were interviewed using the semistructured interview format. The teachers volunteered to participate in the research study by completing an online questionnaire that was posted on social media platforms and Walden's participant pool. The questionnaire included a consent form and fields for the participant to share their years of experience, grade level, state, and preferred email address for contact. Participants were contacted within 24 hours of completing the form to determine a date and time that was the most convenient to them.

The interviews were conducted through a web-based conference software called Zoom. As a result, participants had flexibility with their location and time. Zoom has a built-in audio recording featured that allowed me to record the audio for each interview.

After the interview, the recordings were downloaded and stored on a password-protected cloud space for security. Each semistructured interview lasted between twenty to thirty minutes and was done once. An interview guide was used during the interview to reference the questions and to take minimal notes for my memo and field notes.

There were two minor variations in the data collection process from the plan presented in Chapter 3. One variation was the actual interviews were shorter than planned. The average interview lasted 20-30 minutes, whereas my original approximation was planned for 45-60 minutes. There could have been a number of factors that may have affected the expected time versus the actual time. After reflecting with the help of my field notes, I was able to identify two potential factors. With the majority of teachers working from home during the pandemic the amount of screen time had increased. Participants answers were very precise and shorter than expected, and it is my assumption that after long hours of teaching online, the participants did not want to prolong the time spent online during the interviews. Location may have affected the length of the interview as well. A majority of teachers chose to participate from their home in a private location. The locations were not affected by other employees or students; this promoted a safer space for the participants to share and reduced the amount of probing questions asked.

Another minor variation was in the planned transcription process. Instead of using an online service called REV to transcribe the recording, I used the Microsoft Word dictation feature. The feature provided the transcripts with about 95% accuracy. Short

words and phrases were corrected following the process by replaying the audio and fixing the errors manually.

There were two unusual circumstances that were encountered during the interview. Some of the participants disclosed that they had referenced the standards from a website since they could not remember the standards during the interview. Another participant asked me to name the standards as a reference for them because they also could not remember all of them at that moment.

Data Analysis

Data that were transcribed were formatted in Microsoft Word. Each formatted interview transcripts were uploaded into the NVivo12 computer software. I read each interview several times and identified keywords and phrases. These words and phrases were used to create codes. In the NVivo software, they are called nodes. I used the word frequency query in NVivo as a cross-reference to the words used most frequently and compared them to my codes. The automatic query did not generate any other meaningful codes that were manually selected.

After the initial set of codes were identified, I reread the interview questions and research questions to determine if there were any direct relationship between the questions and the codes generated. I assigned a number to the end of each code where there was a direct relationship of a code to an interview question. This process helped me to organize the data and prepare for the next step of axial coding.

The next step was axial coding. This process was used to connect or bring concepts related to the initial codes created. I read each transcript and highlighted the

concepts that were linked to the codes. I repeated this process over several days to reduce any bias in coding and to ensure that each response was carefully categorized to the respective nodes. NVivo drag feature allowed me to select the concepts and drop them under the respective nodes. Some of the categories had longer vignettes than others. The vignettes' length was based on the participants' responses, probing questions, and questions answered with short words or phrases. There were 56 codes.

From the axial codes, I grouped relating concepts into categories. Eleven categories were formed. The categories were used to create themes. There was a total of six themes, with some of the themes having subthemes. Each theme represented concepts that were aligned to the two research questions. Generally, there was a focus on the teachers' current practice, their understanding of the standards, their beliefs, training, supports received, and unmet needs regarding implementing the standards.

Three themes aligned to the first research question (as shown in Table 3). The themes were related to how middle school mathematics teachers perceive they implement the Common Core standards for mathematical practice. According to the interconnected model of professional growth, there are various factors that promote or inhibit the use of the practice (Clarke & Hollingsworth, 2002). The factors that attributed to the teachers' use of the standards surfaced through the themes as well as barriers and challenges. These three themes included teachers' beliefs and attitudes regarding the use of the standards for mathematical practice, teachers' stated proficiency in understanding and using the standards, and factors promoting or inhibiting middle school mathematics teachers' implementation of the standards.

Table 3

Themes, Categories, and Concepts Connected to RQ1

RQ1: How do middle school mathematics teachers perceive they implement the Common Core standards for mathematical practice?		
Themes	Categories	Codes
Theme 1. Teachers' beliefs and attitudes regarding the use of the standards for mathematical practice	-Perceived alignment of the standards to teachers' style of teaching • Perceived benefits of using the standards to students • Perceived benefits of the standards to teachers	Value, uncertainty, problem-solving/critical thinking, mathematical proficiency, developing communication skills, engagement, confidence, ability to teach math, drive the curriculum, shift from procedural teaching to conceptual teaching, write IEP goals.
Theme 2: Teachers' perceived proficiency in implementing the standards for mathematical practice	-Self-reported comfort level of knowledge on the standards -Self-reported comfort level in implementing the standards • Identification of standards that teachers were most comfortable teaching • Identification of standards that teachers were least comfortable teaching	Teachers' stated proficiency level, references made to mathematical practice standards, uncertainty, examples of teachers use.
• Subtheme: Teachers identifying how they engage with	-Teachers engagement with the standards in planning and preparation	Honesty, non-engagement, examples of engagement in

	the standards in planning and instruction	-Teachers engagement with the standards during instruction	planning, examples of students' engagement instruction, examples of teachers' engagement during instruction, references made to mathematical practice standards, pandemic.
	• Subtheme: Teachers identifying how their students engage with the standards	- Students' engagement with the standards for mathematical practice.	look at students' work, students' discourse, students' observation
Theme 3: Factors promoting or inhibiting middle school mathematics teachers' implementation of the standards		-Positive factors influencing teachers' use of the standards -Negative factors influencing teachers' use of the standards	Transferability with experience, professional development, collaboration with peers, education/coursework, mindset, curriculum alignment, none, inadequate training, require shift in pedagogy, schools having competing values or priorities, students' buy-in, time, virtual learning

For the second research question, there were three themes generated (as shown in Table 4). The themes aligned to the supports middle school mathematics teachers perceive they need to implement the classroom's mathematical practice. The themes were based on the

support teachers received in the implementation process, unmet needs regarding supports, and recommended strategies for administrators in the implementation process.

Table 4

Themes, Categories, and Concepts Connected to Research Question Two

RQ2: What supports do middle school mathematics teachers perceive they need to implement the standards for mathematical practice in the classroom?		
Themes	Categories	Codes
Theme 4: Supports provided to teachers with the implementation of the standards for mathematical practice	- Previous supports and training opportunities provided to teachers	Webinars, collaboration, other resources, education, informal training, formal training, coursework, alignment to the curriculum, experience.
Theme 5: Teachers unmet needs regarding the implementation of the standards	-Current unmet needs regarding the implementation of the standards.	Formal training, informal training, education, awareness, practice seven, practice three, positive attitude.
Theme 6: Teachers recommended strategies for implementation of the standards	-Implementation Strategies	stakeholders' implementation meeting, teachers' assessment, teachers training, classroom observation, coaching, lesson planning compliance.

Discrepant Cases

All the participants volunteered by completing the online questionnaire and consent form. A few participants did not qualify for the study since they were not licensed teachers but worked in a math classroom. Those participants were excluded from the study. Two participants were special education mathematics teachers. The teacher met the criteria, so they were allowed to participate in the study. None of the participants had follow-up questions regarding the study after completing the questionnaire.

Evidence of Trustworthiness

The credibility of the research was based on the criteria used to select participants for the study. The participants included middle school mathematics teachers who taught from Grades 59. Although the typical middle school includes Grades 68, some models included Grades 5 and 9. All of the participants reported that they have been teaching for more than 2 years. I ensured credibility by sending the results to the participants for member checking. The participants did not report any discrepancies, questions, or concerns from the results.

There was transferability of the results. Thick description was used to provide sufficient context of the participants' past and present experiences. Information shared included participants' years of experience, grade level, and detailed descriptions of positive and negative factors influencing the teachers' use and support needs with implementing the standards. Other middle school mathematics teachers, school administrators, higher education teacher training institutions, researchers, and

policymakers can generalize the results and apply them to their needs based on the detailed description provided.

To ensure that there is confirmability, I kept an audit trail. The audit trail consisted of a memo detailing the data collection phase. This includes records of my data collected, analysis, and interpretation of the data collected. A reflective journal helped me to record my thoughts throughout the research. This was especially useful during the interview. I was able to explicitly assess my biases in conducting the research. There was no adjustment of the strategies stated in chapter three.

To achieve dependability, I recorded the interview and have records of the transcripts stored on password-protected cloud space. These records will be kept for any inquiry. Also, the method of collecting and storing the data was consistent throughout the entire process and following what was reported. Details of this process were clearly presented in this report.

Results

In this section, I will report the findings from the study. The interconnected model of professional growth, the research purpose, and research questions informed these results. Through a thematic analysis process of coding, six themes emerged from the study. Each research question had three themes. The theme for research question one had several categories and subcategories, whereas the themes aligned to the second research question had one category.

RQ1

To answer the first research question, I asked Interview Questions 1, 2, 3, 5, 6, and 7 to the 12 middle school mathematics teachers. From these questions, three themes emerged and two subthemes. These themes represented teachers' understandings and use of the standards and concepts relating to the personal domain, the domain of practice, and the domain of consequences from the interconnected model of professional growth framework.

Theme 1: Teachers' Beliefs and Attitudes Regarding the use of the Standards for Mathematical Practice

Theme 1 represents the 12 teachers' attitudes and beliefs regarding the use of the standards. This theme is related to the first research question and is closely aligned with the personal domain from the interconnected model of professional growth framework. Based on the model, teachers' attitudes and beliefs can influence teachers' use and promote or inhibit a change initiative. Even though the mathematical practice standards outline the criteria for students' outcomes regarding processes and proficiencies, mathematics teachers must use appropriate teaching practices to promote such outcomes. Popova et al. (2020) found that teaching beliefs are aligned to their instructional practice.

