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Exploring Perceptions of Math Instructional Practices in Preparation for High-Stakes Testing

by

Rachel M. Green

A Dissertation submitted to the Education Faculty of Lindenwood University

In partial fulfillment of the requirements for the

Degree of

Doctor of Education

School of Education

Exploring Perceptions of Math Instructional Practices in

Preparation for High-Stakes Testing

by

Rachel M. Green

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Dr. Randy Caffey, Committee Member Date

Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work here at Lindenwood University and that I have not submitted it for any other college or university course or degree here or elsewhere.

Full Legal Name: Rachel M. Green

Signature: ____ Date: __05/27/2022__

Acknowledgments

Philippians 4:13

In all things, I give my God glory; He is my strength and comforter. To my mom, thank you for giving me life and choosing to love me relentlessly. You are, to me, an inspiration and a warrior for Christ. To my mother-in-law, my first classroom teacher, completing this project could not have happened without you. Its success is just as much yours as it is mine. Thank you for giving me my best friend and biggest supporter. To my Joe, the wind beneath my wings and protector of my heart, you have been with me through every season of my life from our earliest years and beyond. I don’t know why God saw me fit to deserve such a strong and loving man, but I thank Him every day for you. Thank you for always knowing exactly when to stand in front of me and behind me and hand-in-hand beside me. To my Grant Green, you are my greatest gift of love from God. You are the light of my life. Always remember how much dad and I love you. Every day, you make us so proud. I can’t wait to see what God has in store for you.

Thank you to Dr. Wisdom for the leadership and direction you have continuously provided through this project. In summer 2018, God put you in my path. Blessed by your patience and guidance, I returned to finish something abandoned and am forever indebted to you. Thank you to Dr. Caffey and Dr. Vest for serving as committee members. I am grateful for your generosity of time and commitment to helping me complete this project.

Thank you for the path you paved to my dad, my father-in-law, Granny Edna and Uncle Lynn, Grandpa Windy, and all the grandmas and grandpas that have gone before me. To all my family near and far, you are a piece of my life’s puzzle, and I thank you for

completing me. And to Grandpa Dan, the Senator, I burnt the midnight oil. I hope its glow was bright enough for you to see from Heaven.

Abstract

The debate between traditional math instructional practices, as opposed to those found in constructivism, student-centered, and inquiry-based, influence the quality of mathematics instruction students encounter in classrooms and is reflective through students' performance data at district- and state-level assessments. The methodology mathematics teachers use reflects individual teachers' mathematics learning philosophies. Many variables influence teachers' attitudes toward mathematics learning and teaching, including background knowledge and personal math learning experiences, level of comfortability navigating mathematics curriculum, and perspectives regarding process versus conceptual learning and teaching. Educational leaders' support of the development and implementation of teachers' math instructional practices are influenced by philosophies of mathematics learning and management style coupled with leadership expectations established and maintained by each district. Upper-elementary students that lack foundational math knowledge struggle to find success in mathematics. This mixed-methods investigation sought to explore the potential relationships between teachers' and district leaders' perceptions of procedural and conceptual math instructional practices in preparation for high-stakes testing and the potential for teacher accountability to influence instructional practices. Moreover, the research embedded within this study sought to explore the role of district leaders' support in developing and implementing teachers' instructional procedures. The research site is a central-Missouri school district along the I-44 corridor. The methodology reflects the explanatory sequential research model in that the investigation is two-phased. In the first phase of the study, 27 teachers of mathematics ranging from third through sixth grades and six building leaders were asked to complete a closed-ended questionnaire. Participants were invited to participate in an in-person interview in the second phase. In a final analysis, the researcher looked for potential evidence between interview participants' dialogue and students' performance data reflected through Missouri Assessment Program (MAP) scores and the district's schoolwide assessment tool, NWEA.

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Chapter One: Introduction

Background of Study

At some point in their educational experience, many students have encountered some level of struggle in mathematics; however, today, math educators face an alarming increase in math learners who lack the basics (Musti-Rao et al., 2015). Fuhring (2020) relayed that math learners who lack fundamental skills and experience repeated defeat struggle to tackle higher-level, advanced, and abstract curricula. It may also stifle confidence and diminish self-worth, leading to a general avoidance of mathematics (Fuhrman, 2020). Hogan (2017) explained that a strong foundation in number sense helps young math learners develop confidence and flexibility in reasoning. Computational fluency can be described as quick and accurate arithmetic (the basics: addition, subtraction, multiplication, and division) that lays the foundation for high-level mathematics, such as algebra, geometry, trigonometry, and calculus (Harris, 2019). With the increasing number of math learners lacking basics and computational fluency, educators must ponder what has impacted this trend (Musti-Rao et al., 2015).

Research has shown a variety of plausible determinants. For example, a recent study showed that parents' math anxieties stifled their mathematics learning (Maloney et al., 2015). Cultural views or mathematics perspectives may influence students' performances in this content area (Horn, 2017). Teachers have found teaching elementary and middle school students basic fact fluency using rote memorization to be more and more unsuccessful (Kling & Bay-Williams, 2014). Time constraints have impacted teachers' instructional planning and delivery of content (Ray, 2013). Confusing language embedded within the Common Core State Standards for Mathematics Torres may contribute (Torres, 2014).

This mixed-methods study sought to investigate and explore the potential impacts of high-stakes testing, teacher accountability, and instructional technique and practices on elementary classrooms' procedural and conceptual math learning. The researcher acknowledges the plethora of variables that may contribute to the complexity of the problem; therefore, the following considerations will be explored.

High-Stakes Testing

As schools in America moved from educating the elite to educating the masses, high-stakes testing became the tool to measure accountability for free public-school education (Gershon, 2015). The Glossary of Educational Reform (n.d.) described high-stakes testing as:

> Any test used to make important decisions about students, educators, schools, or districts, most commonly for the purpose of accountability-i.e., the attempt by federal, state, or local government agencies and school administrators to ensure that students are enrolled in effective schools and being taught by effective teachers. In general, ’high-stakes’ means that test scores are used to determine punishments (such as sanctions, penalties, funding reductions, negative publicity), accolades (awards, public celebration, positive publicity), advancement (grade promotion or graduation for students), or compensation (salary increases or bonuses for administrators and teachers) (High-stakes testing, n.d., para. 1).

High-stakes testing has been the driving force behind educational reform, as the government has worked to allocate and ration public funding for schools (Gershon, 2015). As early as the post-Revolutionary period, standardized testing was evolving as part of universal schooling initiatives and the idea of schooling the masses to Americanize immigrants and address rapidly growing cities (Loveless, 2021). The Elementary and Secondary Education Act of 1965 opened the door to standardized testing in America's public schools. An integral part of President Lyndon B. Johnson's 'War on Poverty' initiative, it strived to ensure all students were allowed not only to have a free public-school education, but one that was 'equitable' (Paul, 2018). The reform provided federal funding to all public schools for professional development, instructional materials, resources to support educational programs, and the promotion of parental involvement. The reception of the funds warranted schools to meet specific criteria; hence, accountability in education is born. Standardized testing became the method for gathering students' achievement evidence and school performance data (Paul, 2018).

Reauthorization of the Elementary and Secondary Education Act. President George W. Bush's No Child Left Behind Act of 2001 reauthorized the Elementary and Secondary Education Act of 1965 (Paul, 2018). Accountability, flexibility, research-based education, and options for parents were the four components embedded within the bill. It provided America's schools with funding to implement these resources and assess their efficacy through adequate yearly progress and student performance data. The end goal: every student would meet proficiency in reading and mathematics by 2014 (Loveless, 2021). While standardized testing was nothing new for America's schools, NCLB made it plausible that high test scores indicated quality education. If a student performs well on the standardized assessment, they receive a high-quality education from high-qualified teachers within a highly-qualified learning institution. If a student does not make the grade, this could indicate that the student is receiving a subpar education (Zhao, 2009). The NCLB era precedes the era of Race to the Top, President Barack Obama's educational reform initiative (Loveless, 2021).

Common Core State Standards

In 2009, the Common Core State Standards initiated the implementation of learning standards that encompassed consistent learning goals (Loveless, 2021). Before 2009, each state composed, implemented, and assessed its own specific standards and defined its own resolution of proficiency (Loveless, 2021). This effort allowed state governors and state commissioners of education and experienced teachers and experts within education to collaborate to standardize what is taught, assessed, and the definitions that measure students' performance data (Loveless, 2021). By 2015, approximately 42 states had adopted the Common Core State Standards and began implementing these standards at the local level (Loveless, 2021). By developing and implementing the Common Core State Standards, standardized instructional and assessment content sought to ensure all students graduating from high school were prepared and ready to conquer college, careers, and life in general (Loveless 2021).

Under new presidential leadership and as 2014 approached, many of the No Child Left Behind requirements became less demanding, and states were granted more flexibility. President Obama signed the Race to the Top initiative, which encouraged states to compete for additional funding based on their students' strong test scores (Loveless, 2021). Loveless (2021) explained that schools were persuaded to develop assessments that were better aligned with state standards. Additional factors were included in the evaluation and attendance and graduation rates.

In 2015, President Obama signed the Every Student Succeeds Act and reauthorized the Elementary and Secondary Education Act of 1965. It also was built upon many of the key components of No Child Left Behind (Loveless, 2021). While the Common Core State Standards movement emerged during the Obama administration, the Every Student Succeeds Act returned local control to the states' adoption of standards aligned to college entrance requirements and post-high school career readiness (Loveless, 2021).

Missouri Learning Standards

Sawchuck (2020) reported that most states took advantage of the opportunity to revise and redevelop Common Core State Standards at the local level. Even so, most states kept their math standards with the same level of rigor, with the depth of knowledge at its highest and 21st learning skills at their foremost (Sawchuck, 2020). Missouri's Common Core State Standards are the Missouri Learning Standards (MLS). The Department of Elementary and Secondary Education (DESE) described the Missouri Learning Standards as high-quality academic expectations in English Language Arts and mathematics (Department of Elementary and Secondary Education, 2022). These standards measure what skills students should know and master at the end of each grade level in preparation for college- and career-readiness (DESE, 2021).

According to DESE (2022), the Missouri Learning Standards promote more explicit expectations for all stakeholders, including students, parents, teachers, and the community, while encouraging the development of learning resources aligned with standards. The Missouri Learning Standards also help teachers develop and implement a high-quality curriculum aligned to standards and high-quality assessments aligned to the standards that measure student performance (DESE, 2022).

Missouri Assessment Program (MAP)

Implementation of high-stakes testing has evolved from traditional pencil and paper methodology assessing content knowledge to the computer-based software and applications of today's tech-savvy classrooms that measure students' abilities to analyze, synthesize, and apply the content knowledge (Herold, 2016). Today's Missouri Assessment Program (MAP) is a summative measurement that depicts students' learning and mastery of the Missouri Learning Standards (DESE, 2022). It is administered to third-grade students through eighth-grade students through the DESE's online application and scored electronically (Bock, 2015). The year 2015 marked the pilot year for the new delivery and implementation of the Missouri Assessment Program (Bock, 2015). Initially, the Missouri Assessment Program was intended to be an 'adaptive' assessment that would use smart software and smart technology to change the questions' difficulty level and paint a picture of each student's ability level (Bock, 2015). Bock (2015) reported that delays in technology and time constraints prevented this development as test validity was of concern.

Northwest Evaluation Association (NWEA) and Measures of Academic Progress

The Northwest Evaluation Association (NWEA) was founded in 1973 by Allan Olson and George Ingebo, in conjunction with educators and researchers in the Oregon and Washington state school districts (The Northwest Evaluation Association [NWEA], 2021). Its purpose was to revolutionize how individual students' learning, growth, and achievement were measured and assessed. These students' learning, growth, and achievement measurements produce a RIT score (Rasch Unit) for each student. A RIT score is calculated based on the accuracy percentage in each tested subject. According to *Everything You Need to Know About NWEA*, a published blog by The Critical Thinking Child (2021), if a student answers less than 50% of questions within a specific skill set correctly, then these skills are identified within the RIT score as concepts that the student still needs to be introduced and practiced. Suppose the student correctly answers more than 50% of questions within a specific skill set. In that case, these skills are identified within the RIT score as concepts in which the student is approaching mastery (The Critical Thinking Child, 2021). NWEA (2021) explains that teachers use RIT scores to identify the following for each student: identify the student's missing skills, connect the student to instructional resources aligned to the student's RIT score, track longitudinal growth, group students for differentiated learning, provide information about what the student is ready to learn, and set growth goals for the student.

As student performance data from standardized testing in schools reflect how well schools are helping students meet state standards and evaluate the quality of instruction that teachers deliver, such high-stakes could possibly impact student learning. Throughout this study, the researcher will investigate potential connections between high-stakes testing and procedural versus conceptual learning of math among elementary students from the perspectives of teachers and leaders within education.

Significance of the Study

Struggling math students, especially those in the upper-elementary and middle grades, depend on the basics to reach their full potential in mathematics (Karp et al, 2021). All higher-level mathematics courses should build upon strong fundamentals

(Wriston, 2015). Teachers play an essential role in cultivating a learning environment that promotes higher-level thinking, but firmly implements practices that reinforce the basics (Bidwell, 2014). This study aimed to investigate teachers’ and educational leaders’ perceptions of high-stakes testing and the ability to move students to levels of proficiency in mathematics. The researcher sought to discover how teachers and educational leaders perceived high-stakes testing related to elementary students’ procedural and conceptual math learning. The researcher explored how teacher accountability from high-stakes testing may or may not influence math instructional practices.

The researcher thought it was important to investigate the perceptions of teachers and educational leaders regarding accountability for student achievement and performance. In the researcher's professional experience and observations of teaching fifth- and sixth-grade mathematics, she perceived a noticeable lack of preparation of incoming fifth- and sixth-grade students. Therefore, the researcher analyzed perceptions of elementary teachers and leaders within education, along with student performance data from the Missouri Assessment Program and the NWEA, to make recommendations related to curricula and instructional practices that may improve the transitioning from lower- to upper-elementary and middle school mathematics. The information from this study could potentially influence professional growth for current educators, help guide teacher-readiness in teacher-education programs, expand students' learning of math, and increase student achievement.

School districts could potentially use this research to highlight the importance of instructional practices balancing procedural and conceptual learning to move students to proficiency levels in elementary years and attain high levels of self-achievement in post-upper- and middle-grades mathematics (Chaman et al., 2014). Schools that facilitate professional learning communities may be able to use the results from this study to promote and encourage conversations about continuous school improvement in connection to instructional techniques and to assess and interpret evidence of students' learning. Teachers' and educational leaders' perceptions of high-stakes testing could potentially conclude that teachers will show more accountability through students' mastery by teaching more excellent mathematics skills than broader ones.

Student performance could be considered a reflection of teachers' quality in relation to instructional practices and its connection to teachers' perceptions of procedural and conceptual math. While there is a wealth of studies that analyze the perceptions that teachers and leaders within education have regarding procedural and conceptual learning of math, as well as a multitude of research on the topic of high-stakes testing and teacher accountability, the researcher has found little to none that consider how one may influence the other.

Purpose of Study

This study aimed to analyze the impacts that standardized testing and teacher accountability may have on elementary students' learning of procedural and conceptual math based on the perspectives of teachers and educational leaders. The study was designed to analyze such perceptions regarding the effects of high-stakes testing on students to identify potential improvements in curriculum and instructional approaches. To accomplish this, the researcher will compare the perceptions of teachers and educational leaders to the student performance data from both the Missouri Assessment

Program and the district-wide assessment tool: NWEA (NWEA, Measures of Academic Progress, 2021).

With the increasing demands of high-stakes testing and its influence on school monetary resources, curricula freedom or instructional creativity has eroded as ‘teach to the test’ has become the norm (Walker, 2017). As school leaders must ensure schools perform proficiently and as classroom math teachers feel the pressure to cover rigorous state-mandated curricula, the researcher seeks to discover if correlations between these influences exist.

Research Questions

Within the context of this study, the following questions guided the research:

1. What are teachers’ and educational leaders’ perceptions of procedural and conceptual learning of math in preparation for high-stakes testing?

2. What influence (if any) has teacher accountability in preparation for high-stakes testing had on instructional practices?

3. How has high-stakes testing influenced district leaders’ roles in supporting elementary teachers’ development and implementation of instructional practices?

Hypotheses

The researcher composed and investigated the following hypotheses in response to the research questions within this study:

Hypothesis 1

There will be a relationship between teachers’ perceptions of high-stakes testing, and the third- through sixth-grade scores reflected through the math portion of the Missouri Assessment Program (MAP) as well as the math portion of the NWEA.

Hypothesis 2

There will be a relationship between district leaders' perceptions of high-stakes testing, and the third- through sixth-grade scores reflected through the math portion of the Missouri Assessment Program (MAP) as well as the math portion of the NWEA.

Struggling math learners in elementary and middle school classrooms do not have a solid foundation in math fundamentals. Students' lack of fundamentals may be due to the impact that teacher accountability tied to student performance data from high-stakes testing has had on procedural and conceptual learning of math (Richards, 2020). The research conducted in this study investigated potential connections between teachers' and administrators' perceptions of high-stakes testing compared to student performance data collected from the Missouri Assessment Program conducted in the spring of 2021, as well as data collected from the district-wide assessment tool, NWEA, that is conducted within the research site at multiple times throughout the school year.

Limitations and Assumptions

While mixed-methods research can facilitate more in-depth investigations, it can also produce complexities as the researcher will need to demonstrate fluency in quantitative and qualitative collections and data triangulation (Dawadi et al., 2021). Limitations of this study may include the chosen framework and methodology for the research. Halcomb (2018) explains that issues beyond combining methods include the complexity in creative design, the lack of existing literature detailing the 'why' and the 'how' to mix the research, the necessity for team-based approaches in resources, time constraints when conducting the research, and communicating the results. Additionally, Halcomb (2018) claimed that consensus when measuring the quality of mixed-methods studies does not exist.

Additional research limitations include those found in the project's population and sample. Govindan (2014) describes sampling as picking a portion of individuals to represent the population. A mixed-method survey was distributed to elementary and middle school teachers and educational leaders within one specific school district. Because the research site selected is limited to a single district, the researcher recognizes that this particular exploration is specific to the district itself and does not represent surrounding school districts in Missouri, although the results from the research may benefit other schools facing similar circumstances.

Another limitation of this study was that the sample might not have acknowledged receiving the survey instrument or chose not to participate in its completion. DeWitt's research (2019) implicates that educators and researchers sometimes miss opportunities to collaborate, due to research being too complicated or the context being irrelevant. Teachers and educational leaders often feel overworked and undervalued (Henebery, 2021); therefore, subjects may be too busy to participate in research. Furthermore, teachers and educational leaders within the research site may not feel comfortable providing formal feedback about their perceptions regarding instructional practices in relation to high-stakes testing. Teaching styles also impact performance data, making it difficult to determine an honest appraisal from teachers concerning their teaching styles.

The Merriam-Webster Dictionary described assumptions as plausible things that are accepted as true. The following assumptions guided the researcher's initial direction when formulating this study's research plan. Holding teachers accountable for their standardized test scores has impacted math's procedural and conceptual learning in elementary and middle school classrooms. By the time students get into upper-elementary grades, the deficit of the mastery of lower-level skills has become apparent. The researcher assumed that these fundamental deficits would continue to impact learners' future performance in higher-leveled math negatively. The researcher assumed that teachers feel the rush and the urgency to push through conceptualized and abstract math to cover a broad curriculum that standardized tests might assess. This tendency might contribute to teachers devoting more time to students' mastery of procedural skills that influence students' successes in higher-level mathematics.

The researcher assumed that elementary and middle school students are affected by teacher accountability. Upper-elementary and middle school math students who lack fundamentals and basic fact family fluency move from one grade level to the next without fully mastering the foundational math skills of the previous year. This creates deficits that keep expanding. The researcher assumed that this contributes to students' math anxieties, low self-confidence, feelings of inadequacy, and discontent with math content. Another assumption is that teachers' methods to identify deficits in students' skills and fundamentals are reliable and valid forms of assessments.

The researcher assumed that all elementary teachers and educational leaders would voluntarily consent to participate in the survey about their perceptions of accountability from standardized testing and its potential effects on student learning and academic performance in an honest manner and complete the instrument in its entirety. Also, the researcher has assumed that teachers and leaders within education would feel compelled to participate in this study as it would allow their perceptions to be examined.

Conceptual Framework

Shakespeare (1885) once wrote, “All the world is a stage and all the men and women merely players. They have their exits and entrances and one man in his time plays many parts” (p. 1). When thinking of the world of education as a stage or political arena, educators could be compared to the players. The players in education have been affected by the political entities that govern what they must do (Pelsue, 2017). For instance, the politics of standardized testing has been tied to the government through funding and accreditation. Schools must perform in ways that meet criteria and standards set forth by both local and federal governmental bodies; in other words, teachers and administrators have been tasked to perform for pay (Thompson, 2018). Bolman and Deal (2021) have described the political framework as one of four ways organizations are structured and governed. Politics have been the natural process of making decisions and allocating resources in a context of scarcity and divergent interests (Bolman & Deal, 2021). Therefore, the political framework was chosen to guide and conceptualize this study as teacher accountability and standardized testing could be connected to government funding and political agendas, such as educational reform initiatives (Paul, 2018).

Trueman (2015) explained that a functionalist perspective views education as the process of maintaining a society that challenges its students to achieve and compete with the opportunity of equality. Since the functionalist theory perceives school organizations as integral parts that are interdependent upon each other, it applied to this study in conjunction with a political framework. When thinking of schools as societies, the researcher acknowledges that influential stakeholders within education include parents, students, teachers, counselors, faculty, and administration. Each of these counterparts affects one another and works together to form a ‘shared’ or ‘common’ vision for the ‘bigger picture’ (Trueman, 2015). The functionalist theory is based on the works of French sociologist Emile Durkheim. Durkheim believed that education fosters social solidarity, thus, creating a sense of commitment to society’s goals (as cited in Thompson, 2021).

The researcher used the human resource frame to design this study. Bolman and Deal (2021) explained that the human resources conceptual framework focuses on what organizations and people do to and for one another. Schools traditionally have been organizations made up of many stakeholders. The research in this study is sensitive to the role that students, teachers, administrators, and school districts have played in high-stakes testing and how each one has affected the other. Many theorists have examined and strived to connect how individual needs and goals influence the performance of their organizations, or in contrast, how the organizational needs and goals influence its individuals. Educational organizations and their stakeholders (such as teachers, district leaders, and parents) want students to perform at proficient levels; the ‘how to get there’ is complicated from many perspectives. All stakeholders may have the same end goal; however, organizations have ideas and assumptions about what their stakeholders want. They have sets of needs that organizations must meet to produce a commonly desired outcome (Bolman & Deal, 2021).

Contributing factors that influence students’ performance data include human needs. For example, Maslow (1954) developed a model of Maslow’s Hierarchy of Needs that depicts levels of performance based on a set of initial needs that must be met. In applying Maslow’s theory, students will perform best when their basic needs are met basic safety, shelter, and food, emotional support (McLeod, 2020). If this is true, student performance data may not meet standards due to a missing factor within Maslow's model. Perception is a factor that cannot be overlooked.

Cherry (2020) described perceptions as cognitively processing information. She explained that perceptions are sequential responses that act as filters to help interpret internal and external stimuli (Cherry, 2020). She described that perception could influence motivation, expectations, emotions, and attitudes, and it can influence culture (Cherry, 2020). People's perceptions influence relationships with colleagues, mentors, and school leaders. Student performance is maximized when the student and teacher perceptions of education and learning align (Karp et al., 2021); therefore, student performance on standardized testing could potentially influence the teacher's evaluation.

A Russian psychologist, Vygotsky, developed the Sociocultural Learning Theory composed of three key concepts: culture, language, and zone of proximal development (Pappas, 2017). Based on the idea that environment influences learning, Vygotsky's theory may be instrumental in helping guide this study. While the culture and language components within the Sociocultural Learning Theory are notable contributions, a learner's 'zone of proximal development' may be a factor that teachers and administrators consider when perceiving procedural and conceptual learning of math. Vygotsky's zone of proximal development can be described as the span between a learner's potential academic development and the actual growth that the learner achieves (as cited in Pappas, 2017). *Scaffolding* is a concept that emerged from the zone of proximal development (Cherry, 2018). Teachers break lesson concepts into smaller chunks when scaffolding to help students build accuracy and fluency (Alber, 2014).

Students must feel achievement and accomplishment before moving on to higher-level concepts. Engaging in higher-level concepts that require higher-level thinking without a solid foundation may not allow students to grow within their zone of proximal development.

This research study also considered the works of Bloom, an American educational psychologist. Bloom's published framework categorizing the educational goals described as ‘Bloom's Taxonomy’ outlines specific levels of thinking to achieve mastery (Hall, 2015). David (2017) explained that the newest version of the model includes a six-tiered hierarchy of learning levels: remembering (the lowest level), understanding, applying, analyzing, evaluating, and creating (the highest level of learning). Miller (2014) explained that the newest forms of standardized testing seek to evaluate students' learning by using questions that assess the depth of knowledge beyond recall, comprehension, or inference. When considering Bloom's hierarchy of learning, it is crucial to consider Vygotsky's zone of proximal development. Vygotsky's and Bloom's theoretical ideas correlate with this study as instructional practices and state objectives and standards influence curriculum design. Administration, curriculum specialists, and teachers reflect on the ideas of Vygotsky and Bloom when planning for curriculum, instruction, and assessment. The Missouri Assessment Program (high-stakes testing) measures how well the school organization performs. The research embedded within this study aims to understand the perceptions of the school's stakeholders through the lens of Durkheim's functionalist theory, Vygotsky's theory that the environment impacts learning, Bloom's Taxonomy concerning students' mastery of concepts, and the influence of the political spectrum as described by Bolman and Deal (2021).

Definition of Key Terms

For the purpose of this study, the following terms were defined:

Accountability. Holding everyone with responsibilities accountable for high standards of performance (Education Post, 2018).

Bloom's Taxonomy. A classification system used to define and distinguish different levels of human cognition - i.e., thinking, learning, and understanding. Educators have typically used Bloom's Taxonomy to inform or guide the development of assessments, curriculum, and instructional methods (The Glossary of Education Reform, 2014).

Common Core State Standards. The Common Core is a set of high-quality academic standards in mathematics and English language arts/literacy (Gerwertz, 2020).

Computational fluency. Math computation skills referred to as basic arithmetic (addition, subtraction, multiplication, and division) that help lay a foundation for success in higher learning of math concepts (Harris, 2019).

Conceptual math. Conceptual math is the ability to demonstrate knowledge and an understanding of more than isolated facts and methods. Conceptual math is referred to as being able to transfer knowledge into new situations and apply it to new concepts (Andrew, 2017).

Curriculum. The term curriculum refers to the lessons and academic content taught in a school or in a specific course or program. In dictionaries, *curriculum* is often defined as the courses offered by a school, but it is rarely used in such a general sense in schools. Curriculum, which is aligned to statewide standards, is created, defined, and evaluated by the local school district (The Glossary of Education Reform, 2015).

Depth of Knowledge (DOK). The complexity or depth of understanding required to answer or explain an assessment related to a classroom activity (Meador, 2017).

DESE. The Missouri Department of Elementary and Secondary Education (DESE) is the administrative arm of the State Board of Education. It primarily has been a service agency that works with educators, legislators, government agencies, community leaders and citizens to maintain a strong public education system (Foster, 2015).

Durkheim's Functionalist Theory. Emphasizes a societal equilibrium where society is based on interrelated parts. For example, states provide free public-school education and families pay taxes that help support public education. Students get educated and become law abiding, productive citizens of society (Thompson, 2021).

Elementary and Secondary Education Act (ESEA). The federal Elementary and Secondary Education Act (ESEA), enacted in 1965, is the nation's national education law and shows a longstanding commitment to equal opportunity for all students. It was part of President Lyndon B. Johnson's 'War on Poverty' (Paul, 2018).

Every Student Succeeds Act (ESSA). ESSA (2015) was a reauthorization of the Elementary and Secondary Education Act of 1965 and was built upon the No Child Left Behind Act of 2001. It was signed into law under the Obama administration (Loveless, 2021).

High-stakes testing. Any test used to make important decisions about students, educators, schools, or districts, most commonly for the purpose of accountability - i.e., the attempt by federal, state, or local government agencies and school administrators to ensure that students are enrolled in effective schools and being taught by effective teachers. In general, *high-stakes* means that test scores are used to determine punishments, accolades, advancement, or compensation (The Glossary of Education Reform, 2014).

Missouri Assessment Program (MAP). An annual, statewide, grade-level student assessment that measures the progress toward mastery of the Show-Me Standards (for students grades 3-8) (DESE, 2021).

Missouri Learning Standards (MLS). The Missouri Learning Standards define the knowledge and skills students need in each grade level and course for success in college, other post-secondary training, and careers. These expectations are aligned to the Show-Me Standards, which define what all Missouri high school graduates should know and be able to do (DESE, 2022).

No Child Left Behind (NCLB). The No Child Left Behind Act (NCLB) reauthorized the Elementary and Secondary Education Act of 1965. Signed into effect under President George W. Bush's administration, it required students to take annual achievement tests in Reading and Mathematics with all students reaching proficiency by 2014. It provided funding to schools to support these efforts (Klein, 2020).

NWEA. The NWEA (Northwest Evaluation Association) is the educational non-profit organization responsible for the MAP assessment. MAP, which stands for Measures of Academic Progress, refers to tests given multiple times throughout a school year to measure students' growth in a variety of subjects (NWEA, 2021). The NWEA is a district-wide assessment tool that is used by the school district within the research site.

Procedural fluency. Procedural fluency has been described as a critical component of mathematical proficiency. Procedural fluency is the ability to apply procedures accurately, efficiently, and flexibly; to transfer procedures to different problems and contexts; to build or modify procedures from other procedures; and to recognize when one strategy or procedure is more appropriate to apply than another. It has become a critical component of mathematical proficiency (NCTM, 2022).

Race to the Top. Race to the Top was an educational reform initiative during the Obama presidency that encouraged states to compete for additional funding based on their students' strong test scores (Hawkins, 2014).