The teachers were asked to share their views on why they believe the Common Core standards for mathematics included the mathematical practice standards in addition to the content standards. They were also probing regarding the benefits of this move and whether the standards align with their teaching style or philosophy. One category was used to create this theme: the alignment of the standards to the teachers' teaching style.

There were two subcategories under the category of alignment of the standards to the teachers' teaching style: the benefits or lack of benefits of using the standards to students and benefits or lack of benefits of using the standards to teachers.

Alignment of the Standards to Teachers' Style of Teaching

Teachers are more likely to adopt practices that are aligned to their teaching philosophy. According to Aslan (2018), there is a relationship between teachers teaching philosophy and teaching practices used in the classroom. Bouchamma et al. (2017) claimed that the domain of consequences from the interconnected model of professional growth is affected by complex changing factors within the school environment. The complex changing factors can alter teacher's pedagogical alignment and influence the success of implementing the standards for mathematical practice. When asked about the alignment of the standards to teachers' philosophy and teaching style, all 12 middle school mathematics teachers claimed that the Common Core standards for mathematical practice are directly aligned or somewhat aligned to their teaching philosophy and saw values in using the practices. These results are positive toward the implementation process since there is alignment between the teachers' transformative teaching practices and that which the standards demand.

The majority of teachers claimed a direct alignment of the mathematical practices to their teaching style. Seven teachers shared a direct alignment by confirming with an assertive “yes.” The participants then elaborated on their responses. P2 shared, “My philosophy as a teacher is to ensure that there is value in math regardless of your career path; for example, problem solving is a transferable skill and can be used in any career."

This category also reflects the teachers' current teaching practices related to the standards, highlighting what they value as a teacher and sharing examples of how the mathematical practices connect to their value. P9 claimed, "It is not my philosophy to teach out of a book, I never wanted to be one that just teaches to the test even before I was teaching regents classes." P9 claimed that that the standards for mathematical practice promote an actual love for learning and teaching mathematics. P5 made the connection of a teacher's belief and enactment of the standards. They claimed, "I see value in the standards, I think if we as teachers ourselves don't see the value in what we are giving to our students, we probably won't use it." Administrators can leverage these epistemological beliefs of the teachers in the implementation of the standards.

There was some uncertainty with teachers claiming a direct alignment of the standards for mathematical practice with their teaching style to a lesser extent. Five of the 12 participants' responses were coded as partial alignment. P3, P4, P7, P11, and P12 used phrases such as; "I guess so," "I think so," and "I think they can be worked into my teaching philosophy" in their responses. These uncertain phrases were followed with justifications to confirm partial alignment or highlight specific parts of the standards that have direct alignment. P4 shared, "I want them [my students] to be attend to precision, and this does align with what I do regularly." The participant was able to pinpoint a specific standard that aligned with their philosophy in teaching mathematics. P7 claimed, "I want to say I have a casual teaching style, so it is easy to work in the mathematical practice into my philosophy. Based on the response given by P7, the teacher shows openness to incorporating new practices. Later on, during the interview, it was more

evidence that the uncertainty of the alignment may be linked to the teachers' perceived lack of knowledge of the standards. According to Clarke and Hollingsworth (2002), teachers' knowledge is crucial in the growth process and positively or negatively affects the enactment.

Benefits of Using the Standards to Students

During the interview, the 12 middle school mathematics teachers identified benefits to students regarding the standards' use. As shown in Table 5, seven of the participants mentioned implementing the standards is beneficial to the students in encouraging critical thinking. Six mentioned the use of the standards to promote mathematical proficiency. Two participants each claimed that the standards do support students to develop communication skills, promote students' engagement and develop students' confidence. The standards for mathematical practice were developed to promote students' process habits in mathematics (Common Core State Standards Initiative, 2019). This category was placed under the theme of teachers' beliefs and attitudes as it contributes to the value the teachers see in using the standards. This category's results connect to the first research question as it relates to the implementation of the standards and teachers' goals for their students. This category had the largest number of concepts and references made during the interview. All of the participants were able to identify at least one benefit.

Table 5

Students Benefits of the Standards for Mathematical Practice

Benefits to Students	Number of Participants Mentioned
Critical thinking/problem solving	7
Increases mathematical proficiency	6
Developing communication skills	2
Promotes student's engagement	2
Developing student's confidence	2

Seven teachers identified that the standards for mathematical practice influence critical thinking amongst their students. P2, P4, P6, P7, P8, P11, and P12 used various phrases and sentences to describe the students' benefits. P7 mentioned, "They can apply to real-life problems as they are a set of standards that our kids can take with them outside of the math classroom and apply it in all sorts of different ways." P1, P6, and P7 shared subsets of skills that promote critical thinking, such as reason and problem solving. P4 said, "I want them to use appropriate tools strategically; a debate that is going on right now is why we need to teach division or multiplication if we have a calculator?" The participant further elaborated on the benefits of students to reason abstractly. In their claims, they mentioned, "Reason abstractly is huge because we want our students to look at data and come to conclusions, a lot of data are skewed, and they must be able to identify holes in the data." The teachers alluded to the point that the standards are transferable and help students develop their thinking ability as individuals and society members.

The teachers also identified the standards' benefits as they help develop a student's mathematical proficiency. The standards for mathematical practice provide an

opportunity for students to develop their conceptual understandings in mathematics; a lack of understandings limits students to procedural actions in mathematics (Common Core State Standards Initiative, 2019). P11 stated, "The standards promote students to think at a higher level about the process of doing math and not focus solely on the finding the answers." Their response was in close alignment with one of the goals of the initiative. P1, P8, and P9 made similar claims to P11.The benefits they see to this were providing students with foundational mathematical skills to better prepare them for high school and college. P5 mentioned that teachers are told not to use shortcuts such as "keep change flip" however, if students understand the inverse operation, they can use it because they understand the concept behind the mnemonic. They alluded to the Common Core initiative's ideas on the mathematical practice standards complementing the content standards to build students' mathematical proficiencies (Common Core State Standards Initiative, 2019).

Other codes in this category were communication skills, student's engagement, and developing student's confidence. Mathematical practice three; construct viable arguments and critique the reasoning of others promotes mathematical discourse (Common Core State Standards Initiative, 2019). P1 stated, "It helps build mathematical communication amongst students and between the student and teacher." P10 and P12 were special education mathematics teachers. They both identified the importance of the standards in developing students' confidence in doing math. P10 stated, 'In using those tools and strategies, I truly believe it helps students to find confidence within themselves

when they overcome something that has given them anxiety and stress, they can persevere through it.”

Benefits of Using the Standards as Teacher Practitioners

A category that has emerged from the teachers' responses was the benefits or lack of benefits they receive from implementing the mathematical practice standards. Bernander et al. (2020) claimed that teachers could create a mathematical practice culture by applying transformative teaching pedagogy. Transformative teaching practices are required for the implementation of the standards. The teachers were asked if they could identify any benefits of implementing the standards for mathematical practice. An axial code that emerged from the teachers’ responses were benefits or lack of benefits to them as teacher practitioners. Based on the answers, the teachers were aware of the teaching practices needed to achieve the desired outcomes of the standards for mathematical practice, the types of practices the implementation promotes.

Four participants cited the benefits of the implementation concerning growth in teaching practices. A code that has emerged from three of the four teachers was that the practice standards help promote a change from memorization. P9 noted that teachers often need to cover content tested on the state exam and resort to memorization or procedural teaching. The participant mentioned how the standards demand teaching that focuses on conceptual understandings. P3 said, "These are things that help you become a better math teacher; it helps us to determine what we are getting from our students."

There were three discrepant responses from the teachers in this category. Two teachers identified unique benefits they saw to implement the standards, whereas one

teacher identified the lack of benefits. P5 mentioned that mathematical practices' standards are foundational pieces to any mathematics curriculum and across any grade. They said, “You have to adapt the curriculum to the standards as oppose to adapting the standards to the curriculum, in every curriculum student will have to reason abstractly, make sense of the problem and problem solve.” The participant saw the benefits to teachers like the standards as "drivers" to the curriculum. P6 noted that they used the standards to write an individual education plan (IEP) annual mathematical goals. They claimed that the content changes quickly from week to week, whereas the practice standards are transferable and long term.

P2 noted that not all the standards have equal benefits, some were valuable, but others were excluded from their teaching as they saw no benefits to using them. They explained that the mathematical practice standards have never helped them as a teacher; however, it is impossible to teach mathematics without using the standards. P2 further justified their response by sharing that good teaching and curriculum promote pedagogy that fosters the outcomes of mathematical practice standards. P2 noted that even though there was value in using the practices explicitly, it is not necessary if the practitioner implemented good pedagogy altogether.