RIT score. A measurement of a student's academic achievement and growth over time that identifies what skills have been mastered and what skills the student is ready to learn. The RIT score is generated through the NWEA MAP test administered multiple times throughout a school year (NWEA, 2021).

Scaffolding. Refers to a variety of instructional techniques used to move students progressively toward stronger understanding and, ultimately, greater independence in the learning process (The Glossary of Education Reform, 2015).

Standardized testing. Any form of test that (1) requires all test takers to answer the same questions, or a selection of questions from common bank of questions, in the same way, and that (2) is scored in a 'standard' or consistent manner, which makes it possible to compare the relative performance of individual students or groups of students (The Glossary of Education Reform, 2015).

Student growth measures. A comparison of relative change in a student's performance on a specific test to all other students' performances on that same test. The measurement can be used to show growth above or below the median measurement for all students (The Glossary of Education Reform, 2013).

Student performance data. This has been referred to as information about the academic progress of a single student, such as formative and summative assessment data, coursework, instructor observations, information about student engagement and time on task, and similar information (U.S. Department of Education, 2022.).

Teacher accountability. The use of student achievement data to measure teacher effectiveness (Mendro, 1998).

Vygotsky's Social Learning Theory. Russian sociologist's theory that argues social interaction precedes development; consciousness and cognition are the product socialization and social behavior (McLeod, 2020).

Zone of proximal development. The range of abilities that an individual can perform with assistance, but not yet can perform independently (Cherry, 2018).

Summary

In Chapter One of this study, the researcher introduced the potential impacts that high-stakes from standardized testing have had on elementary students' procedural and conceptual learning of mathematics as perceived by teachers and leaders within education. The researcher also introduced how teachers' and educational leaders' perceptions of high-stakes testing might contribute to developing and implementing instructional practices. Since student performance may correlate with instructional practices, the researcher proposed that there could be a connection between teachers' and educational leaders' perceptions of accountability regarding procedural and conceptual learning of math.

Chapter One described the conceptual frameworks of political and human resource frames for which the study will follow and the theoretical correlations between the study and educational theorists Vygotsky, and Bloom and Durkheim's functionalist theory. It also defined key terms and addressed the limitations and assumptions of the study. In Chapter Two, the researcher will review the literature to examine the background of the problem.

Chapter Two: Literature Review

This study aimed to research potential connections between high-stakes testing and teacher accountability, curriculum trends and instructional methodologies, and the impact these educational reforms may have on third- through sixth-grade students' learning of procedural and conceptual mathematics. This chapter discusses various influences that might determine the outcome of student performance. It focuses on the roles that instructional practices coupled with teacher accountability from high-stakes testing may play in determining how students demonstrate achievement; furthermore, the chapter seeks to identify the impacts these influences may have on students' procedural and conceptual learning of math. The chapter also investigates the role of high-stakes testing in evaluating students' academic performances and measuring students' baseline knowledge and growth in academic areas. Adaptive assessments versus traditional standardized assessments will be discussed.

In composing this literature review, the researcher collected a variety of scholarly journals and resources to explore the critical ideas embedded within this study. Careful attention was placed on selecting materials that focused on current or recent educational reforms, mathematics instruction and assessment, student performance data and standardized testing, and the efficacy of teacher evaluation practices related to high-stakes testing. The research conducted throughout the literature review proved to be challenging and complicated. Students' performance in all academic areas is difficult to pinpoint or determine a standalone influence, as many factors might sway students' achievement outcomes (Higher Life Foundation, 2016).

Factors That Affect Student Performance explained that student performances could be categorized as internal and external factors: student-related factors, teacher-related factors, school-related factors, and family-related factors (Higher Life Foundation, 2016). While the Higher Life Foundation (2016) applied these ideas to student achievement in African schools, each key influence may be applied to students in American schools. Each factor explored influences that impacted students' abilities to perform at full potential (Higher Life Foundation, 2016). In student-related factors, the Higher Life Foundation (2016) described issues of bullying and self-motivation as influences that can impact a student's academic performance. Teacher efficacy, including classroom management abilities, teacher's self-interest, self-motivation, and experience and understanding of curriculum, has affected student performance (Higher Life Foundation, 2016). Enrollment issues, funding constraints, school location, and school conditions are a few school-related factors that were found to influence student achievement (Higher Life Foundation, 2016). According to Higher Life Foundation (2016), family-related influences have impacted socioeconomic status, parental involvement, parents' educational experience or perceptions of schooling, and family structure. When thinking of these four factors as overlying umbrellas that encompass a multitude of influences, the researcher began to discover the complexity of tying student performance to teacher accountability.

Similar to *Factors that Affect Student Performance*, Hattie's (2015) *195 Influences and Effect Sizes Related to Student Achievement* outlined an elaborate and specific list of factors that positively and negatively contribute to students' performance. Hattie (2015) used meta-analyses to rank influences that have been found to impact learning and achievement. In his study, *Visible Learning*, (Hattie, 2015) sought to answer the question: What works best for education? Hattie (2015) identified six areas of influence: the student, the home, the school, the curriculum, the teacher, and the teaching or learning approaches. Like the Higher Life Foundation (2016), these served as flat markers that help audiences, such as educational stakeholders, navigate Hattie's (2015) *195 Effects*. If Hattie's studies are valid, his research supports other literary findings that a multitude of contributions ultimately impacts evidence of student achievement.

Does teacher efficacy hold more weight than all the other influences? Does the role that high-stakes testing has played in teacher accountability positively or negatively affect student learning and performance? What role do instructional practices implement within the mathematics classroom play? Are there connections between the two? The researcher has reviewed each topic to look for connections between each theme.

Supporting Students to be Successful Math Thinkers

A 2014 study by Australian researcher, Poropat (2014), claimed that a measure of a student's IQ does not consider personality traits. His study determined that a student's measure of discipline is more accurate when predicting academic success in school (as cited in EdSmart, 2021). Poropat's (2014) findings suggested that the extent of a natural-born genius' intelligence will never be witnessed unless genius-like intelligence is coupled with discipline and a willingness to learn and understand at deeper levels. His findings correlate with Dweck's (2017) discussion of fixed and growth mindsets. IQ measures as a predictor of students' success reflect the idea that people are born with an innate intelligence that does not change (Dweck, 2017). In contrast, growth mindsets reflect the 'can-do' attitude, in which self-discipline and motivation lead to higher levels of student performance (Dweck, 2017). Furthermore, EdSmart’s (2021) article suggests that Poropat (2014) encourages teachers to help students academically succeed by helping them change their behaviors.

However, a 2021 study conducted by Vazsonyi et al. concluded that a student's IQ measure is a stronger predictor of academic achievement than self-control. In this literature, Vazsonyi et al. (2021) highlighted the results of a two-year study designed to replicate Duckworth and Seligman's 2005 study titled, *Self-Discipline Outdoes IQ in Predicting Academic Performance of Adolescents*. According to the literature, Vazsonyi et al.'s (2021) findings did not support the results of Duckworth and Seligman's (2005) research. Vazsonyi et al. (2021) acknowledged that little replication of Duckworth and Seligman's (2005) study existed and suggested that this may be due to cultural differences.

Duckworth (2018), author of *Grit: The Power of Passion and Perseverance*, describes grit as passion and perseverance for very long-term goals and having stamina. Similar to Poropat’s (2014) study highlighted in the 2022 article published by EdSmart (2021), Duckworth (2018) described that the strongest predictor of students’ successes comes from the measure of their grit. She explained that during research conducted with high school juniors, Duckworth (2018) sought to engage students with a questionnaire regarding grit; then, she waited to see who would graduate the following year. Duckworth (2018) found that students who measured grittier were more likely to graduate regardless of similar incomes, scores from standardized achievement measures, and students’ perceptions regarding feeling safe and comfortable at school (Duckworth, 2018). Duckworth’s literature supports the research of Dweck (2017). Duckworth (2018) claimed that to build grit in students, educators must facilitate learning through growth mindsets and encourage teachers to help students learn about how the human brain grows in response to challenges. These strategies help students become more likely to persevere, because students then understand that mistakes and failures are not permanent, rather than moments to reevaluate thinking to learn (Duckworth, 2018).

In *Smarter Than We Think*, Seeley (2014) described the word motivated as both “a word we can use to describe a person,” as well as “something someone does to another” (p. 29). Seeley (2014) declared that students can develop a positive attitude and approach toward mathematics and that the mathematics teacher significantly influences the development of this disposition. In the literature, Seeley (2014) discussed that students are more likely to be motivated through instructional practices that engage them in exciting and challenging math problems, rather than completing a page of exercises to practice a procedure (p. 31). She noted that teachers could help students shift from extrinsic to intrinsic motivation by helping them develop mathematical behaviors through conversational dialogue that helps students connect what is taught to what they have already learned (Seeley, 2014). According to Seeley (2014), these types of engagements facilitate a learning environment where students feel free to take the risk to speak up and share solutions. Seeley (2014) warned of over-praising students, but encouraged praising effort and process for students’ abilities to become smarter rather than correct answers (which could reinforce misinterpretations as to what it means to be smart).

Furthermore, Seeley (2014) acknowledged that many people from many different parts of the world find mathematics challenging. In the United States, many people believe that they cannot do mathematics; and this belief influences personal choices about paths in life (Seeley, 2014). Seeley (2014) stated that this kind of thinking has become acceptable to society in the United States. She rejected the belief that some people can do mathematics and some cannot, stating, “there is no evidence of *a math gene*” (Seeley, 2014, p. 72). Instead, Seeley (2014) declared that everyone could do math if they were provided with a variety of teaching approaches and engaged in various ways that promote learning math as representations of ideas, skills, and problems. She noted that many school improvements and mathematics reforms are met by those who have negative attitudes toward math. She theorized that this is closely related to resistance to change (Seeley, 2014). Changing from tradition can make people uncomfortable, as it may expose their math insecurities (Seeley, 2014).

Seeley (2014) voiced that it is the responsibility of teachers to help students ‘catch a good attitude’ when it comes to mathematics learning. Seeley (2014) encouraged teachers to embrace an ‘upside-down teaching model’ that deemphasizes the teaching of procedural steps, but facilitates opportunities for students to make mathematical connections during problem-solving through discussion. She explained that this kind of learning motivates students to feel that everyone has something to offer (Seeley, 2014). According to Seeley (2014), every student can develop a personal relationship with mathematics through mindset. This does not arrive at birth and is not fixed, but can be grown and developed so that students can see themselves as math doers (Seeley, 2014).

Research over the past few decades has shown that it is now possible for scientists to watch the brain at work, as young people and adults work through math problems (Boaler, 2022). Science can evaluate the brain as it grows and deteriorates (Boaler, 2022). Mateos-Aparicio and Rodriguez-Moreno (2019) described brain plasticity as the ability of the nervous system to change in response to extrinsic and intrinsic stimuli by reorganizing its structure, function, or connections. This is contrary to the past belief that the brain people were born with could not develop or change (Boaler, 2022). Three things happen in the brain when a new idea is learned: a new pathway is formed, an existing pathway is strengthened, and connections are made between pathways (Boaler, 2022, p. 1). Research has shown that brain development happens when these things are happening, thus leading to brain plasticity (Boaler, 2022). In *Mathematical Mindsets*, Boaler (2022) proclaimed that she wished all students knew about brain plasticity and that if students knew that they were changing their brains by learning math, this could influence their mindsets for math learning.

According to Boaler (2022), the discovery of brain plasticity evolved from research conducted during an early 2000s study regarding the preparation discourse for London Black Cab drivers. During the preparation, applicants were required to study for years to learn London's routes, streets, and landmarks; Boaler (2022) described this preparation as rigorous, stating that London was not built on a grid-like system; its structure is interweaving and interconnected. At the end of their preparation, research showed that the hippocampus (responsible for acquiring and using spatial information) of the London Black Cab applicants had significant growth (Boaler, 2022). When scientists compared this discovery to the growth and development of the hippocampus of London bus drivers, they noted that not as much growth and development had occurred and that this could be due to bus drivers' preparation involving more straightforward routes (Boaler, 2022). She explained that this was confirmation that more complex training produced more dramatic brain growth (Boaler, 2022). Consequently, Boaler (2022) relayed that research has shown that the hippocampus of retired London Black Cab drivers often shrinks, due to the decreased use of the brain's established pathways. According to Boaler (2022), more studies would follow, providing more evidence that confirms and supports the concept of brain plasticity.

Evidence from research regarding brain plasticity supports the idea that everyone can be successful in math learning (Boaler, 2022). Boaler (2022) acknowledged that a small population of children have specific special educational needs, but evidence of brain growth and adaptation in response to change provided support that, given appropriate instructional practices in a learning environment, all students are capable of achieving math learning regardless of ability. Brain plasticity also provides evidence that students possessing gaps or deficits in math learning can accelerate their learning, if provided with high-quality teaching and support (Boaler, 2022). Because of brain plasticity, “brain differences children are born with are not as important as the brain growth experiences they have throughout life” (Boaler, 2022, p. 4).

In the literature, Boaler (2022) referenced the studies of Carol Dweck. She reported that in Dweck’s study, 40% of children held a fixed mindset, and this is the belief that intelligence is something one has or does not possess; in contrast, 40% of children held a growth mindset and that this type of thinking aligns with brain plasticity (as cited in Boaler, 2022). The remaining 20% of children in Dweck’s study moved between the two types of mindsets (as cited in Boaler, 2022). Boaler’s (2022) literature also referenced Duckworth’s research regarding grit. Students with a growth mindset were grittier, more persistent, and less likely to give up than students with a fixed mindset (Duckworth, 2018). Boaler (2022) also cited Dweck’s findings that students with fixed mindsets were reluctant to try more challenging work as these students, had already predetermined their abilities to achieve. According to Dweck's work, students who held a growth mindset welcomed challenging and rigorous tasks, and these students looked at mistakes as motivation to try again and do more (as cited in Boaler, 2022). According to research highlighted in Boaler (2022), girls are more likely to possess a fixed mindset. This is evident through decreased female engagement and participation in STEM-related subjects, curriculum, and career pathways (Boaler, 2022).

Boaler (2022) stated that many students have fixed mindsets, due to praise. Like Seeley (2014), Boaler (2022) suggested that when students received fixed praise, such as being told they are smart for giving the correct answer or performing well, they would feel immediate gratification and pride. However, students experience dramatic feelings of failure when encountering unsuccess, which leads them to believe that they are not smart (Boaler, 2022). Boaler (2022) reported that an earlier study by Dweck praised 400 fifth-grade students using fixed praise and growth praise. In this example, 50% of the students were praised for being really smart, and the other half were praised for having worked really hard. Then, students could choose which assessment they would take next (one simple, the other challenging). The results of the study showed that 90% of the students who were praised for having worked really hard chose the more difficult test, and most of the students from the group that was praised for being really smart selected the easier test (Boaler, 2022). Boaler (2022) indicated that telling students they are smart sets them up for future struggles when things get difficult in all areas of learning and throughout life - not just math.

Likewise, reporter and data journalist for Education Week, Sparks (2020), reported that a recent study from the *Journal of Trends in Neuroscience and Education* provided evidence that growing critical thinking skills and cultivated motivation can be facilitated through the presentation of math instruction. The article, *Brain Science Backs Up Role of 'Mindset' in Motivating Students for Math*, explained how researchers used an electroencephalogram to measure electrical impulses and track brain activity, as college students solved math problems (as cited in Sparks, 2020). Students who were given standard math problems demonstrated better accuracy, but did not desire to move through the test (Sparks, 2020). In contrast, students who were given adaptive math problems demonstrated more motivation, as they continued solving problems and moving through the test (Sparks, 2020). Sparks (2020) referenced Boaler's (2022) *student growth mindsets*, emphasizing that math problems that adapt to growth include those that have: multiple representations or encourage various strategies, facilitate student inquiry, ask the problem before teaching the solution, and provide an opportunity for students to demonstrate thinking through drawings or visual representations. These learning opportunities encourage students to justify their reasoning and engage in both higher and lower-level math abilities (Sparks, 2020).

According to Boaler (2022), fixed mindsets support the idea that not all students are developmentally ready to learn specific levels of mathematical knowledge and that this is reflected in our educational systems. Boaler (2022) cited this as deficit thinking. She described this way of thinking as outdated and proclaimed that there is no "preordained pace at which students need to learn mathematics" (Boaler, 2022, p. 8). However, Boaler (2022) acknowledged that some students might be unready for some mathematics. However, it might be because they are missing foundational, prerequisite pieces that they have not learned yet, and this is not to be confused with the inability that their brains cannot grow and develop those connections.

Both Seeley (2014) and Boaler (2022) emphasized the importance of mistakes and struggle. In both sets of literature, mistakes are described as a critical phenomenon for learning to happen. Boaler (2022) relayed that students with fixed mindsets perceived mistakes as indications that they were not math people or were not smart; however, research has shown that a new synapse grows for every mistake made in math. Boaler (2022) described synapses as connections between pathways in the brain. According to Boaler (2022), the brain responds to mistakes differently. Whether or not a student is aware of a mistake, the brain responds to the conflict between an error and a correct answer by increasing electrical activity (Boaler, 2022). Alternatively, the brain responds to mistakes by firing a brain signal that reflects consciousness or awareness of the mistake (Boaler, 2022). Boaler (2022) explained that some teachers argue that this happens when students correct their mistakes, but research has shown that this happens even when students are unaware of their mistakes. This may be due to the brain being in a period of struggle (Boaler, 2022). Brain sparks occur more often when students make mistakes than when they produce correct answers (Boaler, 2022). Brain sparks will happen for all students, but those with a growth mindset will have increased sparks (Boaler, 2022).

Seeley (2014) stated that classrooms could be designed to emphasize teaching to learn from mistakes. She noted that mistakes could be productive opportunities, and teachers should learn to take advantage of mistakes, but it is not enough to require students to revisit or redo math problems (Seeley, 2014). Seeley (2014) encouraged teachers to create classrooms that consider how to handle student mistakes and use student mistakes as opportunities for modeling, discussion, and collaborative problem-solving engagement. This was further illustrated by Boaler (2022), as she described a classroom where teachers specifically called on students who had mistakes in their math. The students were willing to share their solutions and were proud of their mistakes, because they understood that mistakes were valued by their teachers (Boaler, 2022). Teachers who possess growth mindsets and seek to promote growth mindsets in their students should be okay with making mistakes in front of students. This teaches students how to handle their own mistakes through acknowledgment and conversation, which become powerful instructional approaches (Seeley, 2014). Seeley (2014) explained that giving students opportunities to fail benefits all students, especially those of high achievement. She described that high achieving students are often good at listening, memorizing, and task completion but often lack the experience with struggle (Seeley, 2014). Boaler suggested that students internalize failure, because they have been "brought up in a performance culture" (Boaler, 2022, p. 12). Seeley (2014) encouraged teachers to conduct ongoing formative assessments when teaching to learn from mistakes. Seeley (2014) warned that while students' discussing mistakes with classmates leads to good conceptual growth, students who make conceptual errors that represent undiagnosed misconceptions could later struggle with other related mathematics; therefore, careful attention must be placed on "how well every student is learning the mathematics targeted in the instruction" (Seeley, 2014, p. 60). Seeley (2014) suggested that choosing tasks that invite the sharing of solutions and include time for learning from solutions helps students understand that struggling with complex problems and making mistakes can grow intellectually. By utilizing grading policies that value learning from mistakes, students can develop mathematical habits of mind and develop essential skills for lifelong learning - not just in mathematics (Seeley, 2014). Boaler (2022) referenced Peter Sims, a writer for the *New York Times*, relaying that he summarized the habits of successful people. According to Boaler (2022), Sims indicated that successful people feel comfortable being wrong and, are willing to encounter new experiences and, are willing to go against traditional ideas and grapple with the struggle.

Boaler (2022) declared that when we help students approach mistakes positively, students feel liberated from the effects mistakes have on them. She illustrated many strategies for helping students change their mindsets regarding math mistakes. In one strategy, Boaler (2022) described students crumpling up a blank piece of paper, representing how they feel about making math mistakes. After throwing it at the whiteboard, students smoothed out the crumpled paper, traced the wrinkles, and colored the crumpled mess with different colors. This represented the brain making mistakes and creating new synapses (Boaler, 2022). In another strategy, Boaler (2022) explained that when students submit work, teachers can highlight their favorite mistakes, but warned that these mistakes should be conceptual mistakes instead of numeric ones. Boaler (2022) encouraged teachers to share these favorite mistakes to launch a discussion about where the mistake originated, why it was a mistake, and to celebrate that it was a good mistake because the student's brain was in a cognitive state of struggle, and it was sparking and growing. Making mistakes leads to increased synaptic connections and brain growth, whereas producing a correct answer leads to little brain activity (Boaler, 2022).

Science has determined that the brain can change and grow with opportunities for sustained, challenging tasks (Boaler, 2022). This can also be true for physical repair when the brain can adapt and grow to make up for impairment or deficits (Boaler, 2022). A fixed mindset can be caused by a variety of reasons, including the idea of giftedness and the belief that some are naturally better at learning and the types of praises received from parents and teachers (Boaler, 2022). These fixed mindsets result in fear of attempting more challenging tasks and poor and lower achievement (Boaler, 2022). In *Making Sense of Math: How to Help Every Student Become a Mathematical Thinker*, Seeley (2016) described that all students can do math if encouraged to develop a growth mindset, regardless of mathematics ability and achievement. She encouraged teachers to challenge traditional math teaching and learning strategies and emphasized the importance of teachers helping students gain mathematical knowledge and skills necessary for 21st-century learning.

Debating Between Procedural and Conceptual Math Teaching and Learning

The literature reviewed within this study suggested a possible debate surrounding procedural versus conceptual learning and instructional practices in math. The studies conducted by proponents and teachers' experiences contrast with proponents who have claimed that studies prove that number sense and fluency are the key to mastery, and teachers who have resounded that careful scaffolding and instruction followed by practice through discovery are the keys.

Baker (2017) conducted a study to explore the philosophies of mathematics. He illustrated an overview of historical philosophies regarding math theory. According to Baker (2017), there are four math philosophies: logicism (truths of mathematics are truths of logic), intuitionism (mathematics is a result of constructive mental activity of humans), formalism (mathematics are symbolic and meaningless claims), and Platonism (mathematics is abstract and an exploration of an existence outside of humanity).

Izmirli (2019) conducted pedagogical research that discussed reflections on the philosophy of mathematics education concerning arguments of time and content. According to Izmirli (2019), mathematicians decide what math is taught, how it is presented or what instructional practices to implore, and decisions about the course and timeframe for its implementation based on their philosophy of mathematics education. He acknowledged that philosophical views regarding mathematics education influence these decisions, whether a mathematician realizes it or not (Izmirli, 2019).

Like Izmirli (2019), Ernest's (2018) book titled, *The Philosophy of Mathematics Education*, explained that mathematics education reflects social groups' goals, purposes, and rationales. Therefore, one's teaching and learning of math is founded upon philosophy applied to or of mathematics education, philosophy of mathematics applied to mathematics education or education in general, and philosophy of education applied to mathematics education (p. 3). Ernest (2018) described these philosophies as complex and interrelated, as he discussed the essential questions that contribute to the formulation of one's philosophy of mathematics education.

Considering the complexities and implications of philosophical influences on the development and implementation of mathematics in school, the researcher explored literature relevant to education reform and the role that it has played in the procedural and conceptual learning of math. Furthermore, the researcher explored literature relevant to procedural and conceptual instructional practices and students' math learning.

Decades of Math Reform

In *Math Education in the U.S.: Still Crazy After All These Years*, Garelick (2016) provided a brief history lesson regarding educational reform that he suggests initiated as a response to the Soviet Union's launch of Sputnik in 1957. According to Garelick (2016), this prompted the U.S. Congress to draft directives with expectations to motivate new and improved math and science learning in America's schools. He also credited that this national effort was in conjunction with the National Science Foundation (NSF; Garelick, 2016). Furthermore, Garelick (2016) discussed that mathematicians from the mathematics community designed the curriculum to introduce geometry and trigonometry to algebra, which resulted in calculus being taught in high school (p. 9). It also resulted in elementary teachers having to teach number bases, set theory, and axioms (Garlick, 2016, p. 9). Consequently, these changes made it appear that students were not learning basic arithmetic. Garelick (2016) illustrated this by explaining that students could tell you that 5 + 3 = 3 + 5, but could not relay that the value equaled 8 (p. 9).

Garelick (2016) acknowledged that past and present mathematicians agreed that the curriculum deemed to be new math had a flaw in its design. However, the math was mathematically correct and is still used by many algebra and geometry teachers today (Garelick, 2016). According to Garelick (2016), these teachers understand the why and how regarding how these concepts should be taught. Garelick (2016) also discussed that mathematicians were actively involved in schools' math curricula until the 1970s. Students learned math concepts that reflected real-life scenarios relevant to consumer roles in economics, containing little depth or substance (Garelick, 2016). According to Garelick (2016), more reform followed; however, the "controversy over K-12 math education has come to be known as the 'math wars'" (p. 8). Garelick (2016) credited this to mathematicians from the math community excluded from curriculum development and the commercialization of mathematics texts by entities such as the NSF combined with organizations, such as the National Council of Teachers of Mathematics.

In a study conducted by Gokce and Guner (2021), 40 years of mathematics education were examined from 1980 to 2019. As mathematics education transitioned from the new math era and moved through the 1980s (due to social and technological changes), the NCTM developed recommendations for reformation in mathematics education (Gokce & Guner, 2021). Perspectives regarding cognitive thinking in mathematics were developing, and problem solving became a focal point in the math curriculum of schools (Gokce & Guner, 2021). Gokce and Guner (2021) asserted that teachers had difficulty implementing these into lessons, as there was no direction in expectations; however, the 1990s would bring more definitive directives for strategic instruction of problem-solving. Gokce and Guner (2021) also recognized constructivism's notable impact on math education reform in the 1990s, explaining that the curriculum expected learners to construct new knowledge, and conceptual understanding was emphasized. According to Gokce and Guner (2021), NCTM principles and standards for school mathematics determined curriculum and evaluation, and mathematics education in the 2000s shifted from a "cognitive and informative processing framework to constructivist orientation" (p. 515).

Gokce and Guner (2021) examined literary pieces from 1980 to 2019. In their study, Gokce and Guner (2021) used a bibliometric tool to help search for the frequency of keywords in literature collected and analyze the number of mathematics education literature from the 40 years. The research showed trends in mathematics education-related articles from 1980 to 2019. This was a gradual increase from 1980 to 1999 that almost doubled every five years between 2000 to 2019 (p. 518). Eleven articles appeared to have been published from 1980 through 1984 and 33 from 1995 to 1999 (p. 518). Gokce and Guner's (2021) findings showed that during the 2000 through 2004 period, 59 articles appeared to have been published, with 451 articles published from 2015 through 2019 (p. 518). Furthermore, Gokce and Guner's (2021) research revealed that the top five most frequently used terms in mathematics education-related literature during these 40 years appeared to be: science education, reform in mathematics education, professional development, curriculum, and achievement (p. 519). The least frequently-cited terms in mathematics education-related literature appeared to be longitudinal studies, teacher beliefs, teacher learning, early childhood, and algebra (p. 519). Scattered in the middle of this list include problem-solving, teacher education, assessment, motivation, teaching practice, and educational policy (p. 519). Gokce and Guner's (2021) findings provided evidence that depicted the educational system's trends and 'buzzwords' in education and highlighted the notable increase of literary pieces published throughout each decade, which could be evidence that supports that society has increased its interest in education outcomes.

Small (2019) highlighted the NCTM and recognized its central documents and the influence it has had on mathematics education. Chapter One of Small's (2019) *Understanding the Math We Teach and How to Teach It*, explained that the mathematics education community believes that students learn best when they are actively engaged in constructing their own understanding; therefore, classrooms must emphasize multiple avenues of approaching math problems and celebrate students' mathematical reasonings. She indicated that this style of teaching and facilitating student learning is increasingly supported by research (Small, 2019). Small (2019) acknowledged that stakeholders, such as educators, parents, and the community hold different perspectives regarding what constitutes a valuable math education. These differences can vary across the United States (Small, 2019). Small (2019) discussed the importance of the teacher's role in helping students learn mathematics. Research supports that teachers possess pedagogical content knowledge along with cognizance of how learners process and development understanding (Small, 2019). Small (2019) asserted the importance that teachers help their students develop a "positive mindset" when learning math (pp. 10-11).

Small (2019) described big ideas in math as ways to organize strands of learning that "connect new ideas to related ideas that have been previously learned" and that this is "more likely that the new knowledge will be assimilated" (p. 16). Small (2019) explained that big ideas in math are looked at differently by researchers and curriculum developers (some view mathematical domains as big ideas, and sometimes these are reflected through each state's standards). Small (2019) also discussed how the Common Core State Standards (CCSS) language was written to express what is to be taught rather than big ideas. She explained that mathematical processes are standards described through NCTM and CCSS.

In *Between the State and the Schoolhouse*, Loveless (2021) discussed the challenges presented by the CCSS Initiative. He explained that the 1983 release of *A Nation at Risk* called for America's educational systems to raise school performance expectations and that this was a response to the U.S. economic vulnerabilities following a recent recession (Loveless, 2021). Loveless (2021) reported shifts from local control (school districts) to states enacting requirements, such as accountability practices and encouraging educational reforms. He cited that the NCTM published the *Curriculum and Evaluation Standards for School Mathematics* in 1989 and that this became the model for school mathematics instruction and learning. According to Loveless (2021), an essay providing an argument for standards-based reform by a dean and doctoral student from Stanford University resulted in systematic school reform. Systematic school reform would include establishing challenging standards, integrating assessments for accountability, and addressing teacher training, licensing, and evaluation; all of these would be aligned to producing specific outcomes. In his literature, Loveless (2021) noted the argument made by Ball and Cohren during the 1990s. Ball and Cohren challenged the implementation of such reforms indicating that requiring teachers to change their instructional methodologies based on policy is not as easy as changing an article of clothing (as cited in Loveless, 2021). According to Loveless, Ball and Cohren relayed that "the ability of teachers to learn new ways of instruction is bound up with their knowledge of subject matter and ideas concerning teacher and student roles and how students learn" (as cited in Loveless, 2021, p. 37).