Theme 2: Teachers’ Perceived Proficiency in Implementing the Standards for Mathematical Practice

The middle school mathematics teachers were asked to self-assess their proficiency in implementing the standards in their classrooms. Based on the interconnected model of professional growth framework, the categories and concepts in

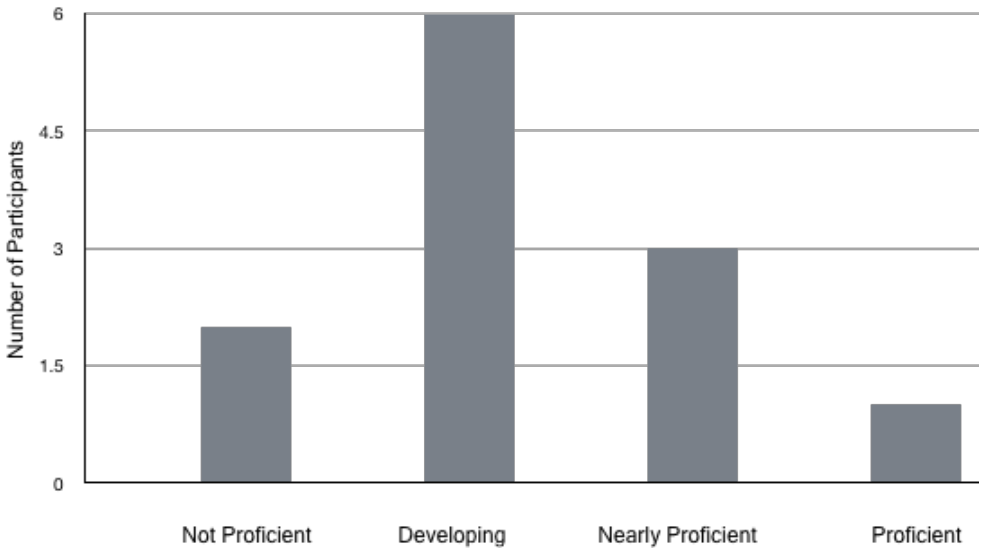
this theme are related to the personal domain and practice domain. Teachers' knowledge is a critical factor that influence their use of the standards (Clarke & Hollingsworth, 2002). The question on proficiency was asked as a foundational reflection question to answer research question one and possibly promote thinking about research question two. By self-assessing their proficiency in understandings and using the standards, the participants could better identify the supports they will need. One category was created from the participants' responses. This category was teachers' self-reported proficiency of their implementation of the standards for mathematical proficiency.

Self-reported Proficiency on Implementation of the Standards

The teachers were asked how they would rate their proficiency in implementing the standards for mathematical practice. This category is connected to the reflection and enactment processes that teachers engaged in according to the interconnected model of professional growth framework. As shown in Figure 2, six teachers reported that they were at a developing stage in the implementation, whereas four reported nearly proficient to proficient. In addition, two teachers reported that they were not proficient. Some teachers responded numerically, whereas others used a categorical response. Further, I probed the participant who chose to use a numerical description to rate it out of 10, with 10 being proficient. This choice was made to allow for comparison amongst the teachers' responses. Based on the participants' responses, the numerical responses were coded categorically for comparative purposes with accompanying justifications.

Figure 2

Teachers' Perception of their Proficiency in Implementing the Standards for Mathematical Practice



Six of the participants used numerical responses after being asked to do so during the interview. P2, P6, P5, P8, P11, and P12 self-reported the numbers two, six, five, eight, eight, and four out of 10, respectively, to rate their proficiency in implementing the standards. Based on the justification of the participants' responses, P2 score of two was coded as not proficient, whereas P6, P5, P8, P11, and P4 self-reported responses were coded as developing. P2 said, "I could only name like two of them, but if I am to review them in detail and compare to them to my execution, it will be higher. Based on the participant's answer, there is a gap in their knowledge of the standards when compared to their actual practice. P2 further self-reported they were confident that their practice gained from experience encompass the mathematical practice's essence. P12 rated themselves as developing based on the difference in proficiency level for each standard.

P12 noted, "I'd say on a scale of 1-10, maybe I am like a four. I feel like I know the standards, and I would consistently reference them; however, I don't feel like I'm proficient in every single one of them." P6's rating was based on their inconsistent use of the standard. They stated, "It's not explicitly integrated into my planning, I think there is evidence, but it's not something that I'm referencing regularly." P11 gave a higher numerical rating of eight, they used the phrase "good understanding" and noted that they are not completely lost in implementing the standards.

Three of the teachers rated themselves as nearly proficient, and one teacher-rated themselves as proficient. The teachers who rated themselves as nearly proficient indicated that there is room for growth. The participant who rated themselves as proficient described several factors they used to justify their rating. P5 claimed, "I would rate myself proficient in using them because I am aware of them, I know how to apply them to different topics that I'm teaching and see the value in using them." Additionally, two teachers rated themselves as not proficient and did not provide justifications for their ratings.

Based on the findings with further probing questions, there were some discrepancies between the teachers' stated proficiency in implementing the standards and their knowledge of the standards. Two of the participants who rated themselves as developing struggled to identify any of the mathematical practice's standards they are familiar with using. In contrast to two other participants who rated themselves as not proficient and were able to identify three to four of the standards, they are familiar with.

Also, the participant who did rate themselves as proficient used a reference sheet during the interview to cite specific standards.

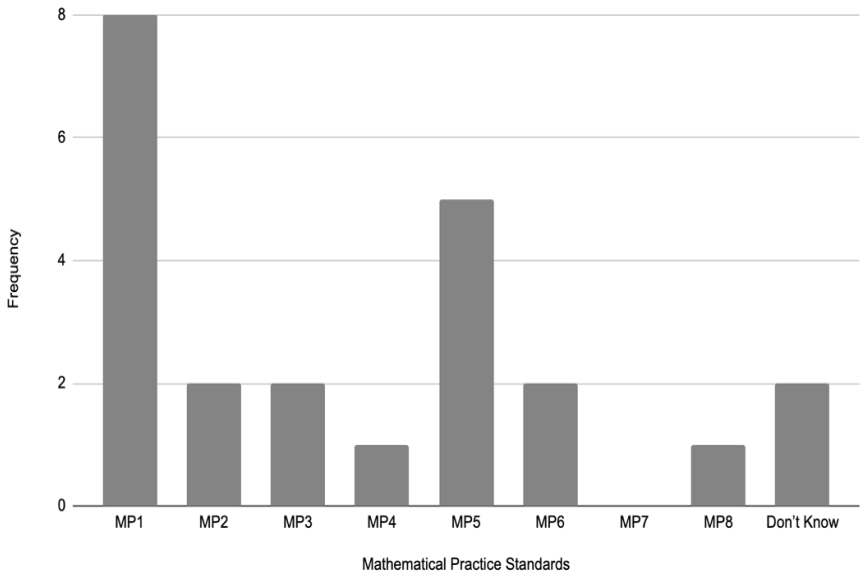
The teachers were asked to identify the standards that they were most comfortable and least comfortable implementing. This question was asked to determine if there are specific standards that the teachers implemented well, and if there are any, they might need greater support. This probing question led to the development of two subcategories on the reported implementation.

Identification of Standards that Teachers were Most Comfortable Implementing. This subcategory was based on a probing question asked once the participants self-assessed the implementation of the standards. As shown in Figure 3, eight participants identified mathematical practice one as a standard they are most comfortable using. Five identified mathematical practice five and two participants each identified mathematical practice two, three and six. None of the participants identified mathematical practice seven as a standard they are comfortable using and one mathematical practice four. The participants cited making sense of the problem and preserving in solving them (mathematical practice one) was one of the most commonly used standards. P3 claimed that it is one of those "everyday standards" mostly applied to word problems. P9 noted that "word problems seem to be an area of concern amongst students, using strategies such as looking for keywords or highlighting information is a simple strategy to help students sense the problem." P10 claimed that even though this was the most commonly used standards; they struggle with strategies to teach

perseverance. P2 and P8 were not able to name any of the standards that they were the most comfortable implementing.

Figure 3

Standards that Teachers are Most Comfortable Implementing



Key

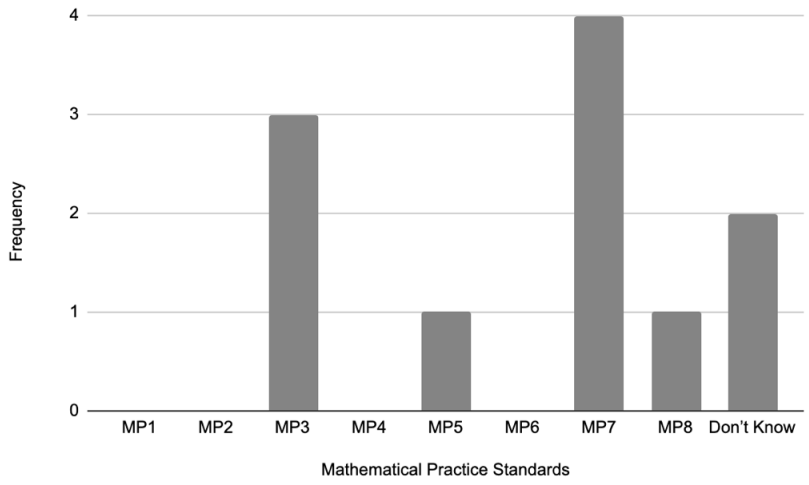
MP1: Make sense of problems and persevere in solving them
MP2: Reason abstractly and quantitatively
MP3: Construct viable arguments and critique the reasoning of others
MP4: Model with mathematics
MP5: Use appropriate tools strategically
MP6: Attend to precision
MP7: Look for and make use of structure
MP8: Look for and express regularity rerepeated reasoning

Identification of Standards that Teachers were Least Comfortable Using

Participants were further probed to identify standards that they were least comfortable using. As shown in Figure 4, four participants identified mathematical practice seven, and three participants identified mathematical practice three as the standards they were the least proficient in implementing. Two participants chose mathematical practice five and eight whereas two participants claiming that they do not know which standards they were least proficient in implementing. P1, P4, P7, and P12 all identified look for and make use of structure (MP7) as the standard they struggle the most with implementing. According to P4, "Look for and make use of structure is one that I don't use a lot, there's nothing really that states like what that means, the language in the description is very vague." Another code that emerged was to construct viable arguments and critique the reasoning of others. Three participants shared that they struggle with implementing mathematical practice three. P8 shared they usually goes straight to the answer when working in groups and confirms whether it's correct or not. The participant was able to identify that what is lacking in their practice is asking students to share their reasoning and strategies. P9 shared that their struggle with mathematical practice three is having students enter dialogue with each other positively.

Figure 4

Standards that Teachers are Least Comfortable Implementing



Key

MP1: Make sense of problems and persevere in solving them
MP2: Reason abstractly and quantitatively
MP3: Construct viable arguments and critique the reasoning of others
MP4: Model with mathematics
MP5: Use appropriate tools strategically
MP6: Attend to precision
MP7: Look for and make use of structure
MP8: Look for and express regularity rerepeated reasoning

Two discrepant cases were answers shared from P5 and P12. P5 shared that they were not comfortable with mathematical practice five; use appropriate tools strategically. The participant mentioned that this standard was not modern enough, and besides compasses and protractors, they do not know what this standard requires. P12 identified mathematical practice eight; look for and express regularity repeated reasoning as the

least proficient in implementing. The participant claimed that they do not emphasize it enough even though it is present, and their students could easily miss it. During the interview, two participants could not identify any standards that they were not comfortable using. P2 was one of the participants who could not identify a standard that they were least comfortable using. This participant also rated themselves as not proficient in implementing the standards. The lack of knowledge could have prevented the participants from identifying the standard that they were least comfortable implementing. From observation during the interview, most participants took long pauses to answer this question.

Teachers Identifying how they Engage with the Standards in Planning and Instruction

Lesson planning allows for teachers to carefully design instruction for students. According to González et al. (2020), lesson planning affects the quality of students learning experiences. Gonzalez et al. (2020) claimed that mathematics teachers often fail to design activities that promote error analysis, perseverance, and collaboration skills. The skills identified by the researchers are central to the standards for mathematical practice. During the interview, the teachers were asked about their planning and preparation routines with mathematical practice standards. The teachers also were asked about their instructional delivery or pedagogy with the standards. These questions were asked to determine to what extent the standards are used in the school environment. According to the Common Core State Standards Initiative (2010), the mathematical practice standards are provided to help students understand mathematics concepts;

however, schools must consider time, resources, and innovative energies to purposefully develop their curriculum and pedagogy. The analysis from the teachers' responses provided two categories under this theme. The two categories were teachers' engagement in planning and preparation and teachers' engagement with the standards instruction. There were 21 vignettes shared by teachers in both categories.

Teachers' Engagement with the Standards in Planning and Preparation

Teachers' engagement with the standards before instruction provides them with intentional use of the standards. During planning and preparation, teachers can embed the standards in their lesson plans to promote usage. According to Clarke and Hollingsworth (2002), there is a connection between teachers' support, their knowledge, instructional action, and students' outcome. The application of the standards is promoted through planning and instruction.

Ten out of 12 teachers who were interviewed claimed that they do not use the standards for mathematical practice when planning lessons. The code "honesty" was common amongst a few of the participants' responses. P7 shared, "I don't think in all honesty's now that I am thinking about it, I don't think I've explicitly planned for them." P3 had similar views; they shared, "I haven't looked at those in a little while; I forgot about those honestly, so no, I haven't used the practice standards." P12 claimed that they do not think that they would plan for the practice standards specifically; however, they thought about them during planning. These findings indicate an area of improvement for the use of the standards and supports that may be provided. P9 was initially confused about the standards that I was asking about and started to talk about the mathematical

content standards. The participant claimed that if it's not an algebra standard, they are not going over it. Also, they are required to cite the standards in their lesson plan and mention how they plan to execute them. During the interview, I asked a clarifying question if they were talking about the mathematical practice standard or the mathematical content standards. The participant quickly apologized and mentioned general practices that they used to foster collaboration and engagement. P2 also had some initial clarifying questions about which standards I am referring to. They stated, "so just to clarify, you are just talking about the mathematical practice standards and not the other standards?"

P4 and P5 were the only two teachers who claimed that they used the mathematical practice standards explicitly when planning. P4 related how having the standards integrated into their curriculum helped with planning. They further stated, "I do plan with a lot of good teaching in general, which I feel encompasses all the mathematical practice standards. I do refer to them specifically about once a week depending on what we're doing." P5 shared examples of how they planned for the standards intentionally. They claimed, “When we were doing proportional relationships, we talked about real-world applications, measurement, and data using manipulatives. When we did integers, I gave them algebra tiles."

There were some discrepant responses in this category. P10 and P6 reported that they may have been planning and using the mathematical practice standards, but they were uncertain. Both teachers school uses the International Baccalaureate standards with the Common Core standards. P6 claimed, “I guess some of them are included in the IB

standards that my school is using.” P10 claimed that they were unsure if the international baccalaureate standards use the same precise language as the mathematical practice standards, but they can recognize similar ideas. Both responses were coded as not explicitly used in planning. One participant stated that there were no expectations for using the standards for mathematical practice standards, whereas another participant noted that only when the state visited, they are required to include the practice standards.

Teachers' Engagement with the Standards During Instruction

A code that emerged from the participants' responses when asked about their use of the standards for mathematical practice was their engagement with the standards during instruction. Two teachers who plan for the standards specifically shared examples of how they use the standards during instruction. P4 shared that they refer to them about once a week and use the actual words such as precision and perseverance to encourage students. P5 shared that before the pandemic, they would use the mathematical practices more explicitly. They claimed, "I had them on cardboard cardstock***s***, each one with their own cardstock and the specific mathematical standard. I would put a post-it on the mathematical standard that we were using that day so the students can connect back." The participant recalled their room having the standards hung up on the wall, for which they frequently referred. They mentioned the availability of manipulatives to do hands-on activities such as algebra tiles that were a part of their instructional practice.

Although most teachers did not use the standards explicitly during planning, they mentioned that the practices are present in their instruction. P7 mentioned that some of the practices that promoted making sense of the problem are present in their teaching

even though they do not explicitly say that. P1 claimed that they encourage the student to think and further develop their understandings of mathematics as those are some of the mathematical practice standards' outcomes. P6 shared that their general pedagogical instruction promotes critical thinking and modeling, and that is where they see the connection. Overall the majority of teachers do not explicitly use the standards for mathematical practice standards during instruction but noted that there are elements of them in their practice.

Teachers Identifying How Their Students Engage with the Standards

Teachers who explicitly or implicitly use the standards for mathematical practice shared examples of how their students engage with the standards. There was one category in this subtheme from these two as it related to how teachers perceive they implement the standards for mathematical practice. Twenty-two vignettes were derived from nine participants. The teachers shared examples of students' outcomes with the standards in both online and in-person learning. Many classes were virtual due to the Covid19 global pandemic. As a result of the pandemic, some teachers mentioned engagement specific to virtual teaching, whereas others shared examples before the pandemic when students were in the physical classroom.

Observable Characteristics of Students Engagement with the Standards based on Teachers' Perception

The majority of teachers were able to report at least two pieces of evidence in their reflection of students' engagement with the standards. As shown in Table 6, 10 participants identified observable pieces of evidence relating to looking at students' work,

students' discourse, and students' observation as indicators of students' engagement with the standards for mathematical practice. The table also includes connection from my analysis toward specific mathematical practice based on the participants description. P3 and P10 decline to answer as they were not sure what observable evidence, they should look for with students engaging with the standards for mathematical practice. P10 shared, "I don't have the answer to what I would be looking for because I don't know what it should look like, but I definitely think it could be there."

Table 6

Observable Characteristics of Students Engagement with the Standards based on Teachers' Perception

Observable Characteristics	Connection to Mathematical Practice	Participants
Evaluating students' work-making sense of problems, attend to precision, reflection.	MP1: Make sense of problems and persevere in solving them MP2: Reason abstractly and quantitatively	P1, P2, P5, P11
Students discourse-sharing reasoning with peers, students justifying their reasoning with teachers, using precise vocabulary	MP3: Construct viable arguments and critique the reasoning of others MP6: Attend to precision MP2: Reason abstractly and quantitatively	P2, P4, P5, P7, P8, P9, P12
Students observation-perseverance, using tools appropriately, using manipulatives, modeling	MP4: Model with mathematics MP5: Use appropriate tools strategically	P1, P2, P4, P5, P7, P12

One of the three codes that were identified was evaluating students' work. P1, P2, P5, and P11 shared that evaluating students' work is a way for teachers to monitor and

assess how students are interacting with the standards for mathematical practice. Each of the teachers highlighted a different piece of evidence they will look for. P1 noted that they would look at their students work to see if the student made sense of the problem. P2 claimed that they will look at students work for how the students solve a problem and if they attended to precision. Both of their responses were aligned to mathematical practice two and six. P5 shared looking at students' reflection notes to observe them engaging with the standards, whereas P11 highlighted looking at students' work but did not specify what they would be looking for.

Another code in this category was students' discourse. Although students' discourse can be incorporated in most of the mathematical practice standards, it is a key practice in mathematical practice three; construct viable arguments and critique the reasoning of others. Most of the participants highlighted the evidence of collaboration and students working together in their classroom with students' discussion. P4 shared, "A lot of times [the students] will turn and talk and they will explain something to each other, I will say; tell him how you got that or tell him why you think that." P2 shared that their students participate in Google chat, Google forms, or verbally discussing problems. A common noticing from the participants' responses was that even though they mentioned students sharing their reasoning, they did not mention strategies for students to engage in critiquing mathematical work. There was an association of discussion with the mathematical practice, but none of the participants mentioned how they would promote mathematical thinking beyond sharing reasoning, answers, and talking to each other. P9 shared that they would listen to students' discourse for students using precise vocabulary.

The teachers mentioned how they use student observations to determine if the student is engaging with the standards for mathematical practice. They will look for perseverance, using tools appropriately, modeling, and using manipulatives. P1 mentioned that they would observe students to see if the students would develop models without prompting them. P4 shared that they will observe students to determine if the students use mathematical tools appropriately and strategically, such as calculators and multiplication charts. P12 mentioned the use of area models by students, whereas P5 mentioned students using manipulatives such as counting tiles or algebra tiles. Through analysis of the pieces of evidence shared by teachers, mathematical practices four and five were aligned to their responses.