According to Loveless (2021), the administration of former U.S. president, Bill Clinton, led to writing national standards that could be used as a model for states to write their standards for school curricula. However, these were challenged with each core subject's standards scrutinized by different stakeholders (Loveless, 2021). Similar to Garelick (2016), Loveless (2021) reported that math standards written by NCTM were criticized by professional mathematicians who claimed that they promoted the use of calculators over standard algorithms and supported “fuzzy math” (p. 38). Loveless (2021) also suggested that much of the standard’s criticism was fueled by a philosophical debate between educational progressivism and traditionalists. Much like Garelick (2016), Loveless (2021) explained that there was much disagreement between constructivism in math versus traditional math. Furthermore, reformers and traditionalists battled over the necessity and importance of basic arithmetic and its role in math learning (Loveless, 2021). Additionally, math reform encouraged the moving away from direct instruction by teachers to student-centered instruction that moved the role of the teacher from one that imparts knowledge to the facilitator of learning (Loveless, 2021).

In the 2000s, No Child Left Behind (NCLB) was established and implemented by the former United States president, George W. Bush (Loveless, 2021). The policy reflected through NCLB projected that all students would perform with "proficiency" by 2014 (Loveless, 2021). Although states developed and implemented their own curriculum standards and assessment measures, accountability in proficiency would be upheld at the federal level (Loveless, 2021). More accountability implications were established for failing schools (Loveless, 2021). According to Loveless (2021), the era of both the Clinton and Bush administrations resulted in ambitious growth in a systematic reformation of educational establishments. However, the policy made it possible to develop and assess standards and enact sanctions on schools that failed to reflect proficiency through test-based student performance (Loveless, 2021). Furthermore, the policy could not control what was happening in the classroom (Loveless, 2021). Loveless (2021) cited Timar as pointing out that most of these policy initiatives "emanated from education progressives, not from the public" (p. 45).

While states determined their starting points and established levels of proficiency reflective of local standards, states also participated in the National Assessment of Educational Progress (NAEP) tests that had their own measurements of proficiency; and because there was a discrepancy between the two measures, stakeholders with educational policy questioned the validity of state assessments compared to those of the NAEP (Loveless, 2021). According to Loveless (2021), NCLB became scrutinized for having such high expectations that could not be reached. At the same time, having allowances for states to measure proficiency at such low levels made it too easy for states to reflect proficiency achievement (Loveless, 2021). In response, CCSS would emerge (Loveless, 2021). In the literature, Loveless (2021) explained that the Common Core project was funded through the Bill & Melinda Gates Foundation (motivated by an investment opportunity in the innovation of publications and productions of curricular materials and resources).

In a final draft, the CCSS was approved as research-based and reflective of high-performing expectations (career and college readiness) by a committee of stakeholders, including academics, policy, and education (Loveless, 2021). According to Loveless (2021), some members, who identified as education traditionalists, would later attest that they did not sign off on approval of the draft. Loveless (2021) referenced committee member Stotsky, professor in the Department of Education Reform at the University of Arkansas, as disgruntled by the lack of requested citations that suggestively supported the claim that the CCSS was backed by scientific research; she claimed that the evidence was never provided.

According to Loveless (2021), even though the debates surrounding philosophical differences regarding the CCSS content and practice endured, the public still favored the idea of a standard national curriculum; therefore, CCSS achieved bipartisan support. The CCSS defined *mathematics instruction* as involving three dimensions: conceptual understanding, procedural skills and fluency, and applications (a synonym for problem-solving; Loveless, 2021, p. 80). Although the CCSS called for each dimension to receive equal attention, Loveless (2021) described the arguments between traditional and progressive mathematics proponents. Progressivists argued that math traditionalists emphasized rote memorization and process learning reflected through drill and kill exercises (Loveless, 2021). In contrast, traditionalists warned against the focus of conceptual understanding proclaiming that it ignores important computational skills that are necessary for calculation and reflects riddled mathematics (Loveless, 2021).

Perception Matters

Loveless (2021) illustrated this debate when he referenced Boaler's concerns regarding the wording of 'fluency' in the CCSS. Boaler (2022) warned that the CCSS used the term fluency with math facts. This may encourage teachers and administrators serving as test writers to equate it to timed testing and that memorizing math facts through practice is damaging (as cited in Loveless, 2021, p. 81). Loveless (2021) noted that this contradicts the thinking of those refuting progressive math reform. For example, traditionalists argue that working memory has limited storage. Because routine tasks are stored in long-term memory, memorization of facts and processes for algorithms is necessary for freeing up working memory to learn more complex concepts (Loveless, 2021, p. 82). In the literature, Loveless (2021) noted that others voiced concern that inquiry and discovery instructional practices do not accredit memory's role in high-level thinking. Likewise, Garelick (2016) argued that traditional math facilitates mastery learning of math, leading to automaticity that frees up working memory allowing students to use facts and procedures to engage in critical thinking. Loveless's (2021) illustration provided evidence that perception of mathematics teaching and learning influences the development (what is taught and assessed) and implementation (the methodology and instructional practices) of curriculum standards.

The emphasis on preparation for high-stakes testing and teacher evaluation based on students' test scores led to much resistance to the CCSS and resulted in some states opting out (Loveless, 2021). Such obstacles regarding the debated curriculum and the challenges of transitioning to computerized assessments led to pushback (Loveless, 2021). Parental pushback canvased throughout social media also contributed (Loveless, 2021). According to Loveless (2021), the CCSS offered pieces that both progressive math reformers and traditionalists could support. However, as the 2014 deadline of NCLB approached and states were granted waivers freeing them of sanctions, the development, and implementation of CCSS became a bargaining piece between local and federal entities (Loveless, 2021).

In *Elementary School Teachers Struggle with Common Core Math*, a link between teacher preparations required to teach math that students are expected to know for state testing contrasted sharply with math methods teachers learned in their preparation courses in college (Ostashevsky, 2016). Ostashevsky (2016), in The Hechinger Report, wrote, "We used to teach procedural math, but now students are required to know the why and how" (p. 1). If the premise of Common Core is correct, then students must understand why and how (Boaler, 2022). Additionally, the practices that teachers have been taught to use for decades, such as rote memory, must be replaced with new methods that help students develop number sense and fluency (Boaler, 2022). It can be interpreted that rote memory is no longer enough and that students must become fluid in numbers (Boaler, 2022).

The disconnect between conceptual and procedural learning was illustrated by Dixon, a professor of math education at Central Florida, when she said, “A problem exists when pre-service teachers have to take regular college classes and a ‘methods’ class.” (as cited in Ostashevsky, 2016, p. 1). These can include college algebra and higher math when more meaningful preparation classes could be taken instead to help better prepare teachers to learn new methods (Ostachevsky, 2016). Some argue that college algebra is unnecessary when teaching younger students to discover (Ostashevsky, 2016). Ewing, president of Math for America, claimed that “because teachers are generalists, they do not understand math in the way that a specialist would” (as cited in Ostashevsky, 2016, p. 3). Ewing favored a system where teachers were trained as math specialists and then tutored other teachers (cited in Ostashevsky, 2016).

Similarly, Bell, dean of the University of Michigan’s education school, disagreed with those who say that teachers who cannot teach Common Core math do not know math (as cited in Ostashevsky, 2016). She felt that teachers need to be involved in classes that teach math in the way that Common Core dictates that students learn it (as cited in Ostashevsky, 2016). If this is the case, teachers would certainly be the student and experience the math, as their students would in the Common Core mathematics classroom (Ostashevsky, 2016).

In the past, procedural learning was the way teachers were trained in the teaching of mathematics (Boaler, 2022). In *Fluency Without Fear: Research Evidence on the Best Ways to Learn Math*, Boaler (2015) relayed that "Common Core deemphasizes the value of memorization of math facts, and that the misinterpretation of the word 'fluency' in the Common Core are commonplace…encouraging that persistence of damaging classroom practices across the United States" (p. 1). Rote memorization was found to be harmful to students (Boaler, 2022). Boaler (2022) related that many students do not memorize well, which does not predict whether they can conceptualize math. However, it limits their thinking when they are forced to take timed memorization tests that produce anxiety (Boaler, 2022). Unfortunately, students who do not memorize well have come to believe that they are not good at math and avoid it (Boaler, 2022). Instead, Boaler (2022) wrote that students need to develop number sense (the way of looking at numbers other than rote memorization of facts). This was the key to a rich and lasting relationship with math and higher math learning and success (Boaler, 2022).

Alternatively, in *Lessons in How Not to Teach Math*, Garelick (2016) disagreed with theorists who promoted the use of so-called authentic learning that was part of Common Core math. He maintained that all math problems are authentic; therefore, procedural learning was discovery learning (Garelick, 2016). Garelick (2016) related that careful scaffolding where students learn concepts scaffolded one upon another and then practiced in discovery is both procedural and authentic. Garelick (2016) argued that as students learn concepts using a set of problems and then practice using slightly different problems, it becomes discovery as they are activated and built upon prior knowledge. In his interpretation, the Common Core discovery that teachers were currently expected to teach leaves students confused (Garelick, 2016).

Jarema (2017), a founder of Googol Learning, Crazy 4 Math, Kidzinfo, and TVvgFree.com, agreed with Garelick (2016). Jarema (2017) related, "Learning multiplication and memorizing times tables are building blocks for other math topics taught in school–higher learning such as division, long multiplication, fractions, and algebra" (p. 1). She continued, "as well as the thinking that the quick recall of multiplication facts was essential not only for school but for everyday life tasks such as cooking and shopping" (Jarema, 2017, p. 1). Children must be able to recall and not depend on charts and calculators (Jarema, 2017). In *The Importance of Memorizing Times Tables*, Jarema (2017) shared that, "Students who rely on calculators are weak in estimating skills and are unaware of wrong answers from keying in mistakes." (p. 1). Jarema (2017) was in favor of a combination of both memorization and understanding. According to Jarema (2017), the best was not to isolate either method as the best to use, but to use both. Jarema (2017) indicated that children must be able to recall multiplication answers quickly to be proficient when they get to higher math. Kids should be taught that multiplication was a way to add numbers quickly and that each fact was simply a group of number sets. Her thinking differed from Boaler (2015), who claimed that the rote memorization caused undue anxiety and a fear of math that was grounded by the inability to memorize easily. Jarema (2017) explained that trouble memorizing multiplication facts and other facts should cause concern. The anxiety comes not from the inability to memorize but from a learning problem that could affect achievement in other areas in schools.

In *Effective Math Instruction: Hiding in Plain Sight*, Garelick (2016) argued that the number of students identified with learning disabilities in the United States has increased. Using statistical information from the National Center for Educational Statistics in 2015, he compared the number of students identified with learning disabilities in 1976-1977 with those in 2013 and described this comparison as nearly tripling. Research and studies demonstrated that early literacy and correct instructional practices with phonics and decoding to children in disadvantaged backgrounds resulted in fewer learning disabilities diagnosed. Garelick (2016) argued that this same effective prevention measure applies to mathematics. He questioned whether these students labeled with learning disabilities could have prevailed to receive effective instruction with more traditional teaching practices (Garelick, 2016). Garelick (2016) claimed that extensive research had been put into early interventions in reading, but no effort has been exerted in mathematics. Garelick (2016) described those resisting these efforts as math reformers. According to Garelick (2016), math reformers mischaracterize traditional math teachings as strictly rote memorization, teacher-centered, routine- and skills-based, and explicitly procedural. He accused reformers as arguers that traditional math does not encourage critical thinking and authentic learning, and because of this, traditional math does not fit the needs of 21st-century learning (Garelick, 2016). Math reform rejected that procedural fluency precedes understanding and encourages conceptual understanding before procedural fluency (Garelick, 2016). This often leads to students using inefficient procedures for years before learning standard algorithms (Garelick, 2016).

Furthermore, Garelick (2016) discussed how changing the Individuals with Disabilities Education Act to the Individuals with Disabilities Education Improvement

Act brought about Response to Intervention (RtI) programs and that the RtI movement potentially led to the decreasing number of students identified as learning disabled. While Garelick (2016) acknowledged that many factors potentially influenced the number decrease, he referenced RtI as addressing the learning needs of low achieving students by providing them with explicit and systematic instructional practices that these students needed in the first place. He questioned why the "RtI" style of teaching is not the instructional practice favored to begin with, instead of "waiting to heal the casualties of reform math" (Garelick, 2016, p. 47). According to Garelick (2016), there is an existing deficit in research examining the effectiveness of reformed math compared to traditional methods. Traditional math methods may have been taught poorly, but that does not mean they should be abandoned (Garelick, 2016). With proper implementation, traditional methods can facilitate engaging questions and challenging problems that reflect complexity, rigor, and conceptualism (Garelick, 2016).

Likewise, a 2017 study conducted by Selvianiresa and Prabawanto (2017) was built upon the works of Piaget and Brunner, in that students build long-lasting learning with more profound levels of understanding when the learning is related to one's experiences and multiple concepts are connected. Selvianiresa and Prabawanto (2017) expressed that mathematics is hierarchical and systematic. To learn math, students must master initial concepts built from simple concepts that build and lead to complexity. In their study, Selvianiresa and Prabawanto use a teaching and learning approach described as Contextual Teaching and Learning (CTL). According to this practice, students apply what they know mathematically to lessons relative to context. This type of teaching and learning helps students better tackle difficult or complex math problems (Selvianiresa &

Prabawanto, 2017). In their literature review, Selvianiresa and Prabawanto (2017) reported that spiraling math is math, where concepts to be taught are prerequisites for what learning is to come. These are connected to previously mastered concepts (Selvianiresa & Prabawanto, 2017). They also reported that the methodology of mathematical learning is inductive, but that concepts must have a process to be reached (Selvianiresa & Prabawanto, 2017). According to Selvianiresa and Prabawanto (2017), contextual teaching and learning apply seven important pieces when planning for effective teaching and learning. These are described as teaching and learning reflecting a constructivist philosophy that encourages students to ask questions (Selvianiresa & Prabawanto, 2017). These inquiry-based instructional practices should be utilized as students collaborate through learning communities (Selvianiresa & Prabawanto, 2017). In their quasi-experimental study, modeling is identified as a critical component of effective contextual teaching and learning and the implementation of reflection exercises with authentic assessments of students' learning (Selvianiresa & Prabawanto, 2017). Initially, both classrooms were given a pre-test to identify the connected mathematical ability of their students. Over six periods, CTL methods were used as instructional practices for one classroom, whereas direct instruction or teacher-centered learning were used for the other classroom. A post-test was used to measure the connection mathematical ability of students. Selvianiresa and Prabawanto's (2017) study concluded that CTL methods could improve students' ability to connect mathematical concepts. This results in students deepening their development of mathematical competence and motivation to become independent learners (Selvianiresa & Prabawanto, 2017).

In *Why Our Kids* Don't Get Math, Ganem (2017) reported that 49% of Maryland high school graduates were entering college short of the knowledge that they needed to gain access to take math classes. Ganem (2017) relayed math-centered programs they wished to pursue; many of them had to take remedial courses before taking for-credit courses or changing courses of study to avoid math. This was surprising, because these students took and passed upper-level high school math classes and were not able to achieve at a level that was satisfactory in college (Ganem, 2017). Ganem (2017) disclosed, "I have done my share of tutoring for middle and high school students (his own), and I know how little understanding is conveyed in those classes. Ironically, much of the problem is a blind focus on raising math standards" (Ganem, 2017, p. 1). He questioned why students are being forced to focus on what he called "developmentally inappropriate" levels of math assigned to middle and high school children (Ganem, 2017, p. 1). In his words, this level of inappropriateness was "bizarre" (Ganem, 2017, p. 1).

In three points, Ganem (2017) gave his reasons for the 'why' of it. Ganem (2017) explained that *difficulty* can be confused with *rigor*. Was it possible that rigor, meaning a high level of engagement and learning, was being confused with the level of difficulty (Ganem, 2017)? Ganem's (2017) second point explained that education today has taken a turn that has mistaken *processes* for *understanding*. Because students can plug numbers into an algebraic expression or spit out the multiplication facts, they do not understand ideas or numbers (Ganem, 2017). Similarly, in a conversation with Zimba (one of the lead writers of the Common Core Math Standards), Northern (2016) sharped Zimba's response about the difference between memorizing and knowing, "I don't think the issue is word choice. The difference is technical. Memorizing naturally refers to a process, whereas knowing refers to an end." (p. 1). Ganem's (2017) third point was that students should be taught developmentally appropriate math concepts.

Tondevold (2019), who refers to herself as the 'recovering traditionalist,' unfolded many considerations to teaching elementary math in her video blog, *How to Teach Elementary Math Without a Textbook*. She relayed that to teach elementary math without a textbook one must understand the progression of students' learning, and she describes this as non-negotiable. Tondevold (2019) referred to math curriculums as a guide designed according to standards, but explained that these are end results and tell educators nothing about what students know and still need to know about the concept at hand. Understanding where students are developmental, where we need to get them, and how to help them progress to that endpoint is critical to good teaching of mathematics (Tondevold, 2019). Tondevold (2019) indicated that a good math curriculum is built around student needs. Good math learning should include these three instructional practices: number sense (not number skills), story problems (understanding the concepts within the story, not necessarily the skill), and purposeful practice (not drill and kill) (Tondevold, 2019).

Moreover, in her blog, *Developing Mathematical Proficiency: Why You Shouldn't Teach Math Through a Textbook*, Tondevold (2019) described the interwoven strands of mathematical proficiencies, as described in the National Research Council's (2021) Adding It Up: conceptual understanding (why), procedural fluency (how), productive disposition (purposeful math for life-long learning), strategic competence (authentic problem-solving), and adaptive reasoning (explain justify, and reflect). Tondevold (2019) proclaimed that these proficiencies are connected, because some students will develop conceptual understanding but not be fluent enough to produce the correct answer through the process. In contrast, some students will demonstrate procedural fluency, but do not possess an understanding of the 'why' (Tondevold, 2019). Tondevold (2019) acknowledged that not all these mathematical proficiencies would be developed and grown through textbooks' instructional paths. Tondevold (2019) cited an illustration from *Adding It Up* (National Research Council, 2001) highlighting the triangular relationship between the teacher, the student, and the mathematics during instruction. In order to grow all math proficiencies, interactions between the teacher, the student, and the mathematics must happen inside a context (Tondevold, 2019).

Like Ganem, Tondevold (2019) expressed the importance of students' being developmentally ready to learn mathematical concepts and content. Tondevold (2019) referenced the *Cognitively Guided Instruction* (CGI) movement as facilitating and promoting the development of mathematical proficiencies, as mentioned in *Adding It Up* (2001). According to Tondevold (2019), CGI was designed to help teachers understand the development of children's thinking. She explained that teachers were to use what they learned about developing children's thinking to help drive instructional practices (Tondevold, 2019). Teachers analyzed how children approach and solve word problems intuitively (Tondevold, 2019). By examining how children solve problems intuitively without instruction or directive, Tondevold (2019) reported that teachers could make decisions about what math students should learn next, or in other words, drive instruction. Tondevold (2019) suggested that students who learned through CGI practices scored just as well on basic computational content compared to those taught with more traditional methodologies, but scored significantly higher in problem-solving and higher-level thinking. “Fidelity to students is better than fidelity to textbooks” (Tondevold, 2019, Vlog).

In *A Textbook Case in Textbook Adoption*, Garelick (2016) provided a framework for the process of adopting new textbooks. He explained that in 2005 there were 13 math series textbooks funded by the Education and Human Resources Divisions of the National Science Foundation (NSF) based on math standards developed by NCTM. Garelick (2016) reported that NCTM’s standards reflected that critical learning is more important than factual learning. It is better to learn how to think and learn in a fast-changing world, rather than learn the information itself, as it will change sooner than later (Garelick 2016). Garelick (2016) claimed that this leads to a laissez-faire approach to math learning and the belief that a student will eventually get it (later than sooner) and encourages spiraling, but detours from repetitive practices. In textbook adoptions, he described the first tactic as one in which school districts or boards publicly state that the traditional approach has not worked (Garelick, 2016). He illustrated this by referencing the 2005 textbook adoption case. Garelick (2016) explained that the school board’s academic officer referred to a debate between traditional versus nontraditional math. According to Garelick (2016), the academic officer eluded that traditional math is characterized as drill, practice, and rote memorization, and nontraditional is more real-life and conceptual math learning. As evidence that the traditional approach to math teaching and learning did not work, the academic officer suggested that traditional math learning does not stick (Garelick, 2016). However, Garelick (2016) challenged this thinking by pointing out that unless one uses learned math every day, one is bound to get rusty (and many jobs in the workforce do not require the daily use of math learned during schooling years). Garelick (2016) suggested that there is evidence that traditional math works in test scores from text series that were not on the 13 NSF-approved lists (such as *Saxon Math*). Garelick (2016) suggested that countries like Singapore and Japan use traditional math and score at the top of international math tests. The second tactic school districts and boards will do when pushing to adopt new textbooks is to patronize stakeholders who have opposing views or voice concerns as being politically affiliated or nonrepresentational of the community (Garelick, 2016). In the third tactic, Garelick (2016) claimed that school districts and boards would declare that the fidelity of any program depends on teachers and that this downplays textbooks and emphasizes the quality of teacher roles. He tied this argument to teacher accountability, claiming that textbooks adopted by schools are never held accountable for poor test scores, but accountability points back to the classroom teacher (Garelick 2016). Garelick (2016) described tactic four as bringing in teachers from more affluent school districts as witnesses. Garelick (2016) warned that comparing schools with different demographics is unfair, because students from more affluent schools are likely to score higher, due to accessibility to resources. These could include better and more frequent tutoring opportunities, obtaining help from parents who can provide help, and having more access to high-quality supplemental materials (Garelick, 2016). In the last tactic, Garelick (2016) illustrated that school districts and boards would assemble expert panels or have an independent consultant summarize the results of the textbook adoption process. According to Garelick (2016), newer teachers will always have better buy-in regarding textbook adoption, because they are well-versed in child-centered and discovery learning. Garelick (2016) noted that the selection and adoption of textbooks is an unfair burden to teachers who are held accountable for their effectiveness, or lack thereof. It is an unfair burden to impose on students who may not have access to outside tutoring or parents that can help teach them what they are not being taught to do (Garelick, 2016).

Alternatively, in *Between the State and the Schoolhouse,* Loveless (2021) highlighted the positive effect that the development and implementation of CCSS had on textbook publications regarding curriculum and instruction. He noted that common standards meant that textbook production costs would decrease because materials would be produced nationally instead of companies producing multiple versions of textbooks that comply with each state's varying standards (Loveless, 2021). Loveless (2021) eluded that the widespread implementation of such resources acting under heterogeneous conditions may have been ideal for "conducting good evaluations" (p. 133). Although, the argument could be made that uniform standards do not increase the likelihood of evaluation and instructional materials that improve the quality of a rigorous curriculum (Loveless, 2021). Loveless (2016) pointed out that critics claimed that textbook companies flooded the education world with too many math texts that proclaimed to be aligned with Common Core. Instead, many of these were just older versions remarked or that some were aligned to Common Core but contained too much focus on some math topics and not enough emphasis on others (Loveless, 2016). EdReports.org helped determine whether math textbooks were aligned with CCSS by providing independent reviews that evaluated focus and coherence, rigor and mathematical practices, and usability (Loveless, 2021, p. 137). Loveless (2021) indicated that alignment is not content but produces different outcomes in students' demonstration of math learning, despite strategies to evaluate alignment. Loveless (2021) further illustrated that the "weak relationship between alignment and effectiveness" is found in the evaluation of Singapore math, according to the EdReports process (p. 139). According to research by Loveless (2021), the series based on Singapore math, *Math in Focus*, does not pass the evaluation measures of EdReports, because its content to be assessed includes standards that are above the specified grade level. Nevertheless, research shows that *Math in Focus* is one of the few textbooks with evidence of its effectiveness (Loveless, 2021). This contradiction may provide evidence to support Tondevold's (2019) claim that helping students achieve mathematical proficiency is less likely to occur if teaching through textbooks that are frequently misleading in terms of effectiveness.

Loveless (2021) explained that the development and implementation of CCSS led to a productive discussion regarding teaching and learning practices as standards dictated what students were to learn. However, CCSS helped stakeholders collaborate to define those methodologies concerning procedural and conceptual math learning (Loveless, 2021). In *Teacher Learning of Ambitious and Equitable Mathematics Instruction*, Chen (2022) of Vanderbilt University described three shifts when teachers learn to develop ambitious mathematics instructional practices. In the first shift, Chen (2022) referenced learning terms and practicing procedures as traditional ready-made math that promotes memorization and algorithms, while deemphasizing student sense-making. She explained that mathematical practices that engage students with argumentation that require justification and proof allow students to develop equal parts conceptual understanding and procedural fluency (Chen, 2022). Chen referenced Horn and Kane (2019). Chen (2022) explained that teachers consider many components when designing lessons and planning for instructional activities, including classroom management factors. These can include seating charts and the availability of materials, manipulatives, or technology resources (Chen, 2022). Communication embedded within the flow of the lesson and formative avenues of assessing students' learning in the lesson could be considered (Chen, 2022). Chen (2022) relayed that these components are often based on teachers' perceptions of good math instruction, but also based on schools' institutionalized policies. In this shift, Chen (2022) explained that the focus is not to emphasize the necessity to supplement material for the existing curriculum, rather than to focus on developing and using deeper math learning tasks. Chen (2022) described rich instructional activities as beginning with a low floor starting point. Regardless of ability level, low floor starting points allow all students to begin somewhere and leads to a high ceiling that allows all students to explore multiple avenues with various knowledge levels (Chen, 2022). This type of facilitated learning allows students to share and compare their solutions leading to a deeper understanding of the task's concepts for all students regardless of their ability level (Chen, 2022). Chen (2022) discussed that planning for these instructional activities is difficult because teachers must know how to make the scenario meaningful and relatable to all students within the group. Teachers tend to make cognitively demanding tasks and *proceduralize* them, resulting in students arriving to correct answers, allowing teachers to feel that content was adequately covered (Chen, 2022). However, it does not provide students with the opportunity for sense-making (Chen, 2022). Chen (2022) emphasized that developing these tasks requires teachers to know their students' familiarities (launching points), plan for pace (allocating the time necessary for seeing the task through), and structure students' interactions during the learning to plan for students' sharing or presentation of findings. In the second shift, Chen (2022) explained that teachers must adjust their understanding of what the math class sounds like. For example, Chen (2022) described the traditional dialogue exchange as looking like teachers asking initial questions with students responding and teachers evaluating students' responses (Chen, 2022). According to Chen (2022), asking students how to do something mathematical limits students' responses and promotes evaluative responses from the teacher, and this scenario closes the opportunity for sense-making. Chen (2022) reported that when teachers prioritize students' sense-making, they shift their questioning to more informative-seeking questions that are more open-ended and unlikely for students to be able to answer. She referenced Hintz and Tyson (2015), claiming that informative-seeking questions require teachers to listen differently and make decisions during learning impulsively (Chen, 2022). She acknowledged that some teachers might need more support in making this shift in classroom management without losing control of the learning environment (Chen, 2022). In the literature, Chen (2022) emphasized the importance of students comparing their works, making conjectures, and critiquing each other's works, as these communications deepen students' understanding. In this shift, Chen (2022) highlighted the importance of student status within the classroom and how mitigating status differences is key to facilitating meaningful and equitable learning. However, assigning roles for students during small group instruction was challenging for teachers to navigate suggested. The final shift required teachers to change their perspectives regarding who is in math class by shifting from thinking about students' mathematical abilities in terms of high, medium, and low classifications to inclusive mindsets that lead to the nature of mathematical competence (Chen, 2022). Chen (2022) explained that according to Horn and Gresalfi (2021), teachers need to understand what it means to be mathematically smart and design their classrooms that help motivate students to become mathematical thinkers. According to Chen (2022), shifting from ‘doing school,’ which looks like students conforming to the norms of a school, to ‘doing math’ involves moving away from those traditional schooling expectations that might include homework with due dates to students being elbow deep in authentic math investigations. The authenticity of math investigations is dependent on perspectives of knowing, doing, and explaining (Garelick, 2016). So, what does mathematical understanding look like?

In its position statement, the National Council of Teachers of Mathematics (NCTM) declared that *procedural fluency* is crucial in developing mathematical proficiency, but is more than memorizing facts or procedures (NCTM, 2022). The NCTM (2022) described *procedural fluency* as using appropriate math procedures with accuracy and efficiency. According to the NCTM (2022), students who can apply procedures to various problems and contexts are procedurally fluent. Additionally, the NCTM (2022) described *procedural fluency* as connecting appropriate strategies to different problems and demonstrating an understanding of how the two interrelate. NCTM (2022) also reported that conceptual understanding can be achieved through instructional practices that highlight the connection between facts, procedures, and ideas and require students to grapple in their mathematical thinking. NCTM (2022) declared that research shows that students instructed in learning environments that facilitate conceptual understanding practices demonstrated a comparable performance in skills-based knowledge (or more) than those instructed in a learning environment that focused on developing skills.

“It is a widespread belief that to be good at math means to be fast at computation” (Seeley, 2, p. 22). Seeley (2014) explained assumptions regarding the mastery of foundational and computational skills. According to Seeley (2014), an assumption is made that students do not need to move on to more complex computational problems until they demonstrate mastery of basic computational skills. She claimed that educators tend to only extend the use of calculators to students who have demonstrated computational mastery (Seeley, 2014). She claimed that these preconceptions hold students back from developing other talents in mathematics (Seeley, 2014). Seeley (2014) described mathematical fluency as dependent on the concept. For example, fluency can describe a student's ability to navigate computational scenarios (Seeley, 2014). It can also describe a student's ability to "tackle challenging problems that go beyond computation" (Seeley, 2014, p. 24). Seeley (2014) charged educators to balance computational proficiency with computational understanding and use computation to motivate the development of conceptual understanding.