Theme 3: Factors Promoting or Inhibiting Middle School Mathematics Teachers' Implementation of the Standards

There is an influence on the external domain of the interconnected model of professional growth toward teachers using mathematical practice standards. These factors can be positive or negative. This theme included the responses from all the participants and derived from two categories. During the coding process, 21 references were coded. Based on the participants' responses, this theme had the most varied answers. It includes barriers and challenges as well as positive factors in both the virtual classrooms and physical classrooms that influence teachers' use of the standards for mathematical practice.

Positive Factors Influencing Teachers' Use of the Standards

From the participants' answers, three major codes were developed to identify the positive factors that influence the teachers' use of the standards. As shown in Table 7, transferability with experience, professional development, and collaboration were positive factors that influenced teachers' use of the standards. The table also contains, other factors that were discrepant cases such as education, mindset and curriculum alignment. Five participants that did not share any positive factor and was coded as "none."

Table 7

Positive Factors that Influenced Teachers Use of the Standards

Positive Factors	Participants
Transferability with experience	P4, P8, P9, P11
Professional development	P3, P8, P9, P4
Collaboration with peers	P1, P11
Other Factors	
-Education/Coursework	P8
-Mindset	P5
-Curriculum alignment	P4
None	P2, P6, P7, P10, P12

The first key factor was the transferability of knowledge based on experience. P4, P8, P9, and P11 mentioned that they connected existing best practices of teaching mathematics to foster the implementation of mathematical practice standards. P4, P8, and P9 all taught over five years and were categorized as experienced teachers. P9, who had the most experience out of the participants with 14 years, shared, "I feel like they've been around for a while, we were told we had to use them from the beginning, so I jumped

right in, I felt like I was using at least some of them beforehand." P11, who was categorized as a novice based on their teaching for five years, mentioned that their experience in teaching mathematics allowed them to implement some of the practices. As shown in Table 8, more experienced teachers were most likely to implement the standards in comparison to novice teachers. Both P1 and P11 were exceptions to the novice groups but shared that a positive factor that influenced their use was collaboration with other teachers.

Table 8

Comparison of Novice and Experienced Teachers Sharing Positive Factors that Influenced Use

Novice (5 or less years of experience)	Shared positive factor(s)	Experienced (6 or more years of experience)	Shared positive factor (s)
P1 (2 years)	Yes	P3 (7 years	Yes
P2 (5 years)	No	P4 (11 years)	Yes
P7 (3 years)	No	P5 (6 years)	Yes
P10 (3 years)	No	P6 (11 years)	No
P11 (5 years)	Yes	P8 (6 years)	Yes
		P9 (14 years)	Yes
		P12 (6 years)	No

Three of the participants mentioned professional development or training on the standards for mathematical practice as a factor that positively influences their use of the standards. P3 mentioned that they had some professional development on some of the standards. P8 claimed, "Because of the different supervisors that I've had, probably seven to 10 different supervisors, everyone shared different teaching strategies." P4 shared that

they independently attended webinars from the National Council of Teachers of Mathematics (NCTM) on practice and process standards. The participant mentioned that even though they did not use the terms standards for mathematical practice, they could see transferability. P4 also noted that they utilized the internet to learn a lot and followed influential mathematical educators who use best mathematics practices.

Two teachers cited collaboration with peers, and three teachers identified educational coursework, mindset, and curriculum alignment as factors that positively affected their knowledge and use of mathematical practice standards. P1 and P11 both shared that they learned from their peers. P11 claimed, "Collaboration with other teachers is important because what I bring to the table is different from what my peers bring, and we can learn from each other." P8 identified their college-level classes, where they learned about strategies to apply in the mathematics classroom. They claimed that their prior course work provided the ability to transfer the best mathematics practices to achieve the mathematical practice standards' desired outcome. According to P4, the standards are integrated with their curriculum and foster mathematical reasoning, precision, and constructing viable arguments, so it is easy for them to use.

Negative Factors that Influenced Teachers' Use of the Standard

There were several limiting factors that the middle school mathematics teachers reported as influencing their identified that influenced their stated use of the standards for mathematical practice in the classroom. As shown in Table 9, the codes that emerged from this category were inadequate training, required a shift in pedagogy, schools having competing values or priorities, students' buy-in, time, and virtual learning. Based on the

interconnected model of professional growth, external factors can influence practice and salient outcomes (Clarke & Hollingsworth, 2002). Identifying and addressing the negative aspects can be used to promote effective implementation of the standards. Although this theme was connected to research question one, the negative factors identified were connected to the second research question on the supports needed.

Table 9

Negative Factors that Influenced Teachers Use of the Standards

Negative Factors	Participants
Inadequate training	P1, P2, P3, P10, P12
Requires shift in pedagogy	P1, P3, P5, P7, P10
Schools competing values/priorities	P3, P6, P10, P12
Students buy-in	P1, P9, P11
Time	P1, P5, P7
Virtual learning (Pandemic)	P4, P8, P12

Inadequate training was mentioned often by participants. There is a variety of literature regarding professional development to promote successful implementation of the Common Core standards (Barrett-Tatum & Smith, 2018; Filippi & Hackmann, 2019; Stair et al., 2017). Five participants claimed that limited training opportunities had limited their use of the standards. P1 claimed that the underlying reasons were that their school and district lacked enough or skilled personnel to provide training. Transitions between schools and content areas also affected teachers' training. P3 changed schools and, as a result, disrupted their path to receiving the training on the standards. P10 noted they were a literacy teacher who transitioned to becoming a math teacher and never received training on the standards. P7, who also transition to becoming a math teacher,

noted the difference in how math is taught from what they experienced as a student. P7 said, "I learned differently than how my students learned math; the way I learned was different from the Common Core. They might solve problems different than I know how to do it." They also alluded to inadequate training being a barrier to the implementation of the standards.

The participants claimed that the implementation of the standards for mathematical practice requires a shift in pedagogy and, as a result, negatively influencing the use of the standards. This shift in practice is a slow and gradual process. According to Jacobs et al. (2006), the transition from teaching traditional mathematics to a student-centered approach will require enormous efforts by the teachers. Each of the standards will require different strategies to promote the desired outcomes. P1 claimed that implementation requires a lot of diligence from both the teachers and students. P3 mentioned that a lack of consistent use has negatively affected their growth and proficiency in implementing the standards. P5 claimed that the resistance to change is a negative factor influencing the use of the standards.

Another code that was identified in this category was competing values faced by the schools and teachers. The standards were not a top priority in many schools. P3 shared their views on the school prioritizing state exams, which they claimed is related to funding and if schools should remain open. P3 said, "Schools don't think about these practice standards; they move over it. However, these standards can help make better teachers and help the school in the long run." A competing value in the schools from P6 and P10 was the international baccalaureate program. Both teachers claimed that their

schools adopted the new program that has its own set of standards. The teachers claimed that the schools were focused more on the international baccalaureate program's standards since it is a new initiative.

Other negative factors that were mentioned included time, student buy-in, and virtual learning due to the Covid19 pandemic. Three teachers identified time as a significant barrier. P1, P5, and P7 all noted that there is a lack of time and that implementing the standards is time-consuming. Students' buy-in was also a challenge. According to P9, some students prefer to work independently and don't like to participate in activities that promote the standards' use. P11, who teaches a self-contained mathematics class, claimed that they are fearful that the standards may confuse their students.

The Covid19 pandemic has affected education across many schools. Schools have used a variety of methods to deliver instruction to ensure students' safety. Some teachers have reported that their school has adopted virtual learning or hybrid learning based on the interview. Both types of learning have their pros and cons. In terms of the use of the mathematical practice, both methods negatively influenced the use of the standards. P12 noted how the pandemic had affected their use of the mathematical practice standards. P12 said:

> I feel like many of the issues are probably due to our current global situation; it's very difficult. I can't have students working in groups, which is not how I like to teach. I love doing things like jigsaws, having students teach each other, having students critique others' work, and learning from

each other; the pandemic has made it difficult to do these things. Technology is also a barrier, and for hybrid classes, there is no space to pull small groups.

Other participants faced similar challenges. P4 and P10 claimed that the pandemic has affected and limit their use of strategies.

RQ2

During the interview, questions four, six, and eight were asked to the 12 middle school mathematics teachers as they related to the second research question. From these questions, three themes emerged. These themes represented the supports teachers received, their unmet needs regarding supports, and recommendations for better implementation. The concepts were related to the personal domain, the domain of practice, and the external domain from the interconnected model of professional growth framework. An external stimulus serves as a trigger for change therefore influencing teachers' knowledge or practice in the changing environment.

Theme 4: Supports Provided to Teachers with the Implementation of the Standards for Mathematical Practice

This theme contains concepts related to support and training that the middle school mathematics teachers received in implementing the Common Core standards for mathematical practice. The external domain contains factors that support teachers' knowledge, beliefs and attitudes, and professional experimentations or usage of the initiative from the interconnected model of professional growth framework. Training and supports are crucial components in the professional growth model. According to Silver et

al. (2019), pedagogical innovations require support through professional development. Silver et al. (2019) claimed that these supports vary and must be adapted to the school environment.

Supports and Training Opportunities Provided to Teachers

Only two of the 12 teachers interviewed mentioned that they had a facilitator led professional development using mathematical practice standards. In terms of formal professional development, the participants reference formal professional development as someone facilitating a session on the standards specifically. One teacher claimed that they received extensive supports whereas the another had much less. P9 claimed, "We have had many PDs and workshops on them, allowing us to understand and break them down in kid-friendly ways. Our current director is wonderful with having us understand all parts of Common Core." In contrast, P3 shared, "We did have professional development on it. During the training they were briefly mentioned like twice on how we can implement those throughout the year and then moving past that I didn't have another training." P3 rated themselves as developing in implementing the standards, whereas P9 rated themselves as nearly proficient. Furthermore, P9 claimed that the lack of consistent use might have negatively affected their use of the standards. P3 noted that their school had not prioritized using the standards for mathematical practice, and the implementation requires a huge shift in pedagogy.