An equal part and balanced approach are warranted in *Why We Need an Understanding-first, Procedures-second Mindset When Teaching Mathematics* (Andrew, 2021). Andrew described procedures-first and understanding-second as a mindset or approach to teaching and learning math (Andrew, 2021). In his blog, Andrew (2021) identified himself as an early proponent of procedures-first, understanding-second teacher, who used instructional practices that emphasized procedural fluency and guided students to understanding through routines. While focusing heavily on procedures and then understanding, Andrew (2021) realized that some students would never reach levels of understanding, and those who did only possessed enough understanding to implement the procedures and skills necessary to navigate the concept, but did not demonstrate true conceptual understanding. Therefore, Andrew (2021) evolved his instructional practices to reflect an understanding-first, procedures-second mindset. Andrew (2021) identified flaws that significantly impacted students' math learning through the procedures-first, understanding-second approach. He stated that this type of teaching reduces the chance of students developing conceptual understanding and a specific lack of conceptual knowledge (Andrew, 2021). Andrew (2021) also reported that when students do not understand math, they develop a dislike for math and a negative mindset that demotivates them. Andrew (2021) highlighted the importance of procedural instruction and suggested that teaching procedures be a priority in instructional practice. However, Andrew (2021) advocated that research showed that learning is meaningful when students can use their knowledge to discover and make connections to new information. Andrew (2021) described instructional practices that promote an understanding-first, procedures-second mindset as those that encourages students to use their own thinking but lead to procedural learning. These activities should be structured, but also student-centered (Andrew, 2021). Furthermore, Andrew (2021) explained that these practices should allow students to collaborate to discover and determine the procedures necessary. These activities should further develop students' conceptual understanding of the content (Andrew, 2021).

In comparison to Seeley (2014), Bay-Williams and SanGiovanni (2021) described the term 'fluency' in mathematics as multifaceted. In *Figuring Out Fluency in Mathematics*, Bay-Williams and SanGiovanni (2021) explained that fluency in language means that there are multiples ways of saying things. However, if fluency in the language is not demonstrated, there is only one way to say something, which depends on the conversationalist's words (Bay-Williams & SanGiovanni, 2021). Bay-Williams and SanGiovanni (2021) reported that procedural and computational fluency do not have the same scope. Instead, computational fluency refers to four basic operations (add, subtract, multiply and divide). In contrast, procedural fluency goes beyond computational fluency, including comparing/contrasting, simplifying or discovering equivalency, and proportional reasoning (Bay-Williams & SanGiovanni, 2021). They also acknowledged that basic fluency is a mastery of working with single-digit numbers such, as fact families (Bay-Williams & SanGiovanni, 2021).

Traditional approaches to developing procedural fluency include instructional practices that provide specific steps and rules followed by application and practice (Bay-Williams & SanGiovanni, 2021). By contrast, procedural fluency practices that reflect efficiency, flexibility, and accuracy increase the development of conceptual understanding, because procedural fluency and conceptual understanding are interrelated concepts (Bay-Williams & SanGiovanni, 2021). Like Boaler (2022), Bay-Williams and SanGiovanni (2021) implied that traditional approaches with procedural fluency led to students' self-doubt and a sense of defeatedness. However, students develop positive mathematics identity and agency when procedural fluency works hand-in-hand with conceptual understanding (Bay-Williams & SanGiovanni, 2021). According to Bay-Williams and SanGiovanni (2021), the most effective instructional practices for fluency development include those that

> establish mathematics goals to focus learning, implement tasks that promote reasoning and problem-solving, use and connect mathematical representations, facilitate meaningful mathematical discourse, pose purposeful questions, build procedural fluency from conceptual understanding, support productive struggle in learning materials and elicit or use evidence of student thinking. (p. 19)

Bay-Williams and SanGiovanni (2021) provided fallacies and truths about mathematical fluency. These fallacies are categorized by language, standard algorithms, access and equity, and teaching and assessing. In the first fallacy, they proclaimed that fluency is not about basic facts suggesting that this could be a misinterpretation reflected through textbooks using the phrase *fluency practice* concerning exercises involving basic facts (Bay-Williams & SanGiovanni, 2021). Instead, mathematical fluency is multifaceted, including more than just basic facts, such as multi-digit operations, fractional and proportional relationships, and number sense (Bay-Williams & SanGiovanni, 2021). The second fallacy described by Bay-Williams and SanGiovanni (2021) contradicted some of Garelick's (2016). "Ideas about mastery, automaticity, and fluency are tangled," and the terms are "used interchangeably" but are not the same thing (Bay-Williams & SanGiovanni, 2021, p. 25). According to Bay-Williams and SanGiovanni (2021), mastery and automaticity are outcomes, whereas procedural fluency is navigation through conceptual understanding. Bay-Williams and SanGiovanni (2021) also indicated that the belief that representations are strategies is a fallacy. They illustrated this by explaining that strategies are ways students think about numbers, but visual representations (although good in supporting reasoning) does not reveal student thinking (Bay-Williams & SanGiovanni, 2021).

Fallacies regarding standard algorithms are that strategies and algorithms have the same meaning; however, this is false because strategies are flexible by design, and algorithms support one-way paths to correct answers (Bay-Williams & SanGiovanni, 2021). Bay-Williams and SanGiovanni (2021) described the fifth fallacy in fluency as the belief that standard algorithms are the best choice. However, standard algorithms are sometimes necessary; they should not replace strategies (Bay-Williams & SanGiovanni, 2021). Furthermore, Bay-Williams and SanGiovanni (2021) indicated a fallacy in fluency when it comes to the standardization of standard algorithms; different geographic locations representing different cultures use different standard algorithms with different notations. Bay-Williams and SanGiovanni (2021) explained that while some believe that some students are better off knowing just one way, students should know multiple useful strategies and be able to determine the appropriateness of using each strategy (the when and why).

According to Bay-Williams and SanGiovanni's (2021) literature, fluency requires higher-level thinking, but some believe "procedural fluency is a low-level cognitive experience" (pp. 36-37). However, mathematical fluency involves students using generalizations and judgments to navigate concepts (Bay-Williams & SanGiovanni, 2021). Bay-Williams and SanGiovanni (2021) described learning concepts and procedures are a fallacy regarding fluency. Instead, they referenced NCTM's position indicating that procedural fluency should coincide with students' conceptual learning as the two components are interrelated and intertwined, not linear (Bay-Williams & SanGiovanni, 2021). There is not a specific setlist of strategies for every concept in math; Bay-Williams and SanGiovanni (2021) explained that the "must-know" list of strategies includes those that are "efficient, usable, and generalizable" (p. 41). According to Bay-Williams and SanGiovanni (2021), it is a fallacy that skills tests evaluate a student's fluency; fluency is separate from accuracy. Lastly, Bay-Williams and SanGiovanni (2021) indicated that conceptual understanding, procedural fluency, and application in mathematics are equally important and must be well-balanced during instruction, contrary to the belief that conceptual learning is more critical than learning skills.

While Garelick (2016) implied that a procedures-first, understanding-second approach to math learning is most often warranted, he acknowledged that research shows that neither procedure nor concept should be underemphasized, but scaffolded between the two. Garelick (2016) also acknowledged that "sometimes understanding comes before learning the procedure, sometimes afterward" (p. 124); more importantly, teachers must recognize when their students are ready to receive procedural or conceptual instructional practices. His literature indicated that struggling students require more explicit and direct instruction and that these students' growth and achievement are limited through student-centered instructional practices (Garelick, 2016). Garelick (2016) proclaimed that "procedural fluency provides the appropriate context within which understanding can be developed" but that the degree of emphasis is dependent on students (p. 125).

Accountability in Measuring Students' Successes

In *Understanding the Math We Teach and How to Teach It,* Small (2019) described the assessment as the formal or informal gathering of data about student knowledge and skills. She categorized assessment into three components: assessment for learning, assessment as learning, and assessment of learning. During assessment for learning, Small (2019) described students as active participants and educators as actively evaluating each student's strengths and weaknesses for instructional direction and designing and implementing instructional paths for learning to progress. When teaching, educators intervene as students grapple with learning tasks, and teachers provide corrective guidance as students grow their thinking (Small, 2019). Small (2019) suggested that this kind of intervention provides an assessment that helps teachers grow individual students and that low-achieving students are the ones who most benefit. According to Small (2019), assessment as learning involves students using self-reflection to compare what they have discovered with others. Such practices are typically modeled by the teacher (Small, 2019). Small (2019) described learning assessment as having multiple purposes, explaining that it can provide information about students' mastery of specific concepts and content or summatively evaluate the end of a unit or course (Small, 2019). This type of assessment provides evidence of students' learning and can include tests or quizzes and evidence observed or collected through conversation (Small, 2019).

Small (2019) discussed evaluation as the process of assigning a value to a students' evidence of learning. This can include one piece of evidence or multiple pieces of evidence, whereas grading is the act of reporting this value to students and parents, and other educational stakeholders (Small, 2019). Small (2019) acknowledged that emphasis has shifted from assessment of learning to assessment for learning and assessment as learning. In mathematics, Small (2019) highlighted good assessments as those that are: appropriate for their purpose, aligned with students' needs and expectations, fair to all students, help assist students with their own learning, set high yet realistic expectations, including a variety of assessment formats, and balances both content and process, as well as measures growth over time (pp. 38-39). Small (2019) explained the differences between small- and large-scale assessments. Small-scale assessments include classroom observations and conversations, learning tasks and assignments, portfolios, and performances on tests and quizzes (Small, 2019). Large-scale assessments include standardized testing built around state and local curriculum standards, as well as the

National Assessment of Education Progress (NAEP) or Trends in International Mathematics and Science Study (TIMSS), which are randomly administered (Small, 2019).

In preparation for large-scale assessments, such as the Missouri Assessment Program (MAP) administered by the Department of Elementary and Secondary Education (DESE), Small (2019) reported that the goal should be for students to understand the curriculum and that the focus should not be on student performances. Small (2019) asserted that students should be encouraged to do their best and not be too deterred by unknown things. Instead, educators should encourage students that some items on the assessment may involve concepts or content that they do not understand or know (Small, 2019). This is okay because the assessment is designed to embrace many topics that will not be familiar to every student (Small, 2019). Small (2019) expressed the importance that students are familiar with the types of formats presented on large-scale assessments. Small (2019) relayed that the goal is not to emphasize how well students should perform; she warned educators not to spend too much time focusing on previously released items, rather than helping students understand the curriculum.

Similarly, Seeley (2014) described high-stakes testing as summative assessments tied to a decision being made based on results or outcomes. Seeley (2014) explained that these large-scale assessments could lead to educators “teaching to the test” (p. 139). Seeley (2014) indicated that benchmark testing, such as interim tests in preparation for the year-end test, interrupts instruction and learning time and increases students’ test anxieties. She warned that teaching mathematics for understanding and proficiency results in real preparation for high-stakes testing (Small, 2019).

In *Between the State and the Schoolhouse*, Loveless (2021) suggested that political organizations raise policy when the state's test scores increase, but blame policy when test scores decline. Loveless (2021) reported that existing research from 2020 presents mixed positive or negative effects of the development and implementation of CCSS on student achievement. According to Loveless (2021), the research does not provide evidence that CCSS improved student achievement in measures of equitable achievement. However, it also does not support the claims that Common Core State Standards are responsible for stagnant growth in academic achievement (Loveless, 2021, p. 132). Loveless (2021) acknowledged that achievement gaps widened between 2009 and 2019, but indicated that research does not support that this is tied to CCSS.

According to Loveless (2021), the problem with the development and implementation of CCSS was that it initially claimed not to be a curriculum that specified standards with instructional practices, but that this proved to be challenging in that it would inevitably lead to changing curriculum and instruction. While research does not suggest positive or negative effects on student achievement from CCSS, teacher surveys revealed that math instruction has a stronger emphasis on conceptual understanding and problem-solving than procedural skills (Loveless, 2021). Furthermore, Loveless's (2021) literature indicated that research does not show that the instructional changes that resulted from CCSS have increased student achievement and that textbooks endorsed by EdReports.org lack evidence of effectiveness on student achievement (p. 158). Loveless (2021) suggested that future policymakers should: scrap standards-based reform, provide flexibility in standards, evaluate assessment and accountability systems, make teaching easier and more effective, and focus future research on the technical core of schooling (pp. 162-169). He suggested a lack of reliable evidence to suggest that one instructional approach or curriculum is better than the other (Loveless, 2021).

Assessment and accountability policies may work against student achievement (Rose, 2022). *The Grade-Level Expectations Trap* explains that shifting the rigor to produce college- and career-ready students has led to the need for more consistent expectations; however, standards and measures leave out the consideration of diverse learners (Rose, 2022). According to Rose (2022), standards and measures do not promote individual learning needs or appropriate pacing. Rose (2022) implied that when schools do not meet expectations in terms of student achievement, they must not have established expectations that reflect rigor. Although classrooms reflected through each grade level are full of diverse learners, some may be performing at grade level where others are below. Rose (2022) expressed that grade-level expectations in terms of content promote that grade-level learning is best for all students and lacks the acknowledgment that students possess different levels of knowledge regardless of grade level. Rose (2022) declared that summative assessments in math aligned to grade levels are tied to policies based on accountability systems. These evaluative measures are used for making decisions. Some evaluative measures reflect student growth in teacher-evaluation systems (Rose, 2022). According to Rose (2022), these scores are used as reliable data pieces that keep school communities focused on student performance outcomes and highlights inequities to be remedied. Teachers endure the implications of test scores through pressure to teach grade-level materials that prepare students for end-of-the-year testing (Rose, 2022). This may enable teachers to devalue students' prior knowledge (Rose, 2022). While education reform has emphasized the importance of measuring student growth, the United States Department of Education claims that including individual student growth and grade-level performance would violate the law of accountability provisions for student performance (Rose, 2022).

Crabtree (2021), of Curriculum Associates, defined adaptive assessments as those designed to individually assess each student by adjusting test questions to identify students' specific strengths and weaknesses reflected through content. These assessments are responsive to how students answer questions, providing more challenging questions to correct answers and yielding easier questions in response to wrong answers. This provides efficient and distinct information regarding where students are in their learning (Crabtree, 2021). Crabtree (2021) explained that these types of assessments differ from fixed-length assessments, known as summative assessments and that these can be high-stakes tests that are designed to measure student performance at the end of each school year. Fixed-length assessments limit students' abilities to show all that they know about a concept and do not adequately identify what students do not know about a concept (Crabtree, 2021). Adaptive assessments diagnose students' levels of proficiencies, and some connect to programs that provide the opportunity to maximize student growth through the creation of differentiated learning paths that remedy academic deficits and address enrichment needs (Crabtree, 2021). Crabtree (2021) asserted that teachers should help students understand that they cannot fail these types of assessments and that some students struggle with the level of difficulty as rigor increases in response to correct answers.

In an article published by Forbes, Ark (2019) expressed that standardized testing aims to identify struggling schools and groups of students performing poorly, due to inequities. Ark (2019) said that good schools already know students' levels of academic performance. Ark (2019) proclaimed that state-mandated tests do not consider what good schools with good teachers already know, but could move to adaptive assessments and end standardized testing. According to Ark (2019), some states are already making these changes. To accomplish such shifts, he suggested that districts and networks of schools should file for an assessment exemption and that filing would result in a comparability analysis to determine whether the assessment system would result in both achievement levels and growth rates (Ark, 2019). If so, Ark (2019) reported that a three-year exemption waiver would be granted. Through this exemption period, districts and school networks should work together to sample student profiles and monitor the accuracy of the adaptive assessment platform (Ark, 2019). Ark (2019) encouraged school districts to network with other schools and developed frameworks for goals and outcomes. He also discussed that the artificial intelligence scoring adaptive assessments could provide states with information about student performance reflective of school quality (Ark, 2019). *Measuring Growth in Test Scores is Key to Understanding Student Progress* explained that standardized tests show student performance from last year's student groups to this year's student groups. Measuring students' academic growth over time may be a better way to measure students' learnings (Martinez & Miller, 2018).

Blazar and Pollard published an article from 2017 titled, *Does Test Preparation Mean Low-Quality Instruction?* In their literature, Blazar and Pollard (2017) expressed that some stakeholders in education blame accountability for high-stakes testing, which lead to test preparation that takes away from high-quality instruction and promotes less-quality instruction, such as procedural practices. The article reviewed literature that indicated standardized testing assesses procedural and superficial content (Blazar & Pollard, 2017). However, tests that promote cognitive thinking and reflect real-life scenarios may motivate better classroom instructional practices (Blazar & Pollard, 2017). The article discussed a three-year study from 2012 by Valli et al. that reported less conceptual instructional practices and more procedural classroom activities as teachers prepared for upcoming state exams (Blazar & Pollard, 2017). According to Blazar and Pollard (2017), observations of math lessons in upper elementary classrooms were videotaped and scored based, on the *Mathematical Quality of Instruction* tool. The tool was designed to capture the cognitive demand of the math activities teachers provide to students, teachers' interactions with students around that content, and the accuracy of the delivered mathematical material (Blazar & Pollard, 2017). It reported that their study's analysis was based on the *Ambitious Mathematics Instruction* dimension. The researchers conducting this study scored teachers' instructional practices according to criteria categorized, such as linking and connections and explanations (Blazar & Pollard, 2017). Blazar and Pollard (2017) explained that teachers used student productions to mark whether these practices were present or not present during instruction. The data collected were analyzed to help categorize each teachers' lesson as engaging in explicit test preparation (or not). Then, the researchers looked at survey results asking teachers to identify which standardized testing techniques were used during their own teachings. The study's findings were consistent with suggestions that honing in on tested items instead of developing the content they aim to measure may take away from ambitious mathematics instruction (Blazar & Pollard, 2017). Test preparation factors negatively impact upper- elementary teachers' math instructional practices (Blazar & Pollard, 2017).

Furthermore, teachers invested more time to prepare for lessons that were deemed as engaging in explicit test preparation than those that were not (Blazar & Pollard, 2017). This might be evidence that more ambitious instructional practices that promote the engagement of all classroom learners may be better developed and implemented by classroom teachers if high-stakes testing was deemphasized or perhaps eliminated (Blazar & Pollard, 2017).

In *How to Improve American Schooling with Less High-Stakes Testing and More Investment in Teacher Development*, Behizadeh (2019) stated that half of Georgia's teachers leave the profession within five years. Behizadeh (2019) relayed that those doing so claimed that the profession demands too much testing of whose evaluation measures are unfair or unreliable and change too often, without seeking feedback from the professionals inside the classroom. At the national level, Behizadeh (2019) reported a survey indicating that teachers and students feel that too much testing takes away from other practical instructional activities. Behizadeh (2019) announced that high-stakes testing takes away opportunities for students to develop critical thinking skills. High-stakes tests emphasize recalling or memorizing facts or other tested information (Behizadeh, 2019). Behizadeh (2019) supported that high-stakes testing does not allow students to show their own evidence of learning.

Furthermore, Behizadeh (2019) stated that teachers underuse research-based theories and tools designed to help support critical thinking, due to test preparation. Behizadeh (2019) indicated that teachers should be included in designing curricula and assessments. It is a better use of professional development when teachers are involved in the scoring process of these assessments (Behizadeh, 2019). To improve teacher recruitment and retention, Behizadeh (2019) claimed that giving teachers more control over the design and implementation of curriculum and assessment is vital.

In *Smarter Than We Think*, Seeley (2014) stated that in response to student achievement growth, educational stakeholders, such as administrative leaders and policymakers should lead teachers in the way that it is expected for teachers to lead student learning in classrooms. Much like teachers are encouraged to not impart all knowledge to students rather than support students in their thinking as they navigate problem-solving, educational stakeholders should facilitate environments where teachers are part of the journey to solutions (Seeley, 2014). Seeley (2014) suggested that teachers exercise their thinking and reasoning skills by examining students' works and collaborating to discover misconceptions. She suggested that administrators should provide time for teachers to share instructional practices that showcase teachers' strengths and that this can help grow teachers' abilities to facilitate high-level learning (Seeley, 2014). Stakeholders within education, including policymakers, should engage teachers in discussions and listen to their input, because they are professionals on the front line (Seeley, 2014, p. 240). Seeley (2014) discussed the importance of encouraging, nurturing, and supporting teachers as they experience accountability from high-stakes testing. Moreover, Seeley (2014) explained that considering the pressures that teachers experience and the conditions in which teachers are expected to navigate to produce favorable outcomes measured by policymakers helps build relationships between administrators, educators, and all stakeholders within education. According to Seeley (2014), the most influential member in the community of education is the teacher.

Summary

In Chapter Two, the researcher investigated various literary resources regarding Common Core State Standards and high-stakes testing concerning instructional practices and efficacy. The researcher discussed broad influences that may impact student performance data while expanding upon the influential roles that education reform and high-stakes testing may potentially have on students' procedural and conceptual mathematics learning.

In Chapter Three, the researcher will discuss the framework, research design, and methodology for investigating the perceptions that educational leaders and teachers may have regarding accountability and the role that high-stakes test preparation may have on procedural and conceptual learning of math.

Chapter Three: Methodology

Purpose

In this study, the researcher gathered evidence to analyze the potential impacts of standardized testing, teacher accountability, and instructional technique and practices on elementary students' procedural and conceptual math learning. This mixed methods research project included two phases. The initial phase of the research was quantitative, using a questionnaire constructed by the researcher. The researcher analyzed the information collected from the questionnaire to conduct the second phase of the research. The second phase of the research included interviews with elementary teachers and building leaders. After the research process, the researcher sought to connect these data collections to compare student performance data reflected through the 2021 Missouri Assessment Program administered by the Missouri Department of Elementary and Secondary Education. The researcher also sought to compare the data from the research to the district-wide assessment tool: NWEA (Measures of Academic Process, 2021).

The research conducted throughout this study is essential to education because it can potentially impact how teachers and educational leaders approach students' performance data assessments. When administrators free teachers from the stigma of high performance and accountability, teachers may be released from the time constraints that high-stakes testing may put on instructional practices (Alzen et al., 2017). Additionally, this study sought to show potential relationships (if any) between the perception of instructional technique and practices within math classrooms compared to student growth and achievement. This study could provide evidence of the influence that teachers' and educational leaders' perceptions may or may not have on the instructional emphasis regarding procedural and conceptual learning of math-related to student performance on high-stakes tests and teacher performance efficacy.

Research Design

The researcher used the following questions to guide the research:

1. What are teachers' and educational leaders' perceptions of procedural and conceptual learning of math in preparation for high-stakes testing?

2. What influence (if any) has teacher accountability in preparation for high-stakes testing had on instructional practices?

3. How has high-stakes testing influenced district leaders' roles in supporting teachers' development and implementation of instructional practices?

Null Hypotheses

The researcher composed and investigated the following hypotheses in response to the research questions within this study:

Null Hypothesis 1

There will be no relationship between teachers' perceptions of high-stakes testing, and the third- through sixth-grade scores reflected through the math portion of the Missouri Assessment Program (MAP) as well as the math portion of the NWEA.

Null Hypothesis 2

There will be no relationship between district leaders' perceptions of high-stakes testing, and the third- through sixth-grade scores reflected through the math portion of the Missouri Assessment Program (MAP) as well as the math portion of the NWEA.

Creswell (2022), a Professional of Educational Psychology at the University of Nebraska-Lincoln, described a mixed-methods approach to research involving the combination and integration of qualitative and quantitative research and data. In this mixed-methods study, the researcher used integrative research methods of both quantitative and qualitative nature during the research process. Using the mixed methods design allowed the researcher to analyze both quantitative and qualitative research practices and fairly measure the results of the data obtained to check for bias, validity, and reliability. Maxwell (2013) explained, “This strategy reduces the risk that your conclusion will reflect only the biases of a specific method, and allows you to gain a more secure understanding of the issues that were investigated” (Maxwell, 2013, p. 102).

Quantitative research focuses on numerical analysis and objective measures (Creswell, 2022). In quantitative research, systematic research is gathered using structured research instruments such as surveys, and the research can typically be repeated provided the research has been found reliable (Creswell, 2022). Maxwell’s *Qualitative Research Design* explained that qualitative research is inductive and flexible (Maxwell, 2013). The process is designed to take “a less structured approach which allows the research to be focused on the particular question being studied” (Maxwell, 2013, p. 88).

Collective instruments implemented throughout the research included: closed-question surveys and Likert scales (quantitative measurements) and open-ended questions during interviews (qualitative measurements). While analyzing the data from both qualitative and quantitative instruments, the researcher looked for connections and emerging themes to validate or refute the researcher’s hypotheses. The researcher displayed collected data through the presentations of tables, charts, and graphs (quantitative displays). Participants' dialogues were recorded, and the researcher used inferential analysis strategies to relay participants' personal experiences and perceptions.

This study was executed in a two-phase design. Initially, the quantitative aspect of the research was conducted by administering a survey questionnaire. The qualitative phase of the research was constructed after the researcher collected and analyzed the quantitative data. This research design approach followed the explanatory sequential mixed methods model.

Population and Sample

This investigation sought to collect two separate sets of quantitative and qualitative feedback from elementary teachers and building leaders within a central-Missouri school district. The researcher has provided the following statistical information to detail the demographics further.

The school district selected to serve as the research site is centrally located in Missouri, along the I-44 corridor. The research site is located in a town that serves as the county seat. Because of its geographic location and large population of university students from all over the United States and international students, the community is composed of ethnic and economic diversity. The United States Census Bureau, in 2019, estimated the population as approximately 20,431 people, and its median household income was $37,000 between the years of 2015-and 2019. In 2019, the location's poverty percentage was an estimated 28.8%.

The research site's school district consists of three elementary schools, grades Kindergarten through third grade, that feeds into one middle school, grades fourth through sixth. It consists of one junior high school containing seventh through eighth grades and one high school hosting grades ninth through twelfth. The school district has a pre-Kindergarten program and a technical and vocational center.

This investigation aimed to explore the perceptions of elementary math teachers and building leaders to seek evidence or connections that high-stakes testing may have potentially influenced instructional practices. A current mathematics teacher within the research site, the researcher observed the populous number of incoming fifth- and sixth-grade students struggling with math proficiencies. These students take the Missouri Assessment Program and the district-wide assessment tool, NWEA. Because this investigation was specific to elementary student performance data in math, the researcher chose third- through sixth-grade mathematics teachers as the study's population. In this study, the total enrollment of students in third- through sixth grades at the research site included approximately 1,131 students.

Participants sampled represent a range of experiences, including first-year teachers and teachers nearing retirement. The three elementary schools within the research site each had four third grades within their buildings; 12 self-contained, third-grade classes within the school district with 12 third-grade classroom teachers of mathematics. The middle school has 12 fourth-grade classes; however, because teaching teams organized the middle school building, there are only six, fourth-grade classroom teachers in mathematics. There are 12 fourth-grade classes within the school district. Fifth-grade demographics reflect those of fourth grade. There are 12 fifth-grade classes at the middle school, with six fifth-grade classroom teachers in mathematics; therefore, district-wide, the research site had 12 fifth-grade classes. Sixth-grade classes at the middle school were organized by teaching teams of three; while there were 12 sixth-grade classes, it had four sixth-grade classroom mathematics teachers. Table 1 displays the demographics.

Table 1

Number of Teachers Instructing Math and Number of Students Enrolled

Position Title	Elementary A (preK-3)	Elementary B (preK-3)	Elementary C (preK-3)	Middle School A (4-6)	Total Number of Teachers	Total Number of Enrolled Students
3rd Grade Teachers	4	4	4	0	12	261
4th Grade Teachers	0	0	0	6	6	280
5th Grade Teachers	0	0	0	6	6	302
6th Grade Teachers	0	0	0	4	4	288
Totals	4	4	4	16	28	1131

Although the research in this study sought to investigate 27 classroom teachers of mathematics, Table 1 reflects the total number of third- through sixth-grade teachers as 28. Because the researcher is a fifth-grade teacher of mathematics included within the population's demographics, the researcher constructed the table to represent its accuracy. However, in the discussion of the research participants and results, the sample number is 27.

Six building leaders were asked to participate in this study. District-wide, the research site has three separate elementary buildings with one building leader for each. Each elementary houses preschool through third-grade classrooms. The middle school houses grade four through six classrooms and have three building leaders: a lead principal, an assistant principal, and a principal intern. Table 2 displays these demographics.

Table 2

Number of Building Leaders

Position Title	Elementary A (preK-3)	Elementary B (preK-3)	Elementary C (preK-3)	Middle School A (4-6)	Total Number of Building Leaders
Building Leaders	1	1	1	3	6

Before initiating this investigation, the researcher reached out to the superintendents of the school district. Because the researcher is a current teacher employed by the district, the researcher provided the superintendents with an introductory video introducing the research project. The researcher met with the district's chief superintendent to secure consent to conduct research within the elementary buildings and middle school. Permissions to conduct this research are reflected in the appendix of this document. After securing permission to conduct the study and after obtaining IRB approval, the researcher extended the invitation to third- through sixth-grade teachers of mathematics and elementary and middle school building leaders. The invitation to participate in the research included an informational video explaining the purpose of the study, expectations, and the consent-to-participate process.

Instrumentation and Data Collection

The researcher used a mixed-methods approach to conduct research within this study, and the research was conducted in two phases. The initial phase of the research was conducted using an instrument consisting of a quantitative questionnaire constructed by the researcher. The instrument was drafted and administered through *Qualtrics* in compliance with Lindenwood University Graduate Program. *Qualtrics* is a web-based software tool for creating surveys and polls to collect feedback using a variety of distribution means (Faulds, 2020).

The Math Instructional Practices and Accountability Questionnaires were a four-part instrument designed by the researcher that reflected the works of two existing survey tools. The Math Instructional Practices and Accountability Questionnaires were inspired by the Validation of the Teacher's High Stakes Testing Survey (Brockmeier et al., 2014). The tool designed for this survey used modified portions of the *Frequency of Mathematics Instructional Practices Survey* (Carney et al., 2015) and modified portions from both the *TIMSS Teacher Questionnaire* and *TIMSS School Questionnaire* (International Association for the Evaluation of Educational Achievement, 2018). Permissions granted to use and modify these instruments are reflected in the appendix of this document.

After the initial research phase of this project, the researcher analyzed data collected from the questionnaire to construct open-ended interview questions for the second phase of research. The second phase of research consisted of in-person interviews with consenting participants. The second phase of this research allowed the researcher to explore different trends from the questionnaire administered in the initial phase. At the same time, the researcher composed a few guiding questions for the interview process before the second phase of research. The composition of additional inquiries to be included were based on the analysis of results from the initial questionnaire.

A final analysis of the compiled data from the questionnaire and participants' interviews was referenced to compare to student performance data of the Missouri Assessment Program and the school's district-wide assessment tool, the Northwest Evaluation Association and Measures of Academic Progress (NWEA, 2021). The researcher sought to connect perceptions of elementary teachers and building leaders and the potential impacts that accountability from high-stakes testing has had on procedural and conceptual learning of math as reflected through students' scores.

Research Bias

Creswell's (2018) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* described various mixed methods designs. In this study, the researcher intended to follow the explanatory sequential model. Creswell (2018) defined explanatory sequential mixed methods as an approach to design research involving two phases. The first addresses the quantitative collection of data, and the second follows up with the qualitative collection of data. This research design approach allowed for the qualitative aspect to further explain the initial results of the quantitative data. Through this process, the researcher encountered challenges that could influence researcher bias.

According to Fetters (2020), *bias* can be defined as any deviation in the interpreted value from the actual value. Researchers can knowingly or unknowingly influence the investigation process, leading to invalid outcomes and poor credibility (Enago Academy, 2021). The researcher needed to consider her role as a fellow mathematics educator currently teaching within the school district serving as the research site, so that any preconceived ideas or personal biases did not interfere with the study processes. The researcher's role was to facilitate the investigation and ensure impartiality when analyzing qualitative and quantitative data collections. Enago Academy (2021) warned that biases could quickly occur during qualitative research if the researcher's role is susceptible to the research topic. The researcher considered other biases when developing the implementation of this investigation, including biases specific to design, instrumentation, and methodology, selection of participants, accessibility to participate, and data collection and analysis.

Ethical Considerations

Enago Academy (2021) described ethical issues as those involving validity, voluntary participation and consent, sampling, confidentiality, risk of harm, and research methods. In this investigation, the researcher sought to conduct an explanatory sequential, mixed-methods study in a research site that is the researcher's current school district of employment. The researcher acknowledged the ethical considerations that must be respected to ensure impartiality and protection of the study's participants' consent, anonymity, and risk of harm.

All consent forms, documentation and notes, and other records will be protected for three years. After three years, these items will be destroyed, as a measure to protect confidentiality. Consent forms were stored in a locked cabinet in the researcher's home office, and electronic forms or data were stored on the researcher's personal laptop, which is password protected and locked away when not in use.

The researcher acknowledged that the small sample size in this study posed a risk that individuals' responses could be identifiable during the second phase of research; therefore, participants were informed of this possibility. Each interview participant's name was assigned a pseudonym to protect the participant's identity. Some dialogue from the interviews was quoted in the final review of the study or utilized in ways that could potentially connect responses to respondents. Anonymity was the researcher's priority in keeping the integrity of this study secured and providing protection to participants engaging in the research. The participants who chose to engage in the second phase of this investigation received consent forms informing them of the investigation's purpose and relevance to education and information regarding the study's duration, including time allowance for survey completion and how the collected data would be used.

In developing this study, the researcher explored multiple instrumentation tools similar to her topic. Through this process, survey questions and methodology were carefully reviewed, selected, and composed with consideration to her role as a mathematics teacher. The instrument to be used in this study ensured impartiality. Because of the researcher's role within education and the topic relative to her school district, the researcher chose to sample elementary and middle school teachers. When considering the participants, the researcher approached the participants' input and responses with sensitivity and regard to the participants' positions within the research site.

According to Creswell (2018), the researcher needed to consider the quantitative results to follow up care and the methodology by which participants are selected for the second qualitative research phase. This could have been problematic for the researcher as potential extremes or outliers in the initial quantitative data could make it difficult for the researcher to correctly connect that information and create appropriate qualitative data questions to which to refer. The researcher considered concerns with validity, as not all pieces of the quantitative database would be expanded upon during the second phase of the study. Focusing on demographics could influence this. According to Creswell (2018), the researcher may also invalidate the data by concluding different samples within the study.

Researcher bias was described as the deviation in the interpreted value from the actual value (Fetters, 2020). Throughout this research, the researcher employed various tactics to prevent researcher bias. The researcher created follow-up questions (within the second phase of the research) that were open-ended and was careful not to influence participants' responses. The content of these questions was guided by the trends and themes that emerged during the analysis of the questionnaire results from the first phase of the study. During the initial data set analysis, the researcher took caution to connect emerging themes that led to questions for the interview, as this could potentially lead to issues with credibility and invalid results. These questions were constructed to promote acceptable responses by all participants. The researcher composed conversational interview questions and focused on word variation (the researcher incorporated the respondent's language during the qualitative data collection). Question-order bias was considered, and the researcher aimed to keep questions varied to prevent questions that led to other questions. The researcher continuously reassessed participants' data to keep it the focus of the research and minimize the opportunity for the researcher to use it to support the hypotheses embedded within this study.

Summary

In Chapter Three, the researcher provided a brief overview and introduction to detail the purpose of this research and its significance to today's educational organizations and practices. The researcher described various ways researcher bias may influence the research and identify strategies that the researcher will adopt to avoid or prevent these occurrences. Research questions and hypotheses have been provided to help explain the underlying questions to explore during this study. Throughout Chapter Three, the researcher expanded upon the chosen research methodology and design (explanatory sequential, mixed methods) and outlined a plan to implement survey instrumentation to the researcher's population sample, including teachers and educational leaders within the school district. The researcher discussed data collection systems and processes for analyzing qualitative and quantitative databases.

In Chapter Four, the researcher will discuss the results of the research conducted and expand upon the ideas of this study.

Chapter Four: Results

This exploration occurred within a Missouri school district near the I-44 corridor in central Missouri. It was designed to study teachers' and building leaders' perceptions of the role that math instructional practices in preparation for high-stakes testing may have played on the procedural and conceptual math learning of third- through sixth-grade students. The researcher used the following questions to guide the research:

1. What are teachers' and educational leaders' perceptions of procedural and conceptual learning of math in preparation for high-stakes testing?
2. What influence (if any) has teacher accountability in preparation for high-stakes testing had on instructional practices?
3. How has high-stakes testing influenced district leaders' roles in supporting teachers' development and implementation of instructional practices?

Null Hypotheses

The Null Hypotheses addressed in analysis were:

Null Hypothesis 1

There will be no relationship between teachers' perceptions of high-stakes testing and the third- through sixth-grade scores reflected through the 2021 math portion of the Missouri Assessment Program (MAP) as well as the 2021 math portion of the research site's district-wide assessment tool, NWEA.

Null Hypothesis 2

There will be no relationship between educational leaders' perceptions of high-stakes testing and the third- through sixth-grade scores reflected through the 2021 math portion of the Missouri Assessment Program (MAP) as well as the 2021 math portion of research site's district-wide assessment tool, NWEA.

A mixed-methods, explanatory sequential design was used to explore connections between teachers' perceptions and building leaders regarding instructional practices in the mathematics classroom and accountability from high-stakes testing. The research was conducted in two phases. In the initial phase of this research, 27 third- through sixth-grade teachers and six building administrators were asked to participate in a quantitative survey drafted and distributed through *Qualtrics*. The Math Instructional Practices and Accountability Questionnaire for Teachers (MIPAQ-T) *and* The Math Instructional Practices and Accountability Questionnaire for Leaders (MIPAQ-L) were constructed by the researcher using modified portions of the *Frequency of Mathematics Instructional Practices Survey* (Carney et al., 2015). Modified portions from both the *TIMSS Teacher Questionnaire* and *TIMSS School Questionnaire* (IEA, 2018) were also used. The MIPAQ-T and MIPAQ-L were inspired by the *Validation of the Teacher's High Stakes Testing Survey* (Brockmeier et al., 2014). Permissions granted to use and modify these instruments are reflected in the appendix of this document.

In the second phase of this study, the researcher conducted in-person interviews with willing participants from the MIPAQ-T and MIPAQ-L. These interviews allowed participants to explain their input on the survey and expand upon their personal experiences relating to procedural and conceptual learning, math instructional practices, accountability, and high-stakes testing. This chapter discusses the results from both phases of research.

The Math Instructional Practices and Accountability Questionnaire for Teachers

The survey tool distributed to 27 third- through sixth-grade teachers included 14 items categorized into four parts: demographic information, math instructional practices, accountability from high-stakes testing, and an invitation to participate in the second phase of research. *Qualtrics* reflected 15 responses to the survey; however, upon reviewing the survey results, data from 14 participants were collected and reported.

Demographics

Table 3, Table 4, and Table 5 show the percentages of participants according to age, gender, and ethnicity. Most teacher participants fell into the age categories of under 34 and 34 through 49 years, a combined 85.72%. Only one participant identified as between 50 and 65 years (14.29%). The survey indicated that only those identifying as female participated in the MIPAQ-T (100%). Roughly 93% of the participants identified as White (not Hispanic), and one identified as other (7.14%).

Table 3

MIPAQ-T Participants' Ages

Age	Percentage
under 34 years	42.86
35-49 years	42.86
50-65 years	14.29
66 + years	0.00

Table 4

MIPAQ-T Participants' Gender

Age	Percentage
female	100.00
male	0.00
nonbinary	0.00
non-disclosure	0.00

Table 5

MIPAQ-T Participants' Ethnicities

Ethnicity	Percentage
White (not Hispanic)	92.86
Black (not Hispanic)	0.00
Hispanic	0.00
Asian or Pacific Islander	0.00
American Indian or Alaskan Native	0.00
Other	7.14

Out of the 14 respondents, no participants identified as first-year teachers; however, one participant selected the 2 through 5 years range (7.14%). Most participants fell into the 6 through 12 years of teaching category, reflected as 57.14%. Table 6 shows the participants' feedback regarding their years of experience in education, whereas Table 7 shows the participants' years of experience teaching content specifically relative to mathematics. While 7.14% of participants possessed 2 through 5 years of experience in education, 21.43% of the participants possessed 13 through 19 years of experience teaching mathematics-specific content.

Table 6

MIPAQ-T Participants' Years of Experience in Education

Years of Experience	Percentage
1st year	0.00
2-5 years	7.14
6-12 years	57.14
13-19 years	21.43
20-26 years	14.29
more than 26 years	0.00

Table 7

MIPAQ-T Participants' Years of Experience Teaching Mathematics Content

Years of Experience	Percentage
1st year	0.00
2-5 years	14.29
6-12 years	57.14
13-19 years	21.43
20-26 years	7.14
more than 26 years	0.00

Nearly 43% of teachers participating in the MIPAQ-T identified themselves as teachers of all core-subject areas in elementary school. In contrast, roughly 57% of teachers participating in the MIPAQ-T reported their role in elementary education as part of a teaching team. Third-grade classrooms within the research site are contained classrooms, whereas the middle school's fourth-, fifth- and sixth-grade classes are organized by teams, and teachers are only responsible for assigned core-subject areas. The data reflected through MIPAQ-T's item number six could indicate that 43% of the participants were third-grade teachers at elementary schools, and 57% were teachers from the middle school. Furthermore, Table 8 shows the percentages of participants' descriptions of their teaching responsibilities, and Table 9 depicts the data collected regarding participants' assigned teaching content.

Table 8

MIPAQ-T Participants' Descriptions of Teaching Responsibilities

Responsibilities	Percentage
contained classroom (all core subjects)	42.86
team teaching (only specific subjects)	57.14

Table 9

MIPAQ-T Participants' Core-Subject Teaching Assignments

Core-Subject Area	Percentage
ELA	13.89
Math	38.89
Science	33.33
Social Studies	13.89

Math Instructional Practices

The MIPAQ-T surveyed participants regarding math instructional practices. Item eight of the MIPAQ-T addressed teacher behaviors and expectations regarding mathematical practices, whereas item nine addressed math instructional practices regarding number sense and computational fluency. Both items were designed for participants to indicate their level of agreement with statements regarding math instructional practices using a Likert scale.

In Table 10, 50% of teachers reported that they encouraged the discussion of the connections between various models and strategies daily. Additionally, 33.33% reported this practice as implemented two to three times per week. Nearly 92% of participating teachers indicated that they demonstrated to the class the correct way to use a particular procedure or model before they started solving problems. Twenty-five percent of teachers reported that their students solved problems that allowed for several different approaches two to three times per week, but 58.33% indicated that this was part of their daily math instruction. The data indicated a wide variety of instructional practices that involved the use of standard algorithms. Twenty-five percent of teachers reported presenting one standard method of solving a task or performing an algorithm daily, with 33.33% utilizing this strategy two to three times per week. While only 8.33% reported using this instructional practice once per month, 16.17% indicated that it was used once per week or never.

Nearly 58% of teachers surveyed disclosed that they avoided student errors and misconceptions daily, when a topic was first introduced, by explaining how to solve a problem before they start. In contrast to the literature, 91.67% of teachers reported that they explained the steps to a procedure or algorithm when they introduced new topics. Table 10 shows the results from item eight.

Table 10

MIPAQ-T Participants' Behaviors and Expectations of Math Instructional Practices

Math Instructional Practices	daily	2-3 times per week	once per week	2-3 times per month	once per month	2-3 times per year	never
I encourage the discussion of the connections between various models and strategies.	50.00	33.33	8.33	8.33	0.00	0.00	0.00
Students take notes on how to perform each step in a procedure or algorithm.	33.33	33.33	25.00	8.33	0.00	0.00	0.00
I demonstrate for the class the correct way to use a particular procedure or model before they start solving problems.	91.67	8.33	0.00	0.00	0.00	0.00	0.00
Students solve problems that allow for several different approaches.	58.33	25.00	8.33	0.00	8.33	0.00	0.00

Classroom tasks and activities are selected to provide opportunities for students to explain the mathematics behind an answer.	16.67	66.67	0.00	16.67	16.67	0.00	0.00
I present one standard method of solving a task or performing an algorithm.	25.00	33.33	16.67	0.00	8.33	0.00	16.67
Students analyze the connections between various models and procedures.	16.67	41.67	16.67	8.33	16.67	0.00	0.00
Classroom tasks and activities are based on their potential to encourage discussions of students' mathematical ideas.	15.38	46.15	15.38	23.08	0.00	0.00	0.00
I explain the steps to a procedure or algorithm when I introduce new topics.	91.67	8.33	0.00	0.00	0.00	0.00	0.00
I emphasize the use of multiple models for recording and communicating student thinking.	33.33	33.33	8.33	16.67	0.00	8.33	0.00
I avoid student errors and misconceptions when a topic is first introduced by explaining how to solve a problem before they start.	58.33	16.67	16.67	0.00	0.00	0.00	8.33
Students learn by copying down examples from a teacher demonstration.	38.46	38.46	7.69	0.00	7.69	7.69	0.00
I facilitate discussion about underlying mathematical concepts (i.e., composing or decomposing numbers).	41.67	33.33	8.33	16.67	0.00	0.00	0.00
I facilitate small-group or whole-class discussion on student thinking.	45.45	18.18	9.09	18.18	9.09	0.00	0.00

In Table 11, 50% of teachers reported that they encouraged the discussion of the connections between various models and strategies daily. Additionally, 33.33% reported this practice as implemented two to three times per week. Nearly 92% of participating teachers indicated that they demonstrated to the class the correct way to use a particular procedure or model before they started solving problems. Twenty-five percent of teachers reported that their students solved problems that allow for several different approaches two to three times per week, but 58.33% indicated that this is part of their daily math instruction. The data indicated a wide variety of instructional practices that involved the use of standard algorithms. Twenty-five percent of teachers reported presenting one standard method of solving a task or performing an algorithm daily, with 33.33% utilizing this strategy two to three times per week. While only 8.33% reported using this instructional practice once per month, 16.17% indicated that it was used once per week or never.

In contrast to the literature, 91.67% of teachers reported that they explained the steps to a procedure or algorithm when they introduced new topics. Nearly 58% of teachers surveyed disclosed that they avoided student errors and misconceptions daily when a topic was first introduced, by explaining how to solve a problem before they start. Table 11 shows the results from item nine.

Table 11

MIPAQ-T Participants' Math Instructional Practices in Number Sense and Computational Fluency

Math Instructional Practices	daily	2-3 times per week	once per week	2-3 times per month	once per month	2-3 times per year	never
drill and skill of addition and subtraction facts	25.00	25.00	16.67	16.67	0.00	8.33	8.33
drill and skill of multiplication and division facts	50.00	25.00	8.33	0.00	8.33	8.33	0.00
constructing part whole models or models to relate addition to subtraction	16.67	8.33	8.33	25.00	8.33	8.33	25.00
constructing arrays or other models to depict multiplication and division relationships	33.33	8.33	8.33	16.67	8.33	16.67	8.33
place value of whole numbers	33.33	16.67	0.00	25.00	16.67	8.83	0.00
decomposing and composing whole numbers	27.27	18.18	9.09	27.27	9.09	9.09	0.00
understanding and representing common fractions	27.27	18.18	9.09	27.27	0.00	9.09	9.09
computations with common fractions	18.18	9.09	27.27	27.27	0.00	9.09	9.09
ordering of fractions	10.00	0.00	20.00	50.00	0.00	10.00	10.00
relationship between common fractions and decimals	9.09	0.00	18.18	45.45	0.00	18.18	9.09
place value of decimal numbers	9.09	9.09	9.09	36.36	0.00	9.09	27.27
understanding and representing decimals	10.00	0.00	10.00	50.00	0.00	0.00	30.00

computations with decimals	9.09	0.00	9.09	45.45	0.00	9.09	27.27
rounding whole numbers	36.36	9.09	9.09	36.36	9.09	0.00	0.00
rounding fractions and decimals	9.09	0.00	9.09	36.36	9.09	9.09	27.27
estimating the results of computations	18.18	9.09	18.18	54.55	0.00	0.00	0.00

The collective data reflects that most teachers who participated in the survey favored instructional practices that support procedural learning and teaching. Math instructional practices that use language that suggests process were rated high, indicating that these practices were most frequently employed by third- through sixth-grade math teachers. Math instructional practices that could imply conceptual learning and teaching showed a more comprehensive range of percentages indicating that the frequency in which participants employed conceptual instructional practices varied, dependent on a wide range of factors.

Accountability and High-Stakes Testing

Teacher participants of the MIPAQ-T survey were asked to indicate their level of agreement regarding statements about high-stakes testing and accountability practices outside of instructional activities using a Likert-scale rating system. Table 12 displays item 10's responses. When lesson planning, 63.64% of surveyed teachers indicated that they *agree* that their lesson content is created to reflect what will be tested at the end-of-the-year MAP test; however, roughly 9% is reflected in each of the other categories. When reporting about using students' data from NWEA to create lesson content, the data suggested that teacher participants range between *disagreeing* and *agreeing*, with 0.00% reported in *strongly agree* and *strongly disagree*. Nearly 55% agree that time spent preparing students for high-stakes testing detracts from other core subjects' preparation times, but 27.27% indicated they *neither agree nor disagree*. Approximately 45% indicated that they *neither agree nor disagree* that MAP and NWEA data allows improvement of instructional technique and allows for the implementation of various instructional practices, but 36.36% indicated that it does. A combined 63.63% disagree or strongly disagree that students' scores from MAP and NWEA reflect the quality of their teaching; similarly, 54.55% *strongly disagree* that they are better teachers because of NWEA and MAP testing (27.27% *neither agree nor disagree*). Seventy-three percent of participants *agree* to spend more instructional time on certain math concepts than other math concepts, because of MAP testing. Most participants *neither agree nor disagree* that building leaders support the development and implementation of instructional practices. Nearly 55% *agree* that process teaching and procedural learning lead to more profound knowledge and mastery of math concepts, but 63.64% *agree* that teaching conceptually and conceptual learning leads to more profound knowledge and mastery of math processes. This could indicate that teachers surveyed had difficulty taking a position regarding their perception of procedural versus conceptual learning in preparation for high-stakes testing or that participants value both.

Table 12

MIPAQ-T Participants' Perceptions of High-Stakes Testing

High-Stakes Statement	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
When lesson planning, I create lesson content that reflects what will be tested at the end-of-the-year MAP test.	9.09	9.09	9.09	63.64	9.09

When lesson planning, I use student’s data from NWEA to create lesson content.	0.00	27.27	36.36	36.36	0.00
The time I spend preparing for high-stakes testing in math detracts from the time that I have to prepare for other core subjects.	0.00	0.00	27.27	54.55	18.18
MAP and NWEA data allows me to improve my instructional technique and implement a variety of instructional practices.	9.09	0.00	45.45	36.36	9.09
My students’ scores from MAP and/or NWEA are a reflection of the quality of my teaching.	36.36	27.27	18.18	9.09	9.09
I spend more instructional time on certain math concepts compared to other math concepts because of MAP testing.	0.00	0.00	9.09	73.73	18.18
I am a better teacher because of MAP testing and NWEA.	54.55	9.09	27.27	0.00	9.09
Educational leaders within my building provide guidance that help support the development and improvement of my instructional techniques and practices.	9.09	27.27	45.45	9.09	9.09
Process teaching and procedural learning leads to deeper levels of knowledge and mastery of math concepts.	0.00	9.09	18.18	54.55	18.18
Teaching conceptually and conceptual learning leads to deeper levels of knowledge and mastery of math processes.	0.00	0.00	9.09	63.64	27.27

Twenty-five percent of surveyed teachers reported spending three to four hours preparing or grading students' tests or exams, but 41.67% disclosed that they spent less than one hour. Most teachers indicated spending one to two hours reading and grading other students' work. About 58% percent expressed that they plan lessons by themselves for one to two hours, while 50% indicated that they spend one to two hours participating in professional development with colleagues. Student and parent collaboration reflected 41.67% and 50%. Fifty percent of teachers participating in the MIPAQ-T reported spending one to two hours updating students' records. Table 13 shows percentages of participants' responses to item 11.

Table 13

MIPAQ-T Participants' Accountability Outside of Instruction

Accountability Outside of Instruction Statements	none	less than 1hour	1-2 hours	3-4 hours	more than 4 hours
preparing or grading student tests or exams	0.00	41.67	33.33	25.00	0.00
reading and grading other student work	0.00	25.00	50.00	25.00	0.00
planning lessons by yourself	0.00	16.67	58.33	25.00	0.00
participating in professional development with colleagues	8.33	33.33	50.00	8.33	0.00
meeting with students	8.33	41.67	41.67	8.33	0.00
meeting with parents	25.00	50.00	16.67	8.33	0.00
updating students' records	8.33	33.33	50.00	8.33	0.00

The Math Instructional Practices and Accountability Questionnaire for Leaders

The Math Instructional Practices and Accountability Questionnaire for Leaders *(MIPAQ-L)* instrument was distributed to six building leaders. Three principals from three separate elementary schools were invited to participate, and three principals from the elementary schools and middle school. Of the six prospective participants, three-building principals provided feedback. In addition to obtaining demographics, the survey tool was designed to collect information about building leaders' perceptions of math instructional practices concerning accountability and high-stakes testing.

Demographics

In the survey, the three participants identified demographic information about themselves. When asked about their ages, each of the three-building leaders fell into different categories: one identified as 31 through 41 years of age, another identified as 42 through 51 years of age, and the third participant identified as 52 through 61 years of age. Table 14 shows the percentages of leaders' ages.

Table 14

MIPAQ-L Participants' Ages

Age	Percentage
under 30 years	0.00
31-41 years	33.33
42-51 years	33.33
52-61 years	33.33
over 61 years	0.00

In the second item, 66.67% of the participants identified as male, whereas 33.33% identified as female. In this study, nearly 67% of the participants identified as White (not Hispanic), with one participant (33.33%) identified as American Indian or Alaskan Native. Table 15 and Table 16 show the percentages of participants' genders and ethnicities.

Table 15

MIPAQ-L Participants' Gender

Age	Percentage
female	33.33
male	66.67
nonbinary	0.00
non-disclosure	0.00

Table 16

MIPAQ-L Participants' Ethnicities

Ethnicity	Percentage
White (not Hispanic)	66.67
Black (not Hispanic)	0.00
Hispanic	0.00
Asian or Pacific Islander	0.00
American Indian or Alaskan Native	33.33
Other	0.00

Table 17 and Table 18 show percentages of participants' years of experience in education and teaching experiences. Two of the three participants indicated that they have been in education between 20 and 26 years (66.67%), and one participant indicated that he/she has been in education for 13 through 19 years (33.33%), and lastly, item five surveyed participants about their previous teaching experiences before transitioning into administrative roles. One participant reported that he/she did not have prior experience in teaching mathematics before moving into administration. In contrast, two participants reported that they taught mathematics in the classroom before becoming building leaders (one participant indicated 1 through 5 years, and the other indicated 6 through 12 years).

Table 17

MIPAQ-L Participants' Years of Experience in Education

Years of Experience	Percentage
1st year	0.00
2-5 years	0.00
6-12 years	0.00
13-19 years	33.33
20-26 years	66.67
more than 26 years	0.00

Table 18

MIPAQ-T Participants' Years of Experience Teaching Mathematics Content

Years of Experience	Percentage
no experience in math instruction	33.33
1-5 years	33.33
6-12 years	33.33
13-19 years	0.00
20-26 years	0.00
more than 26 years	0.00

Accountability and High-Stakes Testing

In the sixth and seventh items of the MIPAQ-L, building leaders rated their level of agreement through Likert scales to express their perspectives regarding math instructional practices and accountability and high-stakes testing. Table 19 illustrates perspectives of accountability and high-stakes testing with standard deviation values. It should be noted that the MIPAQ-L contained a typo in the Likert-scale rating. When the survey was distributed, the five-point Likert-scale category *strongly agreed*, mistakenly substituted with *disagreeing*.

One hundred percent of leaders participating in the MIPAQ-L indicated that they *agree* that teachers should create lesson content that reflects what will be at the end-of-the-year MAP test. However, 33.33% *strongly agree* that teachers should use students' data from NWEA to create lesson content, with 66.67% reporting that they only *agree*. The leader participants in this study indicated that 67% *agree* that high-stakes testing encourages teachers to spend more time preparing for tested core subjects and detracts them from preparing for non-tested core subjects. This was supported by the evidence that 66.67% *strongly agree* that teachers spend more time on certain math concepts than other math concepts because of MAP testing. While 66.67% reported they *agree* that data from MAP and NWEA allowed teachers to improve their instructional techniques and implement instructional practices, 33.33% indicated *they disagree.* Additionally, 33.33% disclosed that they *strongly disagree* or *disagree* that MAP and NWEA testing encouraged teachers to grow professionally and strive to do better (33.33% agree). The data reflected differences in perspectives. When surveyed to indicate the level of agreement regarding students' scores from MAP or NWEA as a reflection of high-quality teaching, 66.67% reported that they *agree*, with 33.33% disclosing that they *neither agree nor disagree*. Building leaders indicated that they provide guidance that helps support instructional practices' development and implementation, indicating 66.67% *agree* and 33.33% *strongly agree*. Like teacher responses, 66.67% of building leaders surveyed *agree* that process teaching and procedural learning lead to deeper levels of knowledge and mastery of math processes, but also, that 66.67% *agree* that teaching conceptually and concept learning leads to deeper levels of knowledge and mastery of math processes. The data emphasize that building leaders perceive both as valuable and significant components of math learning. Supporting evidence will be discussed later in this chapter.

Table 19

MIPAQ-L Participants' Perceptions of High-Stakes Testing

High-Stakes Statement	strongly disagree	disagree	neither agree nor disagree	agree	disagree (strongly agree)
Teachers should create lesson content that reflects what will be tested at the end-of-the-year MAP test.	0.00	0.00	0.00	100.00	0.00
Teachers should use students' data from NWEA to create lesson content.	0.00	0.00	0.00	66.67	33.33
High-stakes testing encourages teachers to spend more time preparing for tested core-subjects and detracts them from preparing for non-tested core-subjects.	33.33	0.00	0.00	66.67	0.00
MAP and NWEA data allow teachers to improve their instructional technique and implement a variety of instructional practices.	0.00	33.33	0.00	66.67	0.00
Students' scores from MAP and NWEA are a reflection of the teacher's quality and effectiveness.	0.00	0.00	33.33	66.67	0.00
Teachers spend more time on certain math concepts compared to the other math concepts because of MAP testing.	0.00	0.00	0.00	33.33	66.67
MAP testing and NWEA encourage teachers to grow professionally and strive to do better.	33.33	33.33	0.00	33.33	0.00
As a building leader, I provide guidance that helps support the development and improvement of teachers' instructional techniques and practices.	0.00	0.00	0.00	66.67	33.33
Process teaching and procedural learning leads to deeper levels of knowledge and mastery of math concepts.	0.00	0.00	0.00	66.67	33.33
Teaching conceptually and conceptual	0.00	0.00	0.00	66.67	33.33

learning leads to deeper levels of knowledge and mastery of math processes.					
Students’ scores from MAP and NWEA help building leaders make decisions about teachers’ assignments to content and placement of grade-level.	0.00	0.00	33.33	33.33	33.33

Interviews with Participants: A Discussion of the MIPAQ-T and MIPAQ-L

Upon completing this study’s first phase of research, the researcher used descriptive statistics to help construct interview questions for potential participants. The MIPAQ-T reported five teacher respondents who volunteered to participate in phase two of this research. In contrast, the MIPAQ-L reported three-building leader respondents who volunteered to participate in phase two of this research. In each separate interview, participants were asked to describe their philosophies of math teaching and learning regarding procedural versus conceptual. Additionally, participants were asked to expand upon their perceptions of accountability from high-stakes testing such as the Missouri Assessment Program. Perceptions of adaptive assessments, such as the school’s district-wide assessment and NWEA were also discussed. While each interview contained authentic discussion, the following questions were used to help guide the conversation:

1. When teaching math, what value do you place on process and concept?
2. What is your understanding of procedural fluency?
3. Do you feel supported by building leadership in the development and implementation of instructional practices?
4. What is your perception of MAP testing?
5. Does MAP testing influence your instructional practices?