Although the other teachers did not have formal training with a facilitator guiding the teachers on implementing the standards, they have had other supports. P8 was supported through their college coursework. P4 indicated huge support in the

implementation with the school's curriculum alignment and support they individually seeks from online webinars. P1 and P11 were supported through collaboration with peers. Five participants, P2, P6, P7, P10, and P12, had no formal or informal opportunities to integrate pedagogies to support the standards' use. They all rated themselves as not proficient in developing in the implementation. Through the interview, they alluded to the idea that they do, however, have some knowledge of the standards.

Theme 5: Unmet Needs Regarding the Implementation of the Standards

One of the main focuses of this study was to explore the supports that teachers need. This theme is directly related to teachers' unmet needs regarding implementing the standards for mathematical practice. There was a clear consensus amongst the participants on what was missing from the implementation. Based on the lack of variety of answers, there was one code within the theme.

Current Unmet Needs Regarding the Implementation of the Standards

An important factor that was considered in collecting data was to explore what the unmet needs of the teachers were. Ten of the twelve teachers interviewed claimed that they had not received formal training in implementing the standards for mathematical practice from their current school. Apart from P4 and P9, all the participants mentioned a need for formal training on the implementation of the standards. P2 shared:

> I have had training as a math teacher in the philosophy of teaching, problem-solving, and multiple different approaches, but no one ever sat me down and said these are the standards, here is how you make MP1 happen, here's what MP 2 looks like, I never got that.

P11 shared that their district is big on turn-keying professional development where someone would go out for training and then bring back the practice to share with the teachers. According to that teacher, "I feel like it would be better just to get the formal training versus turn-key because I feel like it's a game of telephone; you lose some of the aspects of the training." Beyond the formal training, the teachers did not identify any other supports they would need. Based on their responses, the training might provide them with a better understanding of the standards and how they can shift their current practice to better support the implementation.

Seven participants identified to look for and make use of structure and construct viable arguments and critique the reasoning of others as two standards; they were the least comfortable in implementing. P1, P4, P7, and P12 claimed that the wordings of MP7 are vague, and as such, they could not relate pedagogies to support the standards. P3, P8, and P9 claimed that the support they need with MP3 is how to facilitate students' buy-in and positive dialogue using the standards. Additional supports are needed with the implementation of these standards.

All 12 of the middle school mathematics teachers indicated a positive attitude toward the standards of mathematical practice and a philosophical alignment toward the pedagogy that the standards promote. Through the interview, they show eagerness to learn more and are willing to support the standards' implementation. P12 summary of the final question regarding anything they would like to share about the mathematical practice sums up the willingness to learn more with appropriate supports. P12 noted that

they believe the standards are great, especially talking about them and having a moment to deep dive into them.

Theme 6: Recommended Strategies for Implementation of the Standards

As a key stakeholder in implementing the standards for mathematical practice, the teachers were asked to identify their implementation approach. The question came as a probing question but provided vital information on recommendations for administrators. This theme contained one category of teachers' recommendations to support the implementation of the standards. The reflection process is central to this study's conceptual framework and is valued as a key factor in the changing environment.

Teachers' Recommendation to Support the Implementation of the Standards

During the interview, the teachers were asked to brainstorm the types of supports they would use to implement mathematical practice standards. As shown in Table 10, six teachers shared their recommendations. These recommendations were coded as formal training to support larger groups of teachers, informal training that is individualized and continuous and schoolwide implementation policies.

Table 10

Teachers' Suggestion on Implementation Strategies

Recommended Implementation Strategies/Supports	Participants
Formal Training (Group) • Explain rationale for the use • Enhancing current lesson plans with standards • Developing teachers' knowledge and application of the standards • Provide resources • Opportunities to ask questions • Transition of the standards between grades	P1, P3, P4, P7, P8, P12
Informal Support (Individual) • Ask teachers to self-assess their current use/practices. • Complete teachers' evaluation on the use of teachers use/practice • Observe teachers on the use of the standards	P4, P12,
Policies • Modify existing lesson to incorporate a place for teachers to cite the standards • Making the standards mandatory for teachers to use. • Seek teachers input in the implementation	P4, P12

Formal training was one of the most common supports identified. However, the teachers identified key elements of formal training that are crucial to the success of the implementation. P1, P3, P4, and P7 recommended that awareness is the first step, and a meeting should be held specifically to discuss what the standards are and why it is needed. P7 noted that the discussion should include how they transition between grade levels, and P1 claimed that teachers should be afforded the opportunity to ask questions and be provided with resources to use. P8 suggested that the training allows teachers to work on their current lesson plans and practices to enhance the standards.

P4 and P12 suggested two different approaches. P4 claimed that administrators should seek teachers' input in the implementation process. They mentioned that teachers should complete a self-assessment on their current knowledge in addition to assessments from administrators. These assessments should be used to help to build on teachers' current practices. P6 also shared the concept of developing teachers' current practices instead of starting from new and using a forceful approach. P6 said:

> I don't really believe in them feeling like they have to abide so closely to that [the standards] if they have been integrating those ideas organically and what makes sense for their population. I think that the teacher should feel empowered to continue to make these decisions.

P12's suggested approach was more aligned to policy. They claimed that once teachers are trained, the standards should be mandatory. Teachers should be observed on the use of the standards. They also suggested that lesson plan templates should be modified to include a place where teachers should cite the standards for each lesson. Table 9 contains key concepts shared from the participants regarding recommended strategies for implementing the standards.

Summary

In this study, there were two research questions to explore what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. Twelve middle school teachers participated in the study to share their perspectives on the standards' use and support needs. The interview data were transcribed and coded using thematic analysis. From the participants' responses, six

themes were developed. These themes were used to answer the two research questions in this study.

RQ1: How do Middle School Mathematics Teachers Perceive They Implement the Common Core Standards for Mathematical Practice?

The first research question was aligned with themes one, two, and three. Middle school mathematics teachers' use of the standards for mathematical practice were dependent on a variety of factors. According to the conceptual framework of the interconnect model of professional growth, a change in practice in the classroom brings teachers to the forefront (Clarke & Hollingsworth, 2002). Teachers' professional development can promote or inhibit a change initiative. For teachers to use the standards, their attitudes, beliefs, external stimuli, and experimentation with implementation are considered (Clarke & Hollingsworth, 2002). The interview questions used in the research study were used to explore teachers' attitudes, beliefs and implementation of the standards for mathematical practice.

Middle school mathematics teachers identified benefits of using the standards and provided evidence of the standards' alignment to their teaching practice. They saw using the standards as beneficial to their professional growth as well as students' outcomes. The benefits to students include developing their mathematical proficiency, mathematical identity, and efficacy in mathematics. Teachers benefit from the use of the standards for mathematical practice as it related to developing their pedagogy. According to the teachers, not all the standards have equal benefits as some are more useful than others. Although these standards do align or somewhat align with all the teachers, there was a

varying level of proficiency and use of the standards. Eight of the 12 teachers rated themselves as not proficient to developing in using the standards, whereas four rated themselves as nearly proficient to proficient. Ten teachers claimed that they do not use the standards when planning. Some of the teachers struggle to identify observable evidence of students' engagement when using the standards in their classroom. These teachers have cited the lack of their proficiency as a reason. The teachers who used standards shared examples of students' engaging with the standards. The examples shared were students using models, manipulatives, engaging in discussions, asking questions, reflecting, using precise vocabulary, persevering, and looking at another students' work.

Making sense of the problem and persevere in solving them (MP1) and use appropriate tools strategically (MP5) were two of the standards that the participants were the most comfortable using. The majority of teachers identified experience and their ability to transfer their knowledge as positive factors contributing to the standards' use and understanding. Other teachers identified professional development, prior coursework, mindset, collaboration, and curriculum alignment to the standards as positive factors contributing to the standards' use and understanding. Constructing viable arguments and critique the reasoning of others (MP3) and looking for and making use of structure (MP7) were to standards the teachers perceived as the least use.

RQ2: What Supports do Middle School Mathematics Teachers Perceive They Need to Implement the Standards for Mathematical Practice in the Classroom?

The second question was aligned with themes four, five, and six. According to the teachers, construct viable arguments and critique others' reasoning (MP3) and look for

and make use of structure (MP7) were two of the standards they are the least proficient in using and need the most support. In terms of supports, the teachers identified formal training in using the standards as critical support needs to develop their proficiency and use of the standards. The teachers claimed that barriers such as the lack of formal training, lack of exposure, competing values in the school environment, and disruption to their support plans are currently influencing their growth using the standards.

The teachers shared implementation strategies that they would use to facilitate the implementation of standards better. One of the key strategies was providing formal training opportunities for teachers. In these training opportunities, the participants cautioned against the one size fit all approach. Teachers should complete a self-assessment on their use of some of the practices and create opportunities for them to connect their current practices to the standards. The teachers claimed that schools should try to bring awareness to these practices and their use. They suggested that a forceful approach should not be taken, but there should be some accountability level to ensure it is being used.

In Chapter 5, I provide an interpretation of the findings and the limitations of the study. I provide my recommendations along with the implications. For the implications, there were descriptions of the potential influence for positive change. Finally, I concluded the research study based on the purpose of the research and the findings.

Chapter 5: Discussion, Conclusions, and Recommendations

This qualitative research aimed to explore what teachers perceive as the support needed to implement the Common Core standards for mathematical practice in the classroom. Two research questions were constructed. These questions were used to guide the data collection process. Data were collected from 12 middle school mathematics teachers from schools that have adopted the Common Core state standards for mathematics. The research questions are as follows:

RQ1: How do middle school mathematics teachers perceive they implement the Common Core standards for mathematical practice?

RQ2: What supports do middle school mathematics teachers perceive they need to implement the standards for mathematical practice in the classroom?