6. Do you think that building leaders perceive MAP scores as indicators of high-quality instruction, and do you think building leaders consider students' MAP scores when making decisions about your job performance?
7. What is your perception of NWEA testing?
8. Does student growth data from NWEA testing influence your instructional practices?
9. Do you think that building leaders perceive student growth data from NWEA as indicators of high-quality teaching, and do you think build leaders consider student growth data when making decisions about your job performance?
10. When thinking about MAP and NWEA testing, is one more reliable than the other to determine student achievement?

All five teacher volunteers were fourth- and fifth-grade teachers of mathematics. The fourth- and fifth-grades are housed in the same building with three building leaders (one head principal, an assistant principal, and a principal internship). Three of the six-building leaders volunteered to participate in the interview process. Two of the three leaders were building leaders of fourth- and fifth-grade teachers; only one leader from three separate K-3 buildings volunteered to be interviewed. It should be noted that no interviews were conducted with third-grade teachers, although one building leader from a K-3 building provided an interview. Interviews were conducted individually, and the electronic application *Voice Memos* was used to record each interview. Pseudonyms have been assigned to each participant in the discussion of the results.

Teacher A

Teacher A indicated that foundations lead to more abstract math thinking and are obtainable through math process learning and teaching. She illustrated her thinking by stating, to think deeply and understand the concept of long division, students must know the process. Although Teacher A disclosed that she focuses “a huge amount” of time on math processes, she later indicated that she spends equal time on both process and conceptual learning when asked if one is more important than the other. Teacher A discussed procedural fluency as the ability for students to fluently complete operations and demonstrated good number sense, but expressed that she did not know whether procedural fluency and computational fluency were the same or different. When asked whether it is more important for students to know how to calculate the correct answer when operating with fractions or come up with an estimate and justify its reasonableness, Teacher A disclosed that she wants her students to be able to do both. Teacher A suggested that students should have a well-rounded understanding. However, it is not more important than being able to calculate accurately. Her thinking connects to the literature works of Garelick (2016), in that it is possible that Teacher A values both process and concept learning but emphasizes accuracy. Garelick (2016) suggested that both process and concept are essential that “educationalists” will label unfairly mislabel teachers that emphasize correct calculation as “traditionalists.” Teacher A disclosed that a 40-minute math class period is inadequate for good quality math teaching and learning. She elaborated on the importance of using math manipulatives; however, when doing so, she relayed that using manipulatives requires several days of covering that specific math concept. Also, Teacher A explained that she does not have enough time to cover the math standards in the way she thinks they should be covered. Often, Teacher A will skip teaching science content because she feels pressured to cover as many math concepts as possible before MAP testing.

Teacher A relayed that the purpose of the Missouri Assessment Program (MAP) is an accountability piece that compares school districts to each other. She voiced concern that each school district is made up of a unique population, and these populations differ from each other, and that this is an unfair comparison. In contrast, the NWEA testing is the research site’s district-wide assessment tool that tracks the progression of students’ learning. Teacher A claimed that the NWEA test shows students’ growth performance in a more specific way and that this is purposeful for helping teachers make decisions about instructional direction and practice. However, Teacher A indicated that she only sometimes uses the data to plan instructional activities, and when she does, it is almost always in a small group. Teacher A disclosed that she does not feel that MAP or NWEA testing influences her instructional practices stating, “I would be teaching the same way I do regardless of accountability from testing.”

She also indicated no validity in MAP testing; therefore, she does not consider it as influencing teaching style. Teacher A offered that she does spend time in class preparing students for MAP testing, indicating that she uses spiraling reviews throughout the school year, but devotes a significant portion of time to review MAP-like questions and released-items, as MAP testing dates approach. When asked if she felt supported by building leaders in developing and implementing instructional practices, Teacher A answered, "no." Teacher A explained that she is given the autonomy to teach in a way that reflects her teaching style and that she prefers it this way and would not like to be "micromanaged." According to Teacher A, telling teachers how to teach decreases teachers' creativity, leading to teacher inefficacy. Teacher A voiced that she thinks curriculum specialists should provide guidance and recommendations regarding professional development opportunities. However, in her opinion, "they only demand data that they collect and never look at or use." Teacher A indicated that she feels that building leadership does consider students' MAP scores and student growth data from NWEA as indicators of high-quality teaching. She stated, "They say they do not, but I know they do." Teacher A stated that this is unfortunate when a classroom is stacked with students with IEPs or unique challenges. She elaborated, "Administrators tell you not to worry about that, but you do because it reflects your performance." According to Teacher A, she puts much pressure on herself, because she takes MAP and NWEA testing very seriously. However, other stakeholders, such as students and parents, do not feel pressured to perform because they are not the ones held accountable. Teacher A indicated that building leaders emphasize NWEA instead of MAP, explaining that MAP scores are discussed one time at the beginning of the year, when schools obtain that information. However, one building leader periodically sends out emails reporting about the building's student growth percentages. She expressed that leadership style influences how much emphasis is placed on MAP and NWEA to indicate high-quality teaching. Teacher A stated that one building leader is particularly data-driven, but the other leader does not pay too much attention to student performance data. Teacher A believes that this leader has more trust in teachers. Furthermore, Teacher A voiced that students' scores from MAP and NWEA are considered by leadership and that she views this evidence when reading feedback from walk-through evaluations. From her perspective, it is unfair to use students' scores to make decisions about her job performance, because teachers have no control over how a student decides to engage with testing—students' perceptions of testing influence their scores (not the classroom teacher).

Teacher B

Teacher B emphasized process learning. She stated that "teachers can give students all the building materials necessary to build a birdhouse, but students need to know how to follow the process to finish the project." Teacher B relayed that procedural learning is the biggest proponent of problem-solving in mathematics. During a portion of her interview, Teacher B stated that it is more important for students to demonstrate that they know how to navigate a process during problem-solving, rather than produce the correct answer. However, her answer was not as straightforward as whether it is more important for students to know how to calculate the correct answer when operating with fractions, or come up with an estimate and justify its reasonableness. In response to that question, Teacher B suggested that this depends on whether the process is being assessed or the conceptual understanding is being measured. She indicated that math "is very black and white; either a student gets the right answer, or does not." Teacher B declared that if the goal is to measure students' problem solving and conceptual understanding, then estimation with justification is more important; whereas, if the goal is to determine whether students can calculate accurately, the process is more important.

Similar to Teacher A, Teacher B indicated that procedural fluency is how fluent a student can move through a mathematical, step-by-step process. However, she explained that procedural fluency is different from computational fluency as procedural refers to steps in a process, and computational fluency is "computing with numbers using the four operations." When asked about factors that influence procedural or conceptual instructional practices, Teacher B explained that if students do not have a good base of understanding, then it is "really hard" to teach conceptually. She emphasized that students are often moving into the next grade level without mastering the previous years' concepts. She explained that "this is why I feel strongly that students should master the math process first, before learning the concept." Teacher B suggested that if students have not mastered the math process, then it is unlikely that they "have an understanding of the math concept." Her thinking differs from Andrew's (2021). In the early years of his career, Andrew (2021) described himself as using a procedures-first, understanding-second teaching approach. He claimed that using procedures-first, understanding-second instructional practices diminished students' potential to develop conceptual understanding. However, understanding-first, procedures-second instructional practices allowed all students to develop some level of understanding, followed by procedural practices that better reinforce the math concept (Andrew, 2021).

Teacher B described MAP testing as "bureaucracy tied to funding." She claimed that the writers of the MAP test "do not have a clue what's going on within classrooms or about the number of diverse issues that teachers are helping students navigate." As a math teacher, Teacher B voiced that she wished the MAP test was "straight computation," explaining that many reading fluency and comprehension factors impact students' ability to show their mathematical knowledge fully. In contrast, Teacher B discussed NWEA as having more purpose, since it measures students' growth multiple times throughout the school year and adapts to students' responses; however, Teacher B voiced that testing multiple times throughout the school year demotivates students and leads to "over-testing." Teacher B shared that she placed much value on MAP testing as a first- and second-year teacher, but as a ninth-year teacher, it has no influence on instructional practices, and she does not feel that it makes her a better teacher. Instead, Teacher B expressed that MAP testing (more than NWEA) contributes to her frustrations and stresses within education. "If anything, MAP testing makes me a worse teacher because it makes me a mad teacher." Teacher B does not use data from MAP or NWEA to plan instructional activities; however, she did indicate that she does some brief MAP review immediately before testing. She noted that there is no time to teach all the Missouri Learning Standards in math in a way that encourages students' mastery. Teacher B voiced that she does not feel supported by building leaders in developing and implementing instructional strategies. She suggested that building leaders are not prepared or willing to facilitate difficult conversations that may make teachers uncomfortable. This avoidance leads to "colleagues pointing fingers at each other about students' academic abilities deficits." Teacher B said that "it is easy to point out problems but difficult to implement and maintain solutions." Scores from MAP and NWEA can be used as indicators of high-quality teaching and considerations of job performance but are a reflection of leadership style, according to Teacher B. She relayed that "there is something to be said about male versus female brains concerning leadership styles." She also suggested that it is not the only evidence they consider; for example, Teacher B perceives building leaders to put more value on classroom management and teacher-student relationships concerning teacher efficacy. She acknowledged that while scores may be considered, they are not used against teachers unless they support other evidence of a teacher's inefficiencies.

Teacher C

Like Teachers A and B, Teacher C indicated that math process learning is most important, because students take the math process and connect it to the math concept. Teacher C suggested that while most of her students need the process before the concept, she has had students grasp the math concept first before mastering the math process embedded within the concept. According to Teacher C, the influence of procedural and conceptual math learning is "dependent on the individual student." She explained that her perception of procedural and conceptual math learning "changes every year because the learning needs of her students change every year." Furthermore, Teacher C discussed the implications that the Covid-19 pandemic has had on students' procedural and conceptual math learning. She described students' math knowledge deficits as influencing whether she teaches procedurally or conceptually. Garelick (2016) explained that procedural fluency and understanding are equal components of math learning but that the degree of emphasis is dependent on students. This is similar to Teacher C's thoughts about procedural and conceptual learning. When explaining procedural fluency, Teacher C suggested that students can be able to follow the steps in a process. However, her thinking differed from Teachers A and B. Teacher C described procedural fluency and computational fluency as the same thing, but included those procedurally fluent students. They should be able to explain the process. In response to whether it is more important for students to know how to calculate the correct answer when operating with fractions or to be able to estimate and justify reasonableness, Teacher C discussed that this is dependent upon the question being asked from an academic perspective or real-life. She explained, "it is important for students to demonstrate the understanding that comes with operating fractions, but in the real world, all they need to do is pull out their calculator to determine the answer."

"MAP testing is a ridiculous form of evaluating districts because its scores reflect student performance on a test given once a year. This data tells districts nothing about what the student knows academically as a whole rather than just one random piece of information based on one random day." Teacher C voiced that there are too many student-related variables to consider MAP testing a valid and informative assessment connected to teacher performance. Teacher C explained that if a student has personal problems at home on the day of MAP testing, it is likely, that the student's scores from that specific day on that test will not be accurate. According to Teacher C, someone not in education decides "how we collect and look at data and what we do with it." Teacher C's perception of NWEA testing is "a true measuring factor that teachers can use to personalize instruction." However, there is no consistent expectation between building leaders and district leaders regarding how much teachers should use NWEA data when planning instruction. Teacher C shared that she used the data from NWEA more in the past when she had groups of diverse learners that needed enrichment or higher levels of instruction. Like Teacher A, Teacher C voiced that MAP and NWEA testing does not make her a better teacher because she would be teaching the same way regardless of testing. However, she disclosed that MAP testing does influence her instruction in that she does not teach all concepts outlined in textbooks, because they do not reflect the Missouri Learning Standards. Likewise, Teacher C spends more time focusing on concepts she knows will be heavily tested on the MAP. Teacher C shared that she teaches differently now that the MAP test is computer-based rather than on paper. She noted that she spends considerable time preparing students for MAP testing by presenting math instruction in various technology-enhanced formats. This is ongoing throughout the school year. Teacher C expressed concern that she does not feel that building leaders know enough about what is going on in her classroom to support the development and implementation of instructional practices. She suggested that this is because building leaders are often not in and out of classrooms. Like Teachers A and B, Teacher C did not offer a clear description of the role of district curriculum specialists.

Furthermore, Teacher C could not recall the name of the current math curriculum specialist. According to Teacher C, building leaders use MAP and NWEA data as indicators of high-quality teaching. She illustrated her thinking by explaining that building leaders present MAP scores during the beginning-of-the-year meetings and send individual MAP scores directly to teachers. While she acknowledged they are considered, Teacher C indicated that MAP scores are only mentioned at the beginning of the school year. These would be emphasized more frequently if leadership truly valued the data. Similarly, Teacher C voiced that she does not think that building or district leaders are looking at NWEA data as indicators of high-quality teaching. Considering scores as indicators of high-quality teaching, she expressed that her preference would be for building leaders to use NWEA data because it is adaptive and progressive rather than summative.

Teacher D

Teacher D described her teaching as more process rather than concept. She relayed that “students must have choices” in the process and that this most definitely influences students’ conceptual learning and understanding. Teacher D explained that she teaches multiple ways to process math, and students choose the method that works best for him/her to be able to understand the math concept successfully. Furthermore, Teacher D discussed the criticism she receives from colleagues who perceived that learning too many math-solving methods leads students to be confused. However, Teacher D argued that all students have different learning styles, and some need alternative strategies when navigating math processes. Teacher D's thinking supports by Bay-Williams and SanGiovanni (2021). Bay-Williams and SanGiovanni (2021) reported that it is a fallacy that the standardization of standard algorithms results in better math learning. Instead, research shows that students' math learning is maximized when they have learned multiple strategies that are critical in determining the appropriateness of using each strategy (Bay-Williams & SanGiovanni, 2021). According to Teacher D, math learning is equal-part-process and equal-part-concept but learning the process first results in students to better learning the concept. Teacher D described procedural fluency as students being able to "do a procedure consistently and fluently for several days in a row with multiple attempts and successes." Like Teacher B, Teacher D indicated that while procedural fluency and computational fluency are similar, one is about the process, but the other is computing numbers. Furthermore, Teacher D voiced that her instructional practices feel rushed as she perceives the expectation is for her to teach the entire math textbook before MAP testing. She explained that "snow days, excessive student absences, and the time that NWEA testing takes makes this hard to accomplish."

Like Teacher C, Teacher D described MAP testing as "content information about what a student has learned over a year that is collected on one specific day. This is not an accurate academic reflection of the student." Teacher D echoed Teacher B regarding the "overwhelming" presence of word problems in mathematics content. Like Teacher B, Teacher D expressed that students struggling with reading fluency and comprehension have lower math scores, but their scores would be proficient or advanced if they were just tested on computation. Teacher D implied that it is unfair to hold math teachers accountable for students' mastery of math word problems when reading fluency and comprehension are separate content areas. Teacher D explained that the purpose of NWEA is to assess how students are growing and retaining information learned in preparation for MAP testing. While finding it more valuable than MAP testing, Teacher D shared that NWEA testing requires teachers to modify their schedules for three days. Much instructional time is lost with each test taking up to three hours, considering NWEA testing is administered three times a year. Teacher D indicated that she does not use the data from NWEA testing to plan instructional activities, because she feels that she needs more guidance and support interpreting the results to use them effectively and purposefully. However, Teacher D did indicate that MAP testing influences instructional practices, because it puts significant pressure on the pace of instruction. She felt rushed when teaching and pressured to finish the math textbook before MAP testing. Teacher D voiced that she wants to spend more time on specific math concepts that she knows are essential to students' mathematical development, but that she often must move on to "hit everything before MAP testing." She also stated that she feels "overwhelmed" to prepare students for MAP testing by reviewing MAP-like items, word problems, problem-solving strategies, and review concepts throughout the year, while simultaneously "squeezing in the rest of the math textbook before MAP testing." Teacher D acknowledged that accountability is essential; however, unlike Teachers A, B, and C, she voiced that testing makes her motivated to be a better teacher (but she wished there was a better accountability piece instead of MAP).

In contrast to Teachers A, B, and C, Teacher D emphasized that she feels supported by building leaders in the development and implementation of instructional practice, because she has never received feedback regarding strategies for improvement. She mentioned that building leaders write comments of praise and encouragement on walk-through evaluations, but do not provide comments about specific instructional practices implemented. Like Teacher C, Teacher D expressed that she is unsure that building leaders know of her instructional practices, because “they are so busy dealing with discipline, parent-issues, Covid-related issues, and sub shortages.” When asked if building leaders consider data from MAP and NWEA as indicators of high-quality teaching, Teacher D disclosed that it depends on the leader. Similar to the responses of other teacher participants, she mentioned that one leader is more data-driven and the other is not. Evidence of this is reflected in their leadership styles and approaches. She explained that she does not feel pressure to perform from building leaders, but puts that pressure on herself. Teacher D discussed that building leaders want good MAP scores, but understand that those are not what is most important. She relayed that building leaders look at MAP and NWEA scores and consider them, but they are not “the only thing they look at.” According to Teacher D, good teachers grow every student, even with minimal growth.

Teacher E

While Teacher E identified as teaching more process versus concept, she emphasized the value of both. Teacher E explained that students constantly question the importance of the math concept. She indicated that helping students understand the concept can be achieved by connecting and applying it to real-life situations. She also discussed students' inquisitiveness as influencing whether to emphasize procedural or conceptual learning; she noted that some years seem to be more concept-based, but that this year is most definitely focused on math processes and that this could be because of the recent Covid-19 pandemic. Teacher E emphasized that process has more influence on math learning than conceptual learning, because "I think kids want to get the result quickly, so they want to know how they can get the answer and move on. They do not care about why the concept is relevant." Teacher D discussed students' levels of excitement when presented with math content. She indicated that how students respond to new concepts influences how much procedural and conceptual focus she will employ. She stated that students' levels of excitement are reflected through instructional practices. Teacher E explained that sometimes she would use a quick, exciting video clip or introduce a math concept with a short and engaging activity to help catch students' attention and motivate them to want to learn more. Teacher E's practice of gauging students' mindsets when introducing new math topics reminded the researcher of Boaler's (2022) mathematical mindsets. Creating a mindful classroom of students' anticipations of mathematics helps facilitate potential learning for all students. Teacher E's response to procedural fluency echoed Teacher C's, as she explained that "procedural and conceptual fluencies are the same thing: how to follow the steps in a procedure." Like Teacher A, Teacher E mentioned the 40-minute math instructional period as influencing whether she teaches math by focusing on process versus concept.

Teacher E discussed that she preferred NWEA testing instead of MAP testing, because it offers support in response to students' performances at their levels and is given three times during the school year. Hence, the data shows how the student's learning is progressing. Like most other teachers interviewed, Teacher E shared her concerns that "there are too many factors that affect the outcome of MAP testing." She emphasized that some students feel pressured to perform on the MAP test, while others do not put forth an effort. Teacher E voiced that MAP testing is a way to evaluate how effective a teacher is in the classroom and how well their students perform, but that each group of students differs from year to year. She questioned comparing Teacher's MAP scores from year to year, especially since teachers have no control over how many students with special educational needs, such as learning disabilities or giftedness, are dispersed or stacked in homerooms. This echoed the concerns of Teacher A. Teacher E emphasized that NWEA testing provides immediate feedback that details specific information about each student and creates a learning path for each student, based on their learning progression. This is more valuable than data reported from the MAP. When asked if MAP testing influences instructional practices, Teacher E relayed that it dictates what specific concepts must be taught to "meet MAP requirements," but "I do not think it influences how I teach the standards, maybe it should, but I do not think it does."

To prepare for MAP testing, Teacher E shared that she uses online practice tests to review, and these practices are implemented just before MAP testing. Teacher E voiced that NWEA data does not influence her instructional practices but then contradicted that statement by adding, "I use the data from NWEA to plan for instructional activities that reteach or reinforce concepts previously taught." Like Teacher

A, Teacher E emphasized how lucky it is to work in a building that allows teachers to have the autonomy to teach how he/she sees fit. She called it a “blessing” to be trusted, but also voiced that she wished there was more consistent guidance from building and district leadership regarding horizontal and vertical alignment, as well as expectations of NWEA. Teacher E stated, “Even if we had more direction from leadership, I do not think they would communicate or support ‘how’ to meet that expectation.” She discussed that mentoring teachers, not building leaders, supports new teachers’ development and implementation. As a current member of the district’s curriculum specialist team, Teacher E expressed that she is unclear about the responsibilities of her role. Teacher E indicated that she does not offer guidance to other teachers, because she is not sure that it is expected, and if it were, she has received no guidance on how to do that. She expressed that curriculum coaches are different from curriculum specialists. New teachers and struggling teachers would benefit from curriculum coaches to provide support and instructional modeling. While Teacher E shared that “building leaders say they do not use MAP scores to evaluate the quality of teaching,” but expressed that she feels that they do. According to Teacher E, she assumes that building leaders would be more likely to use data from NWEA to indicate high-quality teaching, but MAP scores are considered as well. She explained that even though she does not feel like these scores are considered when building leaders make decisions about her job performance, Teacher E acknowledged that they do for some teachers.

Leader F

Leader F described procedural and conceptual math learning as a balancing act indicating that process is a huge factor in understanding math concepts, so it is most likely emphasized more. Furthermore, Leader F declared that children take to math concepts more quickly when they understand the process and how well students understand a concept is reflected through the process they demonstrate. Leader F indicated that math learning should be an equal process and concept. Leader F disclosed that students' prior knowledge should be the most significant factor influencing math teaching and that instructional direction and practice depend on what students know mathematically. Leader F suggested that math is sequential, which "influences the levels or kinds of engagement that teachers use during instruction." Leader F described the building teachers as a mixture of process-oriented and concept-oriented. This is mostly influenced by the level of their comfortability in math and their own math learning experiences. Their description of procedural fluency supported those of all teacher participants. They explained that it is not just following the steps of a procedure, but instead, it is a student's ability to move fluently between two different math concepts and how well a student can tie the two concepts together to show understanding. Leader F's comparison of procedural fluency and computational fluency supported Teachers B and D. Computational fluency is how numbers are manipulated using operations, but procedural fluency is not that. When asked what procedural fluency looks like, Leader F suggested that procedurally fluent students can connect math processes to concepts and move between them or apply those processes to new concepts. Like Teacher A, Leader F expressed that it is equally essential for students to calculate the correct answer when operating with fractions and come up with estimation and justify its reasonableness. If students can come up with a reasonable estimation and justify their thinking, they demonstrate that they understand the 'why' embedded within the concept. According to

Leader F, this should be the first learning and teaching goal, but the correct calculation should be emphasized.

Leader F described MAP testing much like the interviewed teachers calling it an accountability piece; in contrast, they indicated that it is an accountability piece that holds the district accountable, not just teachers. Furthermore, they emphasized that collective accountability is reflected through leadership. Leader F suggested that the MAP and NWEA are similar, because they use the same language but that the NWEA gives more specific details about student performance and projects where kids are in their learning. Leader F disclosed that they look more at MAP scores than NWEA, because they have not invested the time to learn how to navigate and interpret the reports within NWEA. Leader F discussed that MAP testing influences the instructional practices of third-grade teachers daily because third grade is the first-grade level in which students encounter MAP testing. Even though Kindergarten through second grade is not tested, students' learning during these years is reflected through their performance on the third-grade MAP testing. They also discussed helping lower elementary teachers understand their role in testing.

Leader F noted that they see evidence that teachers' instructional practices are influenced by MAP testing through the types of supplemental materials and resources that they request for purchasing. Third-grade teachers want instructional materials that are MAP-like in presentation and rigor as they take the MAP test very seriously, because their names are attached to those scores. They indicated that third-grade teachers spend at least 20 minutes daily on activities that prepare students for MAP testing. When asked if teachers use data from NWEA to plan instructional activities, Leader F suggested that they may but that the instructional material attached to NWEA (such as Exact Path) is supplemental and perceived as inefficient by the building teachers. Therefore, they use alternative resources. Third-grade teachers are welcome to use the data from NWEA, but Leader F voiced that teachers' perceptions and level of comfort using data influence whether they do (or not). Leader F stated that teachers in their building feel supported in the development and implementation of instructional practices because of feedback received from annual performance surveys; "I always receive high marks in areas of professional development opportunities." They discussed the role of curriculum specialists as "active liaisons" between respected curricula and district leadership. Leader F indicated that curriculum specialists and coaches could have similar or different roles determined by district leadership and expectations. Leader F strongly suggested that MAP scores are not an indicator of high-quality teaching. They explained that when talking with teachers, MAP scores are discussed, but not until everything else has been discussed. According to Leader F, the feedback they provide to teachers is much more relevant and substantial than the discussion about MAP data; and they emphasized that it can be a conversation piece, but not an isolated topic. Likewise, Leader F does not perceive data from NWEA as an indicator of high-quality teaching. They mentioned that too many uncontrollable variables influence students' performance data on testing to tie to a teacher's instruction quality. Leader F voiced that they do not make evaluative decisions based on scores from MAP or NWEA. They stated that sometimes lower elementary teachers want to move into a third-grade teaching position and that this always warrants a conversation related to MAP testing. Leader F affirmed that they have never moved a teacher out of third grade or decided not to rehire a teacher based on MAP scores or data from NWEA. Instead, they suggested that there is usually a list of numerous other reasons that support a teacher's removal from third grade or decision not to rehire. However, it is building leaders' jobs to help struggling educators with the right professional development opportunities to grow and improve. While scores may be a small part of the conversation, they are not the deciding factor.

Leader G

Leader G relayed that the amount of focus placed on math process learning and conceptual learning depended on the grade level when they taught math. They explained that concept comes first, but process builds upon it. Leader G voiced that procedural and conceptual learning should be equally emphasized, because "you cannot have process without understanding, and you cannot have understood without process." They explained that math learning could not be isolated to rote memorization, because math builds upon itself. Rote memorization will not always be purposeful. When describing procedural fluency, Leader G suggested that procedural fluency references the scope and sequence in which math is taught and how those concepts build upon each other. They explained that a procedurally fluent student is a student that is right on target and is ready to transition to the next concept. Leader G disclosed that computational fluency is a result of process teaching, but procedural fluency is how the concept builds in connection to other mathematical concepts; for example, students must be able to multiply and divide before teaching students how to add and subtract fractions. This type of thinking reflects the works of Bay-Williams and SanGiovanni (2021) in that procedural fluency increases the likelihood that students understand mathematical concepts. Like Teachers B and C, Leader G discussed whether it is more important for students to know how to calculate the correct answer when operating with fractions instead of estimating with reasonableness, as influenced by the student and the role in which math will influence the student's path in life. Leader G illustrated their thinking by suggesting that a sixth-grader that does not demonstrate mathematical thinking does not necessarily need to calculate correct answers, rather than use estimation for real-world scenarios.

Leader G emphasized that a teacher's knowledge level of math influences whether they teach more processes or concepts. They indicated that the organization of teaching roles could also influence this; for example, lower elementary teachers are self-contained, and upper elementary teachers sometimes teach in teams, allowing them to craft their instructional practices. In contrast, a strong math student that could potentially take a path in life that involves mathematical thinking should be expected to do both.

Leader G's perception of MAP testing was like Teacher C's response. Leader G voiced that MAP testing is " ridiculous " and has no value." They indicated that MAP testing is a "checkmark for bureaucracy," which echoed Teacher B's thinking. Leader G acknowledged that accountability is necessary but that standardized testing is an obsolete measure that should be replaced with something better, such as the NWEA. They suggested that standardized testing is generalized but that NWEA gives educators and leaders specific information about each student. The data is more relevant than data from MAP testing since it compares students' past and present performance several times throughout the year.

In contrast, MAP testing data compare groups of students from year to year. Leader G emphasized that they try not to put pressure from testing on teachers, but that teachers naturally do this themselves; therefore, MAP testing does influence instructional practices. "Even though teachers are not supposed to teach to the test, it is ridiculous to think they do not." Leader G relayed that the teachers spend time preparing students for testing by presenting and reviewing released items with them. They stated, "Some teachers value themselves as a MAP test score."

In contrast to Leader F, Leader G voiced that they hope teachers are using data from NWEA to plan instructional activities. "I believe in not wasting teachers' time, so if we are not looking at or using the data, why are we doing it?' When asked if they felt prepared to support the development and implementation of instructional practices, Leader G's response differed from Leader F's. Leader G shared that compared to previous administration positions in other districts, they feel that they are unable to support teachers' development and implementation of instructional practices in their current role. They elaborated that building leaders in smaller districts are more involved in the direction of curriculum, instruction, and assessment, but in this district, that is not always the case. Many districts, such as this specific school district, have a superintendent designated to oversee curriculum, instruction, and assessment for all buildings within the district. According to Leader G, the role of the building principal varies depending on the size of the district. They discussed that the district's curriculum specialists do a "pretty good job" at their role, but suggested that time is a significant constraint. When asked if data from MAP or NWEA are indicators of high-quality teaching, Leader G disclosed that they perceive student growth data from NWEA to be an indicator, but do not think that the district looks at it. Leader G stated that they look closely at each teacher's MAP scores, but that they look for trends over a three-year to five-year period. "If a teacher has consistently low MAP scores over consecutive years, my role is to find some way to help that teacher develop through training or pairing that teacher with another teacher that does have ideal MAP scores." Their thinking was consistent with Leader F's feedback. Leader G stated, "I look at MAP scores and consider them, but it is not telling all of the teachings. It is a small piece." They continued, "It is not part of their evaluation; however, I have made decisions where I have removed a teacher from teaching math because of consistent low math scores with no improvement." However, when discussing using NWEA-MAPS data as an indicator of high-quality teaching, Leader G indicated, "I do not." They explained, "I know my teachers' strengths and weaknesses and which ones are teaching, and which ones are not." They emphasized, "I know which teachers may not have chosen the right subject or grade level to teach, but it does not mean they are not capable of teaching it. They may need some extra training."

Leader H

Leader H indicated that the value placed on procedural and conceptual learning and teaching is influenced by preference. They further illustrated his thinking by comparing teachers to coaches. Leader H explained that some coaches focus on the result and others emphasize the process taken to accomplish the result. They acknowledged that they did not know which focus was better. Instead, Leader H focused more on the relationships established and maintained between teachers and students. Leader H discussed their perception that the amount of process and conceptual learning is influenced by teachers' personal experiences and exposures to mathematics, including the methods used to learn math when they were math learners. "Teachers who are more comfortable with the process will teach more math process, and teachers who are more comfortable with math concepts will teach more conceptually." Leader H said they would like to think that procedural and conceptual instructional practices are data-driven and that teachers use data to indicate whether they should teach more processes or concepts. However, that data can be "whatever we want it to be," and sometimes that is "dependent on self-interest." Leader H expressed that they were not familiar with the term procedural fluency, but guessed that it "has something to do with knowing the operations and having a general understanding of how operations work and the necessary steps." Because of the term's unfamiliarity, Leader H guessed that procedural fluency and computational fluency bear similarities, but that "procedural fluency relates to whether a kid can do something mathematically and connect it to understanding." According to Leader H, a procedurally fluent student may not compute the correct answer, but understands the concept. Leader H disclosed that it is more important for students to come up with a reasonable answer when operating with fractions and justify their thinking, rather than calculating the correct answer. They argued that determining the right answer does not necessarily mean that the student understands the problem, but justification bears evidence that mathematical thinking has developed. Leader H discussed that they believe that teachers in the building perceived that they experienced constraints and limitations, but voiced that these are perceptions. They noted that while teachers may perceive that they are limited to curriculum and time, teachers are given the autonomy to use instructional practices that they feel are best for kids. Teachers are "provided with the freedom to innovate and try new things in the classroom as long as they can prove that it is necessary and based on what kids need." They voiced that leadership wants grade levels to be aligned horizontally. However, at the same time, leadership does not want “cookie-cutter” teaching, because diverse teaching and learning styles are essential since classrooms are full of diverse learners with individual learning needs.

Leader H shared value in knowing comparisons of school districts or between buildings in the same school district; however, the comparison is not always fair. For example, Leader H told the story of losing a student last year, right before MAP testing. They indicated that MAP testing was of no concern for that student's classmates or the student's teachers. Leader H discussed the impact that Covid-19 had on last year's MAP test results. They shared that two of the three elementary buildings within the research site completely swapped rankings (MAP scores) when looking at the year before the pandemic compared to the testing data after the pandemic. Leader H voiced that this could be for various socio-economic and family reasons. They relayed that assessments post-pandemic are moving towards individualization and that NWEA offers testing that measures students learning as it progresses while providing individualized learning plans to help further grow each student's learning. Leader H stated, "This assessment and data is much more purposeful than data from MAP testing." Like Leader G, Leader H described leadership as not putting pressure on teachers, but teachers put pressure on themselves regarding MAP performance. Even though leadership does not "overemphasize MAP testing," Leader H voiced that many teachers' instructional practices are influenced by pressure to produce favorable results from MAP testing. They discussed that some teachers feel very worried about MAP test scores if they have a heavy amount of special education students, but that teachers feel better about their scores when the scores of students who have IEPs are removed from their rosters. Leader H acknowledged that as MAP testing dates approach, many teachers within the building say things like, "we are preparing for MAP testing," but they feel this phrase is tossed around a lot. "I do not think teachers must say that they're preparing for MAP testing, and I do not know that it is necessary for them actually to prepare for MAP testing." Instead, they suggested that "Everything we do every day gets kids ready for MAP testing. All things done in just an average day influences MAP scores." Regarding NWEA testing, Leader H shared that some teachers use student growth data to plan instructional activities. However, some do not, which is influenced by the teacher's ability to understand and be comfortable working with data. Leader H mentioned that teachers are more motivated to use the data at the beginning of the year, because the school year is fresh. Most teachers attend training to update their knowledge, but this subsides as the year continues. Teachers tend to move away from using the data. Leader H suggested that some teachers resist looking at and using data, because it might reveal that they need to evolve some of their practices (and change makes people uncomfortable). Leader H indicated that even though they have limited knowledge of math content, they feel able to support teachers' development and implementation of instructional practices. "I have the right questions to ask to help teachers develop their teaching styles." Leader H suggested that MAP scores and student growth data from NWEA can be indicators of high-quality teaching, but they are not always considered indicators of high-quality teaching. They said, "We have great teachers with great MAP scores, and we have great teachers with low MAP scores." Leader H shared that some students who are present with challenging circumstances get assigned to teachers who have demonstrated an exceptional talent for managing those students. This may influence that particular teacher's MAP scores.

According to Leader H, a teacher that can manage challenging students and still grow their academics is a high-quality teacher.

Furthermore, Leader H discussed that teachers' relationships with students that motivate them to grow academically or emotionally are the most significant indicators of high-quality teaching. Sometimes (but not always), this can be reflected through student performance data. They emphasized that student growth data should be the preferred indicator of high-quality teaching instead of MAP-related data. Leader H shared that they have moved a teacher out of the math classroom concerning consistent low MAP scores. This teacher demonstrated a wide variety of issues such as relationships, planning and organization, and responsibilities. In addition to consistently low MAP scores, these issues contributed to the teacher being reassigned to teach non-tested content. Leader H explained that building leaders look at lots of data when considering teachers' job performances. He emphasized that the role of a leader is to help support teachers, but that if a teacher must be replaced or let go, that teacher has most likely "checked off many boxes" regarding problematic areas and that test scores are just one small piece of that decision.

Connecting the Two

Data collected through the MIPAQ-T provided concrete evidence that most third through sixth-grade teachers are process-oriented and suggested that third through sixth-grade teachers acknowledge the significance of conceptual learning. Through discussions facilitated by interviews, teachers discussed their personal experiences and perceptions. While evidence from the MIPAQ-T allowed the researcher to make some connections to individuals' experiences and perceptions during the interviews, the researcher noted participants' reluctance to commit to specific ideas. For example, when discussing the value of procedural and conceptual math learning and teaching, teacher participants waivered in conversation. The researcher witnessed participants grappling with their ideas and occasionally backtracking or contradicting previous declarations. The researcher observed that teacher participants wanted the researcher to 'weigh in' and offer some reassurance that their ideas were 'correct.' The researcher assimilated this phenomenon to teachers being like students in that they perceived correct answers as favorable and wrong answers as having negative implications. This phenomenon could also suggest that the teacher participants were insecure or reluctant to assert themselves, because they were the researcher's colleagues.

Furthermore, the data collected and analyzed revealed misconceptions among participating teachers regarding instructional practices and instructional resources or materials. While the purpose of this study was to seek potential influences that high-stakes testing has had on instructional practices, the nature of teacher participants' conversations almost exclusively redirected to the discussion of how high-stakes testing influences the 'what' instead of the 'how.' Although the researcher attempted to rephrase or help guide the discussion back to methodology, participants almost always replaced practice with standards, math textbooks, and pacing guides. This phenomenon suggested to the researcher that fourth- and fifth-grade teacher participants strongly associate instructional methods with instructional materials. There was conversational evidence that fourth- and fifth-grade teachers rely heavily on math textbooks, and on more than one occasion, these materials were referenced as the curriculum.

The MIPAQ-L reported many similarities regarding how teachers should be using data from testing to create lesson content. This provided guidance helps support the development and improvement of teachers' instructional techniques and practices and the value procedural math learning has concerning conceptual math learning (and vice versa). However, the researcher noted a discrepancy between leaders' responses regarding MAP and NWEA testing, encouraging teachers to grow professionally and strive to do better; discrepancies could reflect a difference in leadership and management style. Interestingly, while all building principals indicated that they provide support in the development and improvements of teachers' instructional practices, one building leader disclosed in the interview process that they did not feel like they could provide such support.

In interviews, all building leader participants indicated that student growth data from NWEA is a better way to measure students' learning and is a better indication of teacher efficacy. However, one building leader made multiple remarks that contradicted previously stated ideas. Regardless of the diverse leadership styles that were made evident through the interviews, all building leader participants strongly emphasized that accountability from high-stakes testing is a small piece of data that is considered when thinking about their building teachers. All participants emphasized the importance of teacher-student relationships and the influences that these relationships have on students' successes, both measures of academic and social-emotional progress. These are the best indications of high-quality teaching.

Summary

This mixed-methods study proved to be complicated as it attempted to tie current trends in educational reform, such as teacher accountability from high-stakes testing, to potentially impact students' procedural and conceptual math learning through teachers' instructional practices. A clear and conclusive outcome was not immediately evident. However, common themes surfaced through the research, such as time constraints, misconceptions about teaching methods versus resources, and confusion about leaderships' expectations within the curriculum, instructional practices, and assessment. The themes emerging from the literature in connection to the research conducted within the study suggest that the arguments between researched-based instructional methodology and teacher preference or perception are complex and intertwined.

In Chapter Five, the researcher will further discuss the research conducted in Chapter Four and look for potential connections between the data analysis and student performance data reflected through each teacher participants' 2021 MAP test scores and 2020-2021 student growth data from NWEA. The researcher will attempt to provide deeper analysis to explain how perception influences testing.

Chapter Five: Discussion and Reflection

In Chapter Four, the researcher reported the Math Instructional Practices and Accountability Questionnaire results administered to 27 third through sixth-grade math teachers and six building leaders that represent the leadership of third through sixth-grades. In addition to the questionnaire results, the researcher shared participants' interviews with five voluntary teachers and three voluntary building leaders. The researcher connected the two collected data sets to report evidence that math instructional practices in preparation for high-stakes testing are potentially influenced by classroom teachers' perceptions and building leadership. In this chapter, the researcher will attempt to provide deeper analysis to explain how perception influences testing. Conversational evidence from each teacher participant's interview (influenced by the MIPAQ-T responses) were analyzed to draw conclusions and inferences about student performance data in mathematics reflected through the 2021 MAP and 2020-2021 NWEA. Furthermore, leadership styles concerning high-stakes testing will be discussed.

Perception and Accountability from High-Stakes Testing

Proponents of this investigation proved to be uniquely challenging and complex. Through this exploration, the researcher learned that perception greatly influences choices regarding instructional direction and practices employed. This is further complicated when philosophies about math learning and perceptions of best instructional practices and accountability do not align between teachers, building leaders, and district leadership. Moreover, the ongoing debate between mathematics learning and instructional practices is well-documented in the literature. Through this exploration, it seems as though all stakeholders possess similar values regarding mathematics education, and all stakeholders strive to maximize students' math learning, but what constitutes best practices is strongly influenced by perception. Assessments tied to accountability are highly influenced by the perceptions of the test-makers and the purpose of the assessment. Teachers' perceptions regarding the assessment are likely reflected through results. Math proficiencies from each teacher participant's 2021 MAP assessment are displayed as figures in each discussed below. Average student growth data from NWEA is reflected in Table 20.

Table 20

Average Student Growth Data in Math from NWEA (2020-2021 School Year)

Teacher Participant	Fall 2020 Average RIT Score	Winter 2021 Average RIT Score	Spring 2021 Average RIT Score	Total Average Growth Points
Teacher A	199.0	205.2	208.6	+ 9.6
Teacher B	201.7	210.5	206.8	+ 5.1
Teacher C	207.9	214.4	212.9	+ 5.0
Teacher D	201.1	206.4	205.2	+ 4.1
Teacher E	202.6	208.1	210.4	+ 7.8

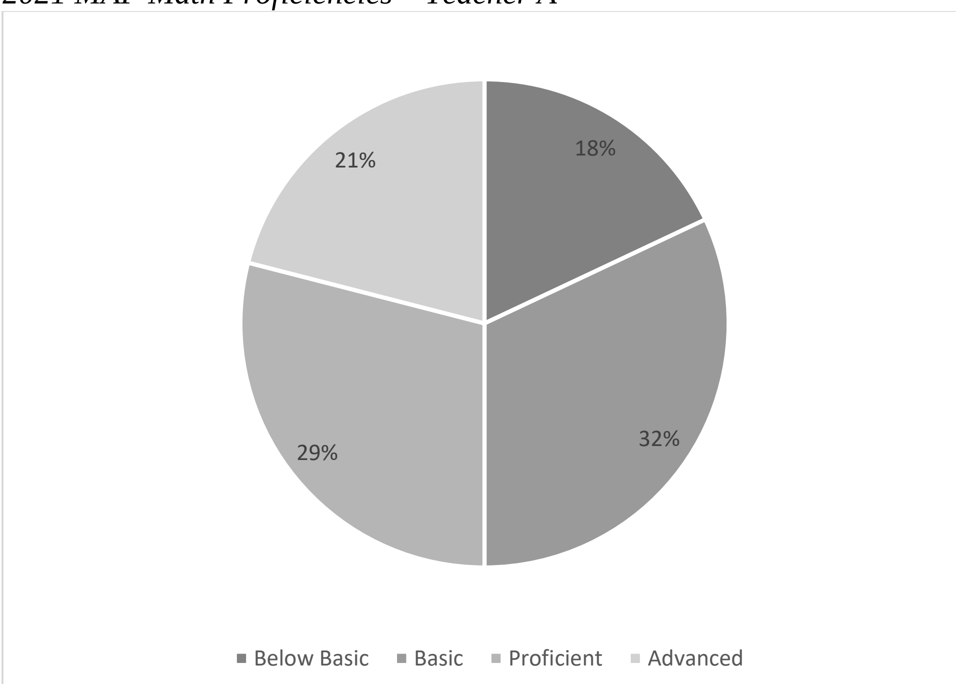
Teacher A

Many factors appeared to contribute to Teacher A’s levels of frustration. For example, Teacher A indicated that time constraints keep her from employing instructional practices that she feels are best to teach math concepts. This includes the time constraints caused by daily scheduling, as Teacher A voiced that using manipulatives in math class extends the lesson content over multiple days. Teacher A’s dialogue in conversation could indicate that she feels pressured by accountability, unsupported by some leaders, and helpless. In her discussion, Teacher A revealed that she is unconcerned with scores, but spends significant time focusing on process learning test preparation.

Additionally, Teacher A feels personally tied to MAP and NWEA results. Teacher A's 2021 MAP math scores reflect 50% advanced and proficient scores, and student growth data from NWEA testing during the 2020-2021 school year reflects students' average growth as increasing 9.6 points. Teacher A's student performance data likely reflects energy and effort motivated by pressure to perform and urgency, coupled with the tendency to internalize outcomes. Figure 1 shows Teacher A's 2021 MAP math proficiencies.

Figure 1

2021 MAP Math Proficiencies – Teacher A

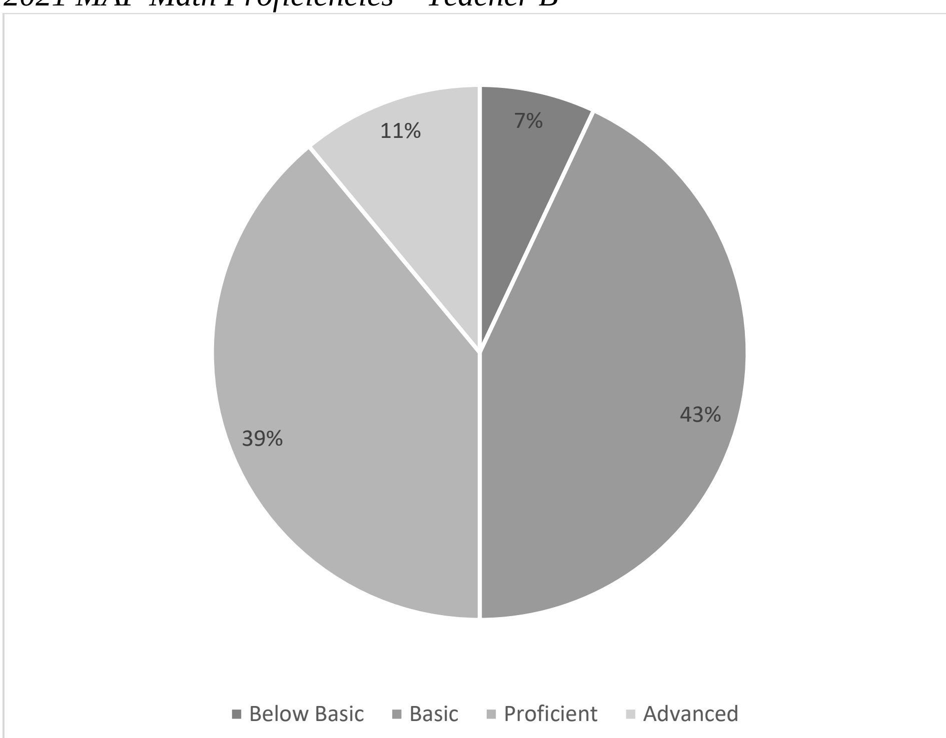


Teacher B

Teacher B's interview suggests that she possesses negative connotations regarding testing. Her dialogue could indicate that Teacher B feels the mathematics portion of the MAP test is skewed and that testing is demoralizing. Her discussion also suggests that accountability from testing does not create and facilitate school community, but that it contributes to teachers blaming each other or leadership. Teacher B appeared absolute and confident during her interview, as her examples were detailed. As a ninth-year teacher, Teacher B shared that accountability from testing does not influence her instructional practices, but acknowledged that it did when she was assigned as a first- and second-year teacher. There is evidence in her conservation that she perceives testing as negatively affecting everyone within education. Her disregard for testing may contribute to 50% advanced proficiency in math reported from the 2021 MAP and an average student growth increase of 5.1 from the NWEA testing performed during the 2020-2021 school year. This could be reflective of her attitude towards relationships over test results. Figure 2 shows Teacher B’s 2021 MAP math proficiencies.

Figure 2

2021 MAP Math Proficiencies – Teacher B

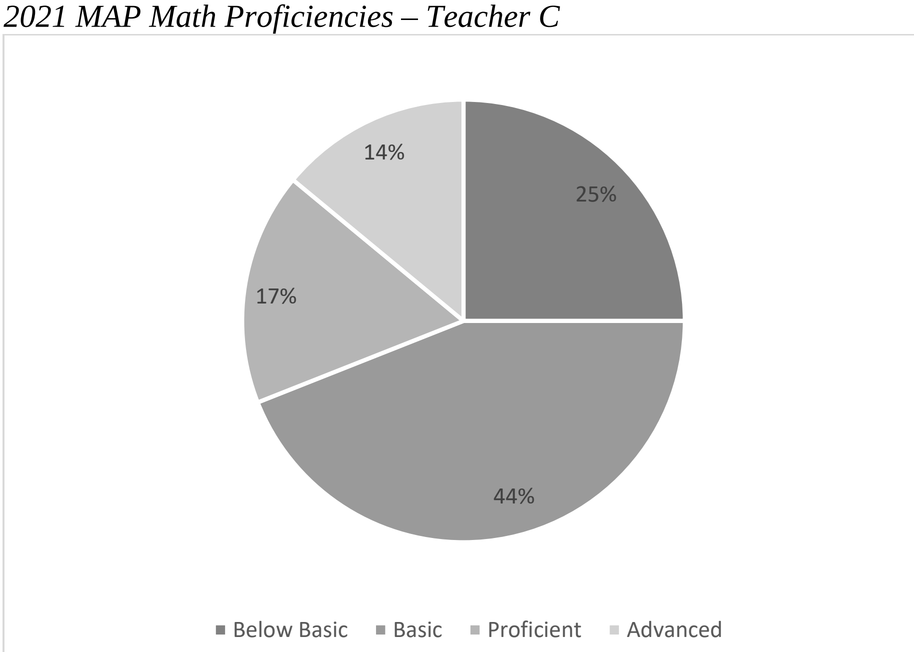


Teacher C

The researcher found Teacher C's interview confusing and difficult to code. Her language suggested that she did not understand most of the procedural and conceptual math learning questions. Teacher C's explanation of procedural and conceptual math learning as changing from year-to-year dependent on students' needs made it appear that she was unwilling to emphasize whether her instructional practices were procedural or conceptual. This could be evidence that she is unsure and insecure regarding math instruction. Through her conversation, she makes it evident that instruction is driven by what is tested. Her statements suggest that she teaches to the test; however, 31% advanced and proficient in math could suggest that these instructional habits or practices are ineffective or counterproductive. Teacher C's average student growth data from NWEA increased 5.0 points during the 2020-2021 school year. Figure 3 shows Teacher C's math proficiencies from the 2021 MAP test.

Figure 3

2021 MAP Math Proficiencies – Teacher C

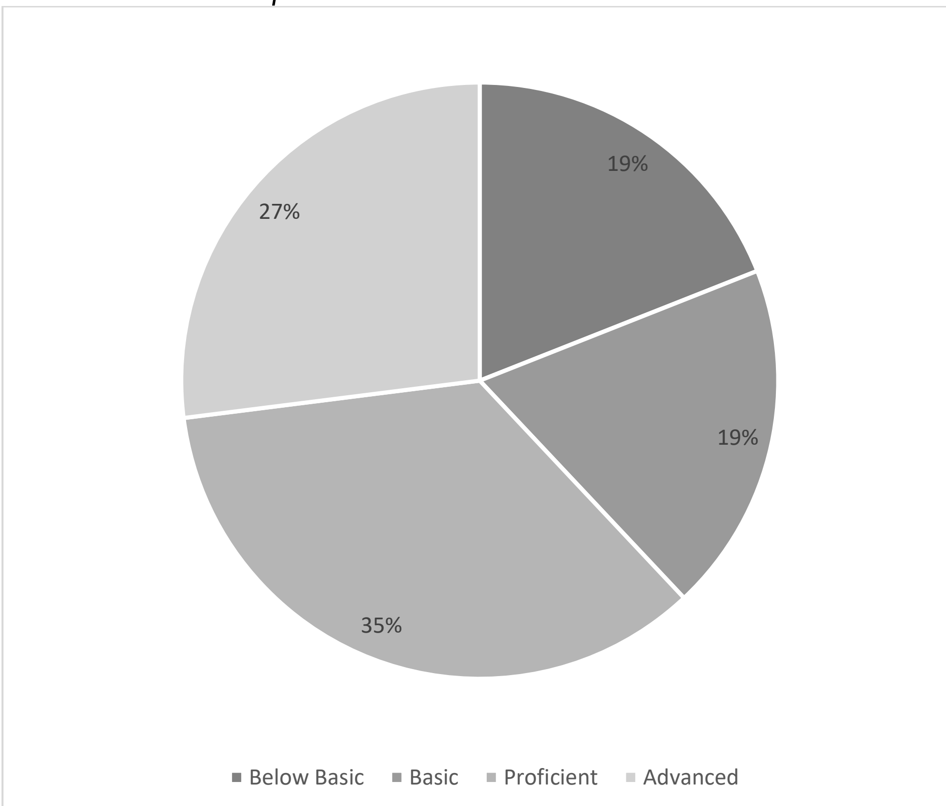


Teacher D

Conversations with Teacher D revealed that she does not feel pressured to perform by leaders. She does feel pressured to cover all standards and teach everything in the math textbook before MAP testing approaches. While Teacher D's interview indicated some frustrations with the lack of training in using data and feels overwhelmed and unsupported, she is motivated by testing; however, her instructional practices are not data-driven, but are student-driven. This could be due to her emphasis on student growth over test scores. Teacher D shared that she perceives her instructional practices as more process-based, but she acknowledged the importance of the equal-part process and equal-part concept. She discussed that her instructional practices always present multiple ways to solve math. Students choose the best method for their understanding, which likely contributes to students successfully solving or calculating. Her practice of differentiation and her motivation to grow students likely contributes to 62% advanced and proficient in the 2021 math portion of the MAP test; however, Teacher D's average student growth data from NWEA increased by 4.1. Figure 4 displays Teacher D's math proficiencies reflected through the 2021 MAP test.

Figure 4

2021 MAP Math Proficiencies – Teacher D

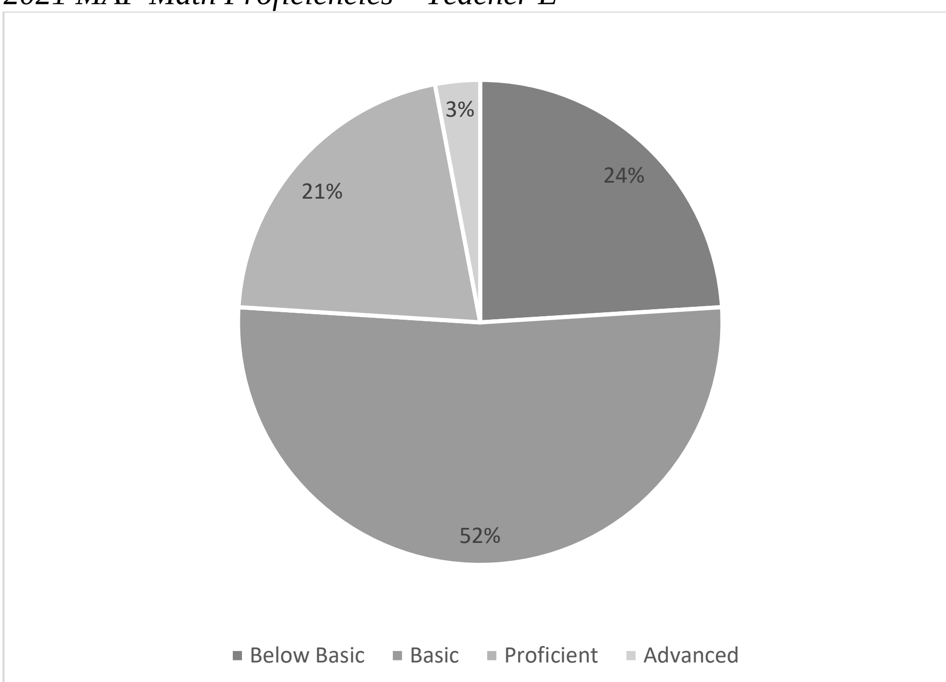


Teacher E

Teacher E emphasized that she values both procedural and conceptual math learning, but focuses on one or the other depending on cues from students. Teacher E discussed that too many variables affect testing and that it is unfair to use testing to evaluate teachers. Teacher E describes her instructional practices as reflective of student interest; however, the language in her conversation suggests that she feels confused about expectations. Even though Teacher E is a curriculum leader, her interview suggests that she craves guidance from leadership, but does not feel that leadership is concerned with her specifically. Her interview did not indicate a strong focus on preparation for testing, indicating that MAP testing is high-stakes for some but not for her. Evidence of this was illustrated when Teacher E relayed that building leaders look at test scores and consider test scores when evaluating teacher efficacy, but that she does not feel that they do the same for her. Because Teacher E's conversation valued taking cues from students, rather than having a solid plan regarding procedural or conceptual instruction, this could have contributed to 24% being advanced and proficient in the math portion of the 2021 MAP. However, Teacher E's average student growth data from NWEA increased 7.8 points during the 2020-2021 school year. Figure 5 shows Teacher E's math proficiencies for 2021.

Figure 5

2021 MAP Math Proficiencies – Teacher E



Implications of Leadership Perceptions

In *Move Your Bus*, Clark (2019) describes members of organizations (such as schools) as runners, walkers, joggers, and riders and drivers. He explains that runners are those energetic and optimistic individuals who strive to help keep the bus moving. At the same time, joggers are individuals who meet expectations, but only exert enough energy to keep the bus moving (Clark, 2019). Clark (2019) describes the walkers as individuals on the bus with runners and joggers pulling along. Riders are dead weight, and drivers are responsible for driving the bus or organization (Clark, 2019). The parable of the bus being an organization and the driver being the organization's leader can be easily connected to the relationships between educators and administrators.

Throughout this study, the researcher could not help but think about the roles of all stakeholders within mathematics education concerning the description of Clark's (2019) bus parable. While perception is influenced by an individual's personal experiences (past and current), the researcher wondered about perceptions concerning runners, joggers, walkers, riders, and drivers. How do stakeholders "on the bus" perceive each other, and would those perceptions be accurate? If all stakeholders "on the bus" analyzed their own positions and categorized themselves as either a runner, jogger, walker, rider, or driver, would their perception be accurate?

Although four of the five teacher participants voiced that they do not feel supported by building leaders in developing and implementing instructional practices, two of the three-building leader participants asserted that they do feel that they offer these supports. While one leader indicated that evidence of this is reflected through leadership surveys and that this is also evident through professional development opportunities extended by leadership, the other building leaders did not provide details as to what “supporting the development and implementation of instructional practices” looks like. This suggests that teachers and administrators do not always accurately perceive their roles as educational facilitators. Teachers who need and want assistance need to be more apparent in what they want from leaders, and leaders need to have a better understanding of what teachers want from administrators to feel more supported. Another inference that could be made is that this phenomenon is an unconscious shift in accountability. Teachers may voice a desire to receive more support in developing and implementing instructional practices, but only if the support reflects their philosophy of math teaching and learning. Such tactics could allow teachers to blame poor test scores for lack of support from leadership. The exact inference could be drawn from a different perspective, in that such tactics could allow leaders to blame poor test scores on teachers' resisting the support employed.

While a few teacher participants and one building leader expressed negative perceptions of high-stakes testing, most participants voiced that accountability is necessary. However, they indicated that student growth data from NWEA is a better way to measure students' progressive learning and explained that it should be used for accountability instead of MAP testing proficiencies. One building leader relayed that MAP testing is collective accountability that reflects building and district leadership, not just classroom teachers; however, the other two building leaders spoke about MAP testing as a reflection of teacher efficacy. All building leader participants indicated that MAP scores are looked at and considered by leadership, but are viewed as one piece of teacher accountability. One building leader asserted that teachers' test scores have never been used to remove a teacher from teaching tested content; however, two-building leaders admitted to doing so. For the most part, teacher participants emphasized that building leaders do value MAP scores, but assume their leaders value student growth data from NWEA more as indicators of high-quality teaching. Three of the five teacher participants perceive building leaders to value test scores more than building participants' voices. Teachers may pressure themselves and find identity in test scores. This could explain why some teachers exhibit negative connotations regarding testing and tend to dwell upon uncontrollable factors that influence outcomes. Even teacher participants that disregarded test scores as unimportant admitted to spending instructional time preparing students for testing (some much more than others). Even though some teachers and administrators perceive results from high-stakes testing as insignificant, their actions could suggest differently.