Six themes emerged through the data analysis process. These themes included

- Teachers' beliefs and attitudes regarding the use of the standards for mathematical practice.
- Teachers' perceived proficiency in implementing the standards for mathematical practice
- Factors promoting or inhibiting middle school mathematics teachers' implementation of the standards.
- Supports provided to teachers with the implementation of the standards for mathematical practice.
- Teachers unmet needs regarding the implementation of the standards.
- Teachers recommended strategies for implementation of the standards.

The key findings were that even though the middle school mathematics teachers saw the benefits of using the standards for mathematical practice there was an acknowledged gap in implementation. The majority of the teachers stated that they do not explicitly plan for and use the standards for mathematical practice. Some of the standards that overlap with best practices of teaching mathematics were most likely to be used by the teachers. The teachers cited that their experience provided the knowledge they gained in best practices, but no formal training was explicitly provided to use mathematical practice standards. There were also no expectations in the schools for using the standards. The supports they identified were formal training on the rationale for use, and how they can identify current practices that are aligned with the outcomes of the standards. For the small sample of teachers that did receive support, it was minimal.

Chapter 5 includes an analysis and interpretation of the findings concerning the literature review and Clarke and Hollingsworth's (2002) interconnected model of professional growth. In this chapter, I described the limitations of the study. Also, I described the recommendations for further research and the implications of the findings. Finally, I concluded my research.

Interpretation of the Findings

Use of the Standards

According to Fernando and Marikar (2017), in a constructivist classroom, students are provided with the opportunities to brainstorm ideas, participate in group discussions, and debate their views on a topic or subject. The standards for mathematical practice are aligned to the outcome of a constructivist classroom. Based on the teachers'

perception, all of them see the benefits of using mathematical practice standards. The teachers' philosophy of teaching was aligned to a constructivist classroom and the standards for mathematical practice.

The results of the study are similar to the literature regarding teachers' knowledge of the standards. Davis et al. (2018) claimed that middle mathematics teachers' knowledge and understandings of the standards for mathematical practice are limited and will require more training regarding the standards' use. During the interview, the majority of the teachers struggled to recall the standards and chose to use a reference sheet to refresh their memory. The majority of the teachers identified formal training as a crucial next step in developing their knowledge and standards.

The middle school mathematics teacher identified mathematical practice three and mathematical practice seven as the least comfortable standards. In Max and Welder's (2020) study, mathematical practice three, construct viable arguments and critique others' reasoning, was identified as one of the most used mathematical practices. In contrast, the teachers in the study cited mathematical practice three as one they don't use often. According to Davis et al. (2018), *Mathematical Practice 7: Look for and make structure* was the least mentioned practice by middle school mathematics teachers. In this study, the middle school mathematics teachers cited Mathematical Practice 7 as a challenging standard that they do not use often and are least comfortable with using.

Support Needs

The middle school mathematics teachers who participated in the study were provided with limited support in implementing mathematical practice standards. The limited support influenced their knowledge and use of the standards. The teachers noted that they would like to receive more support in implementing the standards for mathematical practice. In Davis et al. (2018) study, the researchers found that middle school mathematics teachers had limited knowledge and understanding of the mathematical practice standards. The researchers further recommended that teachers be provided with more training. This study provides an extension to the literature by where middle school mathematics teachers claim that they do need formal training on using the standards.

Teachers' pathways to gaining knowledge of the standards for mathematical practice varied. The literature also cites various means by which teachers can receive support in using mathematical practice standards. Davis et al. (2017) mentioned the positive influence curricular resources had on teachers using the standards. In this study, the one participant who used the standards the most also claimed that their curriculum was aligned to the standards and are referenced. Olson (2016) argued that there is a lack of purposefully aligned materials presented in coursework offered to preservice teachers regarding the Common Core use. One of the middle school mathematics teachers referenced having course work related to the Common Core; however, they claimed that it was not specific to mathematical practice standards.

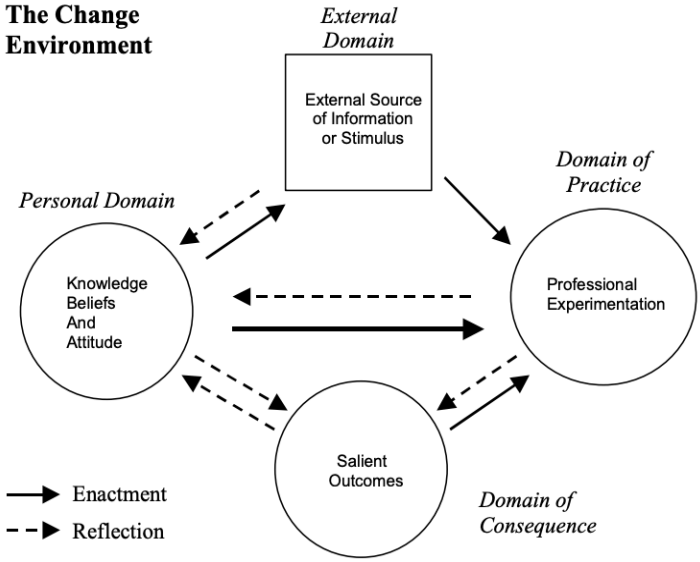
The majority of participants claimed that they would benefit from professional development. The need for professional development for teachers to successfully implement the Common Core state standards was cited by Filippi and Hackmann (2019). Other literature also mentions the benefits of professional development in implementing the Common Core standards (Barrett-Tatum & Smith, 2018; Stair et al., 2017). Participants in the study claimed that professional development providers should help teachers make connections to existing practices rather than a new concept with a one size fit all approach. In alignment with Liang et al.'s (2020) findings, this study found that competing priorities are barriers to a more comprehensive professional development plan in schools.

Conceptual Framework Alignment

This study was grounded in Clarke and Hollingsworth's (2002) interconnected model of professional growth. Clarke and Hollingsworth's interconnected model of professional growth includes four domains in developing teachers' growth as shown in Figure 5. These domains have the external domain, the domain of practice, the domain of consequences, and the personal domain (Clarke & Hollingsworth, 2002). The results from this study can be applied to these domains related to the use and support needs from teachers regarding the implementation of the standards for mathematical practice. Furthermore, the domains are connected through reflection and enactment by which was targeted in this study.

Figure 5

The Interconnected Model of Professional Growth



External Domain

The external domain contains factors that affect the domain of practice (Clarke & Hollingsworth, 2002). Teachers must receive a stimulus to initiate the domain of practice and perform professional experimentation with the practice, according to Clarke and Hollingsworth's (2002) interconnect model of professional growth. Based on the results, there was a lack of stimulus. Ten teachers claimed that they did not had any formal training on the standards. One teacher had limited training, and one had extensive training. The teacher who had extensive training also mentioned that they were proficient in using the standards. They were also able to identify a variety of evidence of when the standards are used. Connecting this to the interconnected model of professional growth, this teacher has experienced change the most due to their receiving training, using the

standards, and positively influencing their knowledge of the standards. Through their reflections, they were able to identify areas of growth in the implementation process. Those teachers who did not receive much of a stimulus regarding the standards, their use was limited, thus negatively influenced the domain of practice, the domain of salient outcomes, and personal domain.

Although most teachers did not receive formal training as an external stimulus, other stimuli allowed the teachers to have some exposure to the standards. These included collaboration with other teachers, integrating the standards into the curriculum, and experience with similar practices. The influencing factors to the teachers not receiving additional supports included: schools not having sufficient resources, lack of time, competing priorities at the schools, disruption of support due to change in school or supervisor, and students buy-in. In terms of competing priorities, one participant spoke about the focus on the state assessments prioritizing the standards for mathematical practice.

Domain of Practice

The domain of practice is based on teachers implementing the standards in their classrooms. The standards' implementation was influenced by the support the teachers received, the outcomes or experiences, and the teachers' knowledge, beliefs, and attitudes (Clarke & Hollingsworth, 2002). Even though most teachers claimed that they do not explicitly use the standards for mathematical practice when planning, they use best practices in teaching. According to the teachers, there was an overlap of general best practices and mathematical practice standards. *Mathematical Practice Standard 1:*

Making sense of problems and persevere in solving them and *Mathematical Practice 5: Use appropriate tools strategically* are two of the most used standards. The participants indicated these two standards are used the most due to the transference of their experiences and knowledge of best practices. The teachers identify the mathematical practice standard three and mathematical practice standard seven as least comfortable in using.

Personal Domain

In the model, the personal domain describes the teachers' knowledge, beliefs, and attitudes regarding the change initiative (Clarke & Hollingsworth, 2002). The middle school mathematics teachers all saw benefits in using the standards and aligning them to their teaching philosophy or teaching style. The teachers claim that not all the standards align with their teaching philosophy equally, and some have more importance than others. One teacher claimed that they saw no deficit in their practice by not using the standards. The teacher claimed that best practices do not need to be explicitly referenced. The question regarding their proficiency in understanding the standards was used to probe into their perception regarding their knowledge of the standards. The majority of teachers reported that they were not proficient in their understandings the standards. The lack of knowledge was related to the result when asked about using or enacting the standards. The majority of teachers claimed that they do not explicitly plan for using the standards. One participant declared, "I don't have the answer to what I would be looking for because I don't know what it should look like." Based on the study results, the lack of knowledge on the standards has negatively influenced teachers' use of the standards in

their classrooms. Their beliefs and attitudes were found to be positive toward the standards as they cited numerous benefits during the interview. The benefits included developing students' mathematical proficiency, developing their mathematical identity, increasing their efficacy in mathematics and positively affecting teachers' pedagogy.

Domain of Consequences

The salient outcomes are found in the domain of consequences (Clarke & Hollingsworth, 2002). Teachers' supports, knowledge, and practice all influence students' achievement. Middle school mathematics teachers who use the standards for mathematical practice or best practices relating to the practice standards were able to identify the observable evidence or salient outcomes. The salient outcomes identified by teachers as a result of implementing the standards for mathematical practice includes; students developing models, students making sense of the problems and preserving through them without the teacher prompting them, increased students participation, students knowing what tools to use and when to use them, students using manipulatives in order to help them in problem solve, students explaining their thought process and engaging in academic discourse with their peers and students sharing their reflections. The teacher identified these outcomes as necessary to increase students' proficiency and problem-solving ability.

Limitations of the Study

There were limitations to this study. The Covid19 global pandemic has affected the educational systems and teachers' practice. Many schools have adopted different strategies to provide students with learning opportunities due to the pandemic's influence.

Methods include asynchronous learning, synchronous learning, and hybrid learning. As noted in the study, the teachers had to adjust their practices based on their school's learning options. There was an influence on the teachers' answers to questions using the standards for mathematical practice.

The location of the participants also influenced the study. There was a majority of participants in the northeastern states that volunteered to participate. Perspectives from middle school mathematics teachers in other states outside the region have limited representation. Statewide implementation plans may have altered the support teachers receive as a central focus of the study. The study does not include middle school teachers' perspectives from all states.

During the study, some of the participants chose to use a reference guide to recall and cite the specific language of the standards. One participant asked me to outline the standards for them. During the interview, I did provide an outline of the standards for the teacher. Even though the effect was minimal, it is worth noting that participants' precise language may have been attributed to the reference used. Another participant disclosed that in preparation for the interview, they quickly reviewed the standards. It was never the intention to assess middle school mathematics teachers' knowledge of the standards, but their use hence the validity of the results, were not affected.

Other factors that limit the study but cannot be eliminated in the qualitative research are the sample size and the researcher's bias. According to Francis et al. (2010), a sample size of 10 to 15 participants in a qualitative study is suitable. Although the study had a sample size of 12, saturation was not guaranteed. Each participant was able to share

their perception based on their individual experience. As a school administrator, I also have experience with the topic. During the data collection process, I wrote my reflections down to ensure that I documented and reflected on potential biases. One internal conflict I had was reciprocating conversational gestures such as nodding in agreement during the semistructured interviews. After I was aware, based on my consciousness during the process, I tried to reduce such gestures for future interviews.

Recommendations

There are four recommendations for further research to be conducted based on the review of the literature and the findings of this study. The first recommendation is related to the use of the standards for mathematical practice in middle school. I would recommend further research into using the mathematical practice with purposeful sampling across each state that has adopted the Common Core state standards. This may allow for more insight into the gap or lack of gap in practice using the standards for mathematical practice. The implementation of the Common Core state standards was not universal. States took their varied approaches and used different strategies to implement the practice. As a result, the outcome differs. Participants from this study were unintentionally located from one region of the United States. The results of this study can be juxtaposed with sampling from other regions not represented in this study.

This study, along with others, has focused on teachers' use of the standards for mathematical practice. A further recommendation is to explore the perspective and knowledge of coaches and administrators responsible for implementing the standards. With the findings of this study showing that teachers lack support with the

implementation, there is a gap in the literature on the implementation strategies, knowledge, and expertise of administrators and coaches who are tasked with implementing the standards. There is an influence of support from coaches and administrators to teachers on the use of mathematical practice standards.

A third recommendation is to conduct research in higher education teachers' training programs to determine if coursework includes supports with mathematical practice standards. With the teachers claiming not receiving training from preservice courses, the burden of the gap in knowledge lies upon schools and districts to supplement. According to Clarke and Hollingsworth's (2002) interconnected model, increasing the stimuli from external domains can promote growth in the changing environment. The level of support is also influenced by schools and districts based on teachers' level of expertise.

The last recommendation is to conduct further research on how successful educators have used each practice standard. The findings can promote more literature on successful strategies used by teachers in the implementation. For example, in previous studies and this study, the results conclude that teachers struggle with MP 7; look for and make structure. There is a gap in literature the literature regarding successful strategies that teachers use to promote this standard. More specific research into each standard can encourage better use and support.

Implications

The findings in this study can positively influence social change regarding college and career readiness. Mathematics proficiency is an integral part of college admission, attrition, and a greater extent of career opportunities. A lack of proficiency acts as a barrier to many students accessing college-level education and jobs relating to having a solid foundation in mathematics. According to Er (2018), a lack of mathematics college readiness has been highlighted as a social problem that affects students accessing college and or needing remediation mathematics classes while in college. One of Common Core state standards initiative goals is to promote better-prepared students for college and career (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010a). To achieve the desired outcome of the initiative, the fidelity with implementation is a crucial component. Poor implementation has been highlighted as a key factor negatively influencing the initiative's success (Common Core Task Force, 2015). The findings of this study add to the existing literature regarding the implementation of the Common Core state standards and the influence on students' mathematical proficiency. Teachers who are knowledgeable and well supported may most likely implement the standards in their classroom. Teachers maximizing the use of the standards can promote students' mathematical proficiency, thus positively influencing access to college and job opportunities.

The significance of this study may also have a positive influence on teachers and school administrators. School administrators and teachers are continually looking for ways to better support students in mathematics. The interconnected model, as a

conceptional framework used in this study, describes the factors influencing teachers' professional growth (Clarke & Hollingsworth, 2002). By providing better support to teachers regarding their instructional practice, they are more likely to implement best practices with a sense of accomplishment. This affect teachers' motivation, identity, and efficacy in teaching mathematics. The findings of this study can fill the gap in practice with professional development offered to teachers based on their needs as a recommendation.

Conclusion

There was a gap in the literature regarding what teachers perceive as the supports needed to implement the Common Core standards for mathematical practice in the classroom. The focus was to explore what teachers perceive as the support needed to implement the Common Core standards for mathematical practice in the classroom. Twelve middle school mathematics teachers participated in semistructured interviews sharing their perceptions as crucial stakeholders in implementing the standards. After analyzing the data collected, I found a gap in practice regarding the use of the standards for mathematical practice like previous researchers who studied the implementation of the standards for mathematical practice. Teachers have identified the lack of formal training as a critical barrier to understanding and using the standards. The support they seek is to have training that can allow them to learn more about the purpose of the standards. The teachers also identified the need for professional development that may allow them to transfer existing practices that may be aligned to the standards. There was a general caution of taking the one size fit all approach to professional development.

Middle school mathematics teachers would like to embrace the standards as they see the benefits of using the standards to develop students' mathematical proficiency.

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Appendix A: Flyer for Recruitment

Teachers' Support in Implementing the Standards for Mathematical Practice

Purpose: To explore how middle school teachers are using the Common Core standards for mathematical practice and what support they need to develop their capacity based on their perception of need.

Volunteer Requirements: Current middle school mathematics teacher teaching in a state/school that has adopted the Common Core state standards for mathematics, at least one year of experience using the standards.

Time Commitment: 95 minutes

To volunteer: E-Mail

Appendix B: Questionnaire

Please complete the questionnaire which will provide basic information to determine eligibility

Name:

Email Address:

State:

Subject you teach:

Grade level you are currently teaching:

Years of experience as mathematics teacher:

Appendix C: Interview Protocol Document

Interview Questions

<table>
<tr><td>Interview #:</td><td colspan="2">Conducted By:</td></tr>
<tr><td>Date:</td><td>Start Time:</td><td>End Time:</td></tr>
<tr><td colspan="3">Greetings:
Hi _____ I want to thank you for agreeing to meet with me and participate in my research. For today's interview I want to collect data on your perception as a middle school mathematics teacher your use and support needs if any on the standards for mathematical practice found within the Common Core state standards for mathematics.
The interview should take about 1 hour. In order to capture accurate data and to be fully invested in listening to your ideas, I will be recording the interview. At times I will be taking some notes as well, but minimally.
As a participant of this interview, the data collected will be held confidentially. While your perception data will be used, your name or identify will only be known to me. You can end the interview at any time and don't have to talk about anything that you don't want too. Are there any questions you have and would like to discuss?</td></tr>
<tr><td>Warm up Question:
How long have been in the education field and what grade(s) level do you currently teach?</td><td colspan="2"></td></tr>
</table>

Reflection:	
1.Think back to the past 3-4 weeks, in what ways have you specifically plan for and use the standards for mathematical practice in your classroom? *-Probe: based on response probe for specific details and examples.*	
Reflection:	
2. If I am observing your classroom within the past week, what should I look for if I want to see students engaging with the standards? *-Probe: based on response probe for specific details and examples.*	
Reflection:	
3.Why do you think the CCSM include the standards for mathematical practice in addition to the content standards? *-Probe: Do you see any benefits of this move?*	

-Probe: How does this align or does not align with your teaching philosophy or style of teaching?	
Reflection:	
4. Describe type of formal trainings (in college or institutional professional you have had development) on using the standards. *-Probe: If teacher responded that they have not had any type of trainings, ask probing question of why do you think this was not covered in pre and or post service institutions?* *Probe: Did you have any informal supports on the standards e.g. coaching, colleague, mentor etc.?*	
Reflection:	
5. Would you rate yourself as proficient in understanding and using the Standards? Why or why not?	

-Probe: Based on teacher answer. *What were some of the factors that have contributed to your proficiency?* *What were some of the factors that have negatively contributed to your lack in proficiency?*	
Reflection:	
6. How have you been trained in using the standards? *Probe: If you were responsible for implementing the standards from an administrative level, what would you do similarly or differently?* *Probe: Depending if teachers answer no. What might be some barriers or challenges at an institutional level that may prevent better support?*	
Reflection:	
7. Based on teacher knowledge of standards: Ask: What standard are you most comfortable with using?	

What standard are you least conformable using?	
Reflection:	
8. Is there anything else you would like to share?	
Closure: Thank you so much for sharing your perception and time with me today. Once the information is transcribed and analyzed, I will get in contact with you through email. This is to verify the accuracy of the interview and to share my findings. Feel free to also contact me if you have any additional questions about the research.	