This study determined that all participants from both teachers and building leaders view student growth data from NWEA as a better measure of teacher accountability. Both stakeholders described the importance of measuring learning as students' progress and at multiple points throughout a school year. Both teacher and building leader participants discussed the MAP test as one week of testing to reflect the academic measures of one specific school year (a summative accountability piece). However, two of three building leaders acknowledged the value of using the data from MAP testing to compare school districts or buildings within school districts. This could suggest that the purpose of the assessment itself influences the perception of high-stakes testing. It could be that both the MAP and NWEA tests provide valuable information about students' learning, but that the NWEA is a better indication of teacher accountability. This could be because NWEA reports student growth throughout a school year, and results from MAP testing are essential, but should not be tied to teacher efficacy.

Strengths and Weaknesses of the Study

Although complex, this mixed-methods, explanatory sequential exploration strengthened the researcher’s current role within education. Conducting research in her school district proved challenging and presented constraints and limitations; however, it provided insight into concerning areas. Although the results of the study were unclear, many revelations surfaced. For example, the research conducted within the literature review uncovered some misconceptions held not only by the participants, but also by the researcher. For example, the researcher accurately understood a part of procedural fluency’s definition. However, the researcher learned that there is much more to procedural fluency than navigating mathematical processes, because of this study. Like participants of the study, the researcher learned the full extent of procedural fluency and the vital role in conceptual understanding.

The researcher began the exploration by posing research questions to help guide the research and formulate hypotheses. While the researcher was careful not to insert into the study her perceptions, the researcher possessed specific ideas regarding procedural and conceptual math learning. The researcher’s thinking was challenged through the literature review, resulting in the researcher re-evaluating her methodologies. This study inspired and motivated the researcher to collaborate with district leadership. It enabled the researcher to provide insightful misconceptions discovered, such as colleagues equating instructional practice and methodology to instructional materials and resources. The discoveries from this exploration facilitated conversations with building leadership regarding scheduling and opportunities for future professional development. It provided clarity and insight that resulted in professional growth.

The researcher encountered a variety of constraints and limitations within this study. Because she is a current teacher within the school district that served as the research site, some participants may have felt uncomfortable participating in the study's second phase. Teacher participants who volunteered for the second phase may have been reluctant to provide feedback regarding procedural and conceptual learning of math related to high-stakes testing. This could be due to the researcher's relationship with colleagues and the participants not wanting to make themselves vulnerable during the interview process. The small sample size limited the research in that the research results represent a small pool of educators and building leaders. *Qualtrics* is Lindenwood University's required platform for creating and administering surveys in research; *Qualtrics* proved not to be user-friendly, and the researcher encountered challenges when seeking assistance regarding the use of *Qualtrics*.

Furthermore, the MIPAQ-L contained a typo in its Likert scale. The strongly agree option mistakenly displays strongly disagree. Although the researcher feared that this error would interfere with feedback collection, building leaders emphasized that they never recognized the mistake and clarified that their responses were accurately reflected through the MIPAQ-L. In conclusion, the most impactful limitation of this study involved the misconception that instructional practices equate to instructional materials or resources. As indicated earlier in Chapter Four, teacher participants almost always spoke of procedural and conceptual math learning and accountability of high-stakes testing in terms of 'what is taught,' and rarely 'how I teach it."

Future Recommendation for Research

This mixed-methods, explanatory sequential study unveiled many pieces of evidence that indicate perceptions of teachers and educational leaders influence instructional practices and have the potential to influence the outcomes of high-stakes testing. However, due to the complexities of this study, the immediate results of the research were inconclusive. To make the results of this exploration more applicable to future research, the researcher suggests narrowing the focus to closely examine teachers' perceptions of high-stakes testing separate from administrators' perceptions of high-quality teaching concerning high-stakes testing. Moreover, further studies should focus on the misconceptions that teachers perceive test scores to bear more weight in determining high-quality teaching, instead of varying perceptions of leadership that seem to be disjointed. Furthermore, the researcher suggests that future studies closely examine the multitude of variables influencing the measure of students' academic successes.

This study is relevant and specific to the researcher; however, its results may not apply to future research. This study may be used to inspire future investigations similar in topic. It has the potential to help facilitate conversations regarding future school improvement endeavors. In *The Math Pact*, a Mathematics Whole School Agreement is described as an

> initiative that refers to a unified and consistent approach to preferred and precise mathematical language, notation, representations, rules, and generalizations that will help clarify rather than muddy children's mathematics understanding and increase their chances of mathematical success as they move into middle grades, high school, and beyond. (Karp et.al., 2021, p. 2)

Karp (2021) explained that cohesive approaches to instruction help minimize students' conflicting language and misconceptions that lead to negative math thinking, but emphasizes that cohesive approaches to instruction help promote positive emotions. Karp (2021) also emphasized that a Mathematics Whole School Agreement is "an agreement that all stakeholders share, helps students make sense of the content, and helps teachers ensure alignment to the standards and assessments for which they are accountable" (p. 5). The researcher found this resource valuable in addressing some of the phenomena discovered throughout this investigation.

Summary

The researcher initially sought to discover what influences teachers' instructional practices, including the potential influences of accountability from high-stakes testing. Additionally, the researcher sought to investigate how teachers perceive educational leaders' roles in supporting the development and implementation of instructional practices in preparation for high-stakes testing. While the researcher discovered that perception influences these ideas, the researcher uncovered many contributing factors, such as misconceptions regarding instructional practices versus materials, gaps in communications regarding expectations, misinterpretation of roles within education, and perceived disjointed leadership. While the direct results of this research are unclear, several revelations surfaced, and these can and should be used as starting points to help remedy weaknesses and initiate actions for school improvement. The researcher will use them to help "move the bus," starting within the elementary and middle school mathematics department.

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Appendix

Documentation of IRB Approval

IRB-22-70 - Initial: Exempt - Approved

do-not-reply@cayuse.com <do-not-reply@cayuse.com>

Tue 1/25/2022 4:07 PM

To: GREEN, RACHEL M (Student) <RMG570@lindenwood.edu>;swisdom@lindenwood.edu <swisdom@lindenwood.edu>

This email originated from outside of Lindenwood University. Do not click links, open attachments, or communicate with the sender unless you know the content is safe and from a reliable source.

Jan 25, 2022 4:07:21 PM CST

RE:
IRB-22-70: Initial - Exploring Perceptions of Math Instructional Practices in Preparation for High Stakes Testing

Dear Rachel Green,

The study, Exploring Perceptions of Math Instructional Practices in Preparation for High Stakes Testing, has been Approved as Exempt.

Category: Category 1. Research, conducted in established or commonly accepted educational settings, that specifically involves normal educational practices that are not likely to adversely impact students' opportunity to learn required educational content or the assessment of educators who provide instruction. This includes most research on regular and special education instructional strategies, and research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

The submission was approved on January 25, 2022.

Here are the findings:

Regulatory Determinations

- This study has been determined to be minimal risk because the research is not obtaining data considered sensitive information or performing interventions posing harm greater than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

Sincerely,
Lindenwood University (lindenwood) Institutional Review Board

MIPAQ-T: ***Math Instructional Practices and Accountability Questionnaire for Teachers***

Section A: Demographics

Which best describes your age?

- under 34
- 35 - 49
- 50 - 65
- 66 or older

To which gender identity do you identify?

- male
- female
- non-binary / third gender
- prefer not to say

Which best describes you?

- White (not Hispanic)
- Black (not Hispanic)
- Hispanic
- Asian or Pacific Island
- American Indian or Alaskan Native
- Other

Which best describes your years of service within education?

- This is my first year.
- 2 - 5 years
- 6 - 12 years
- 13 - 19 years
- 20 - 26 years
- more than 26 years

How many years of experience do you have teaching mathematics in the regular education classroom?

- ○ This is my first year teaching mathematics in a regular education classroom.
- ○ 1 - 5 years
- ○ 6 - 12 years
- ○ 13 - 19 years
- ○ 20 - 26 years
- ○ more than 26 years

Which category best describes your teaching responsibilities?

- ○ I teach all core subjects in a contained classroom (ELA, science, math, and social studies).
- ○ I am part of a teaching team. I teach specific core subjects and another teacher teaches the other core subjects.

Which core subjects do you teach?

- ☐ ELA
- ☐ Math
- ☐ Science
- ☐ Social Studies

Section B: Math Instructional Practices

For each statement indicate the frequency of each math instructional practice in your classroom over the course of the school year.

	daily	2-3 times per week	once per week	2-3 times per month	once per month	2-3 times per year	never
I encourage the discussion of the connections between various models and strategies.	☐	☐	☐	☐	☐	☐	☐

	daily	2-3 times per week	once per week	2-3 times per month	once per month	2-3 times per year	never
Students take notes on how to perform each step in a procedure or algorithm.	☐	☐	☐	☐	☐	☐	☐
I demonstrate for the class the correct way to use a particular procedure or model before they start solving problems.	☐	☐	☐	☐	☐	☐	☐
Students solve problems that allow for several different approaches.	☐	☐	☐	☐	☐	☐	☐
Classroom tasks and activities are selected to provide opportunities for students to explain the mathematics behind an answer.	☐	☐	☐	☐	☐	☐	☐
I present one standard method of solving a task or performing an algorithm.	☐	☐	☐	☐	☐	☐	☐
Students analyze the connections between various models and procedures.	☐	☐	☐	☐	☐	☐	☐
Classroom tasks and activities are based on their potential to encourage discussions of students' mathematical ideas.	☐	☐	☐	☐	☐	☐	☐
I explain the steps to a procedure or algorithm when I introduce new topics.	☐	☐	☐	☐	☐	☐	☐
I emphasize the use of multiple models for recording and communicating student thinking.	☐	☐	☐	☐	☐	☐	☐

	daily	2-3 times per week	once per week	2-3 times per month	once per month	2-3 times per year	never
I avoid student errors and misconceptions when a topic is first introduced by explaining how to solve a problem before they start.	☐	☐	☐	☐	☐	☐	☐
Students learn by copying down examples from a teacher demonstration.	☐	☐	☐	☐	☐	☐	☐
I facilitate discussion about underlying mathematical concepts (e.g., composing or decomposing numbers).	☐	☐	☐	☐	☐	☐	☐
I facilitate small-group or whole-class discussion on student thinking.	☐	☐	☐	☐	☐	☐	☐

For each statement indicate the frequency of each math instructional practice involving number sense and computational fluency in your classroom over the course of the school year.

	daily	2-3 times per week	once per week	2-3 times per month	once per month	2-3 times per year	never
drill and skill of addition and subtraction facts	○	○	○	○	○	○	○
drill and skill of multiplication and division facts	○	○	○	○	○	○	○
constructing part whole models or models to relate addition to subtraction	○	○	○	○	○	○	○
constructing arrays or other models to depict multiplication and division relationships	○	○	○	○	○	○	○
place value of whole numbers	○	○	○	○	○	○	○

	daily	2-3 times per week	once per week	2-3 times per month	once per month	2-3 times per year	never
decomposing and composing whole numbers	O	O	O	O	O	O	O
underestanding and representing common fractions	O	O	O	O	O	O	O
computations with common fractions	O	O	O	O	O	O	O
ordering of fractions	O	O	O	O	O	O	O
relationship between common fractions and decimals	O	O	O	O	O	O	O
place value of decimal numbers	O	O	O	O	O	O	O
understanding and representing decimals	O	O	O	O	O	O	O
computations with decimals	O	O	O	O	O	O	O
rounding whole numbers	O	O	O	O	O	O	O
rounding fractions and decimals	O	O	O	O	O	O	O
estimating the results of computations	O	O	O	O	O	O	O

Section C: High Stakes Testing & Accountability

For each statement indicate your level of agreement.

	strongly disagree (1)	disagree (2)	neither agree nor disagree (3)	agree (4)	strongly agree (5)
When lesson planning, I create lesson content that reflect what will be tested at the end-of-the-year MAP test.	O	O	O	O	O
When lesson planning, I use students' data from NWEA - MAPS to create lesson content.	O	O	O	O	O

	strongly disagree (1)	disagree (2)	neither agree nor disagree (3)	agree (4)	strongly agree (5)
The time I spend preparing for high stakes testing in math detracts from the time that I have to prepare for other core subjects.	O	O	O	O	O
MAP and NWEA - MAPS data allows me to improve my instructional technique and implement a variety of instructional practices.	O	O	O	O	O
My students' scores from MAP and/or NWEA - MAPS are a reflection of the quality of my teaching.	O	O	O	O	O
I spend more instructional time on certain math concepts compared to other math concepts because of MAP testing.	O	O	O	O	O
I am a better teacher because of MAP testing and NWEA - MAPS.	O	O	O	O	O
Educational leaders within my building provide guidance that help support the development and improvement of my instructional techniques and practices.	O	O	O	O	O
Process teaching and procedural learning leads to deeper levels of knowledge and mastery of math concepts.	O	O	O	O	O

	strongly disagree (1)	disagree (2)	neither agree nor disagree (3)	agree (4)	strongly agree (5)
Teaching conceptually and conceptual learning leads to deeper levels of knowledge and mastery of math processes.	○	○	○	○	○

How many hours per week do you normally spend on each of the following activities OUTSIDE of the formal school day (approximately)?

	None	Less than 1 hour	1-2 hours	3-4 hours	more than 4 hours
preparing or grading student tests or exams	○	○	○	○	○
reading and grading other student work	○	○	○	○	○
planning lessons by yourself	○	○	○	○	○
participating in professional development with colleagues	○	○	○	○	○
meeting with students	○	○	○	○	○
meeting with parents	○	○	○	○	○
updating students' records	○	○	○	○	○

How many hours per week do you normally spend on each of the following activities DURING the formal school day (approximately)?

	None	Less than 1 hour	1-2 hours	3-4 hours	more than 4 hours
preparing or grading student tests or exams	○	○	○	○	○
reading and grading other student work	○	○	○	○	○
planning lessons by yourself	○	○	○	○	○

	None	Less than 1 hour	1-2 hours	3-4 hours	more than 4 hours
participating in professional development with colleagues	O	O	O	O	O
meeting with students	O	O	O	O	O
meeting with parents	O	O	O	O	O
updating students' records	O	O	O	O	O

Section D: Phase 2 Research Invitation

In addition to this questionnaire, you are invited to expand upon your thinking by participating in an in-person or virtual interview with the researcher. The interview process in this research may take up to 30 minutes of your time. May I contact you to schedule an interview?

- O yes
- O no
- O maybe

If you answered "yes" to question 13, please list your contact information below. (Before participating in Phase 2 of this research, you will be provided with an additional consent-to-participate form at the time of your scheduled interview.)

Powered by Qualtrics

MIPAQ-L: ***Math Instructional Practices and Accountability Questionnaire for Leaders***

Section A: Demographics

Which best describes your age?

- under 30
- 31 - 41
- 42 - 51
- 52 - 61
- over 61

To which gender identity do you identify?

- Male
- Female
- Non-binary / third gender
- Prefer not to say

Which best describes you?

- White (not Hispanic)
- Black (not Hispanic)
- Hispanic
- Asian or Pacific Island
- American Indian or Alaskan Native
- Other

Which best describes your years of service within education?

- This is my first year.
- 2 - 5 years
- 6 - 12 years
- 13 - 19 years
- 20 - 26 years
- more than 26 years

Before transitioning to educational administration, how many years of experience did you have teaching mathematics in a regular education classroom?

- ○ I did not have experience teaching math in a regular education classroom.
- ○ 1 - 5 years
- ○ 6 - 12 years
- ○ 13 - 19 years
- ○ 20 - 26 years
- ○ more than 26 years

Section B: High Stakes Testing & Accountability

Indicate your level of agreement for each statement.

	strongly disagree (1)	disagree (2)	neither agree or disagree (3)	agree (4)	disagree (5)
Teachers should create lesson content that reflects what will be tested at the end-of-the-year MAP test.	○	○	○	○	○
Teachers should use students' data from NWEA - MAPS to create lesson content.	○	○	○	○	○
High stakes testing encourages teachers to spend more time preparing for tested core-subjects and detracts them from preparing for non-tested core-subjects.	○	○	○	○	○
MAP and NWEA - MAPS data allows teachers to improve their instructional technique and implement a variety of instructional practices.	○	○	○	○	○

	strongly disagree (1)	disagree (2)	neither agree or disagree (3)	agree (4)	disagree (5)
Students' scores from MAP and/or NWEA - MAPS are a reflection of the teacher's quality and effectiveness.	O	O	O	O	O
Teachers spend more time on certain math concepts compared to the other math concepts because of MAP testing.	O	O	O	O	O
MAP testing and NWEA - MAP encourage teachers to grow professionally and strive to do better.	O	O	O	O	O
As a building leader, I provide guidance that helps support the development and improvement of teachers' instructional techniques and practices.	O	O	O	O	O
Process teaching and procedural learning leads to deeper levels of knowledge and master of math concepts.	O	O	O	O	O
Teaching conceptually and conceptual learning leads to deeper levels of knowledge and mastery of math processes.	O	O	O	O	O
Students' scores from MAP and/or NWEA - MAPS help building leaders make decisions about teachers' assignments to content and placement of grade-level.	O	O	O	O	O

Section C: Phase 2 Research Invitation

In addition to this questionnaire, you are invited to expand upon your thinking by participating in an in-person or virtual interview with the researcher. The interview process in this research may take up to 30 minutes of your time. May I contact you to schedule an interview?

- ○ yes
- ○ no

If you answered "yes" to question 7, please list your contact information below. (Before participating in Phase 2 of this research, you will be provided with an additional consent-to-participate form at the time of your scheduled interview.)

Interview Questions – Second Phase of Research

1. When teaching math, what value do you place on process and concept?
2. What is your understanding of procedural fluency?
3. Do you feel supported by building leadership in the development and implementation of instructional practices?
4. What is your perception of MAP testing?
5. Does MAP testing influence your instructional practices?
6. Do you think that building leaders perceive MAP scores as indicators of high quality instruction, and do you think building leaders consider students' MAP scores when making decisions about your job performance?
7. What is your perception of NWEA testing?
8. Does student growth data from NWEA testing influence your instructional practices?
9. Do you think that building leaders perceive student growth data from NWEA as indicators of high quality teaching, and do you think build leaders consider student growth data when making decisions about your job performance?
10. When thinking about MAP and NWEA testing, is one more reliable than the other to determine student achievement?

Permissions Granted to Conduct Research Onsite

1/12/22, 2:47 PM

Rachel Green <rgreen@

spring 2022

8 messages

Rachel Green <
To:

Thu, Dec 2, 2021 at 7:19 PM

1-12-22

Mr.

I am in the process of writing my dissertation (making edits to chapters 1, 2, and 3) through Lindenwood University (Saint Charles, Missouri). The title of this research project is Exploring Perceptions of Math Instructional Practices in Preparation for High Stakes Testing and it is under the direction of my dissertation committee chaired by Dr. Sherrie Wisdom, who can be reached at swisdom@lindenwood.edu. Before I submit my official prospectus and seek to receive IRB approval, I wanted to take a moment to share with you my proposal of this research and to seek initial permissions to conduct my research within Schools. After securing IRB approval next month, I will communicate any adjustments made to the initial proposal to ensure my district leaders have access to the most updated aspects of my research project. While slight modifications to the following proposal may be warranted during the IRB approval process, the proposed investigation and research to be conducted is designed for the following purposes:

Rationale & Significance of the Study

The purpose of this study is to analyze the impacts that standardized testing and teacher accountability may have on elementary students' learning of procedural and conceptual math based on perspectives of teachers and educational leaders. The study is designed to analyze such perceptions regarding the effects of high stakes testing on students for the purpose of identifying potential improvements in curriculum and instructional approaches. In order to accomplish this, the researcher will compare the perceptions of teachers and educational leaders to the student performance data from both the Missouri Assessment Program as well as the School's district-wide assessment tool: NWEA MAP (Northwest Evaluation Association, Measures of Academic Progress). With the increasing demands of high stakes testing and its influence on school monetary resources, curricula freedom or instructional creativity has eroded as "teach to the test" has become the norm (Walker, 2017). As school leaders must ensure schools perform proficiently and as classroom math teachers feel the pressure to cover rigorous state-mandated curriculum, the researcher seeks to discover if correlations between these influences exist.

The research that will be conducted throughout this study will be important to education because it has the potential to impact the way teachers and educational leaders approach assessments of students' performance data. When administrators free teachers from the stigma for high performance and accountability, teachers may be released from the time constraints that high stakes testing may put on instructional practices (Aizen et al., 2017). Additionally, this study may show potential relationships (if any) between perception of instructional technique and practices within math classrooms in comparison to student growth and achievement. Because students who have mastered basic math fundamentals and demonstrate computational fluency tend to achieve higher-level engagement and performance levels in regards to depth of knowledge, the results of this study could potentially provide evidence of the influence that teachers' and educational leaders' perceptions may or may not have on the instructional emphasis in regards to procedural and conceptual learning of math as it relates to student performance on high-stakes tests and teacher efficacy.

Research Questions

Within the context of this study, the following questions will guide the research:

1. What are teachers' and educational leaders' perceptions of procedural and conceptual learning of math in preparation for high stakes testing?
2. What influence (if any) has teacher accountability in preparation for high stakes testing had on instructional practices?
3. How has high stakes testing influenced district leaders' roles in supporting elementary teachers' development and implementation of instructional practices?

Null Hypotheses

The researcher has composed and investigated the following hypotheses in response to the research questions within this study:

Null Hypothesis 1: There will be a relationship between teachers' perceptions of high stakes testing, and the third- through sixth-grade scores reflected through the math portion of the Missouri Assessment Program (MAP) as well as the math portion of the NWEA MAP.

1/12/22, 2:47 PM - spring 2022

Null Hypothesis 2: There will be a relationship between district leaders' perceptions of high stakes testing, and the third-through sixth-grade scores reflected through the math portion of the Missouri Assessment Program (MAP) as well as the math portion of the NWEA MAP.

Population, Sample, and Research Sites
3rd grade teachers @ Elementary, Elementary, and Elementary (including building leadership)
4th through 6th grade math teachers @ School (including building leadership)

Research Design and Time-frame
The design of this investigation follows the explanatory sequential mixed methods model. After securing IRB approval and obtaining all consent-to-participate documents, research will begin in January 2022 and is projected to close in April or May of 2022. The initial phase of the study will be quantitative-driven (questionnaire). After the initial data is collected and analyzed, the researcher will compose qualitative open-ended discussion questions for interview processes with teachers and building leaders who volunteer to participate in the second phase of the exploration.

Thank you for taking the time to preview this proposed research study. I plan to secure IRB approval early in January. After doing so, I will make myself available to meet with you (as well as and) to discuss this project (including any adjustments to it during the IRB approval process). If you foresee any variables that could potentially be problematic to the research or if further explanation or clarification is warranted before providing initial permissions to conduct the research within Schools, please let me know. I am available to meet and discuss as you see necessary. Thank you for your consideration and I look forward to hearing from you.

Sincerely,
Rachel Green
Lindenwood University Doctoral Candidate
rmg570@lindenwood.edu

To: Rachel Green <rgreen@ Fri, Dec 3, 2021 at 11:36 AM

Rachel,

This looks fine to me in order for you to move forward. Perhaps we could visit in more detail sometime, just so I can better understand the commitment being asked of our teachers? We can visit by phone or we can find a time for a brief meeting.

Thanks.

[Quoted text hidden]

Rachel Green <rgreen@ Mon, Dec 6, 2021 at 11:40 AM
To:

Thank you, Mr. Let's plan to meet (either in person or by phone) sometime after we return from break. Does that sound okay?
-Rachel Green
[Quoted text hidden]

To: Rachel Green Mon, Dec 6, 2021 at 11:46 AM

Yes, that will be fine.

1/12/22, 2:47 PM spring 2022

[Quoted text hidden]

Rachel Green <rgreen@ Mon, Jan 3, 2022 at 11:58 AM
To:

Hi, Mr.
I would like to schedule a brief meeting with you to discuss my dissertation project with the first phase of research to be conducted starting sometime toward the middle to end of January. Would you like to visit via phone, google meet, or in person? I do not have a preference. I am available before school (I must be in my classroom by 7:30) or after school (after 3:20) any day next week (Jan 10-14) or the following week (Jan 17-21). Please let me know which method and time works best for your schedule. Thank you, again!
-RG
[Quoted text hidden]

Mon, Jan 3, 2022 at 3:20 PM
To: Rachel Green

Let's meet after school here in my office. I am open Monday, Wednesday, or Thursday next week. If you want to pick one of those days, we can get it scheduled.

Thanks.

[Quoted text hidden]

Rachel Green Mon, Jan 3, 2022 at 3:37 PM
To:

Thank you, Mr. Let's shoot for Wednesday, 1/12. I can be there by 3:20. -RG
[Quoted text hidden]

Mon, Jan 3, 2022 at 4:05 PM
To: Rachel Green

Okay, I'll see you next week.

[Quoted text hidden]

https://mail.google.com/mail/u/0/?ik=8d27d0c473&view=pt&search=all&permthid=thread-a%3Ar3982938560969553846&simpl=msg-a%3Ar-72854878... 3/3

Permissions Request Form to Use and Modify the: ***TIMSS Questionnaire 2018***

IEA

Number IEA-___________ (to be filled by IEA)

PERMISSION REQUEST FORM

To be completed by anyone seeking permission to reuse, reproduce, or translate IEA material.

1. Requested IEA material

Type of requested material (select all that apply):

☐ Assessment/test items ☑ Background questionnaires

☐ Text excerpt (e.g., chapter) ☐ Figure/table

☑ Other, please specify: TIMSS Questionnaire

Please indicate the source of the IEA material:

Author/editor: TIMSS / PIRLS International Study Center Lynch School of Education – Boston College

Title: TIMSS Teacher Questionnaire Grade 4

ISBN: TIMSS School Questionnaire Date of publication: 2018

URL:

Language of requested materials: english

Description of requested IEA material (please indicate item numbers, pages, etc.):

TIMSS Teacher Questionnaire – 17 pages

TIMSS School Questionnaire – 7 pages

I could not find an ISBN for either survey.

NOTE: Please attach text or graphics from the IEA material you would like to use or reproduce.

2. How IEA material will be used

Information about your intended use (select all that apply):

☑ Non-commercial ☐ Commercial

☑ Thesis ☐ Publication (e.g., article, book)

☑ Data collection (sample size: 38 data collection window: 3 weeks)

☐ Other, please specify:

Please provide sufficient information about your research project, (e.g., research question, methodology, etc.): Mixed-Methods study (explanatory sequential design) Exploring perceptions of teachers and educational leaders regarding procedural and conceptual learning of math in preparation for high stakes testing. Does high stakes testing influence math instructional practices?

IEA

☑ Print publication ☑ Online publication (e.g., online journal)
☐ Website (URL:)
☐ Other, please specify: ProQuest Database (Should I choose to publish after I defend.)

Additional information about the planned publication (if applicable):
Author: Rachel Green / Sherrie Wisdom
Title: Exploring Perceptions of Math Instructional Practices in Preparation for High Stakes Testing
Publisher or sponsor:
Language of publication:
Intended audience: dissertation committee / future dissertation students
Number of copies for distribution:
Retail price: N/A
Release date:
Additional comments:

3. Requestor information

First name: Rachel
Last name: Green
Name of institution or organization: Lindenwood University
Address: 209 S. Kingshighway
City and zip code: St. Charles, MO 63301 Country:
Phone: 636-949-4949 Email: rmg570@lindenwood.edu
Signature: Rachel Green Date of request: 1/5/22

To submit your request, please sign and return this form to IEA by mail (Keizersgracht 311, 1016 EE Amsterdam, The Netherlands) or email (permission.requests@iea.nl).

In signing, you agree that the permissioned material will be distributed only as part of or for use along with the original work, where the primary value does not lie with the permissioned material itself.

Please note that by signing this form you also state that you have filled out this form truthfully and to the best of your knowledge and that you have read and will comply with all conditions. Providing IEA with incorrect or incomplete information will not only invalidate permission if granted, but can also hold you liable for any damage arising from your failure to comply with these requirements. In case you have any hesitations and/or reservations regarding the information you have to fill out on this form, please contact IEA. Please allow 4-5 weeks for the processing of your permission request. Please note that your personal information (name, institution, address, email address, phone number) provided on this form will be stored by IEA for documentation purposes.

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Please note that citing without naming the source can or will constitute plagiarism for which you can and will be held accountable.

Number IEA- **(to be filled by IEA)**

Permissions Granted to Use and Modify the: *TIMSS Questionnaire 2018*

RE: permissions to use/modify survey tool

Permission Requests <permission.requests@iea.nl>
Mon 1/24/2022 11:17 AM
To: GREEN, RACHEL M (Student) <RMG570@lindenwood.edu>;Permission Requests <permission.requests@iea.nl>

This email originated from outside of Lindenwood University. Do not click links, open attachments, or communicate with the sender unless you know the content is safe and from a reliable source.

Dear Rachel,

Thank you for your email and for checking this with us. When we mention non-publication, we refer to the instruments themselves. If these are already available on TIMSS & PIRLS ISC website, we kindly ask requestors to refer to those in their publication (include the correct citation in their dissertation) instead of reproducing these in there. If what you would include in this potential publication is your results and adapted versions of the questionnaires (which are no longer the original version), we then kindly ask you to correctly acknowledge the source.

We hope this information suffices, but please let us know if other. Just to confirm the document is already signed by you.

Warm regards,
Marta

Permission Requests
permission.requests@iea.nl

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Researching education, improving learning
International Association for the Evaluation of Educational Achievement

Tel. +31 20 625 36 25 | **www.iea.nl**
IEA Amsterdam | Keizersgracht 311 | 1016 EE Amsterdam | The Netherlands

From: GREEN, RACHEL M (Student) <RMG570@lindenwood.edu>
Sent: Thursday, January 20, 2022 3:46 PM
To: Permission Requests <permission.requests@iea.nl>
Subject: Re: permissions to use/modify survey tool

Thank you for granting permission for me to modify portions of the TIMSS 4th Grade questionnaire as well as the TIMSS School questionnaire for completion of my dissertation work at Lindenwood University in St. Charles, Missouri. I will include my signature on the attached document and return it to you. For clarification purposes, should my dissertation committee and Lindenwood University advise me to publish my finished dissertation, am I permitted to do so in accordance with this document of granted permissions. I noticed that the previous email mentioned "non-publication." The intended audience for my dissertation includes my dissertation committee; however, publishing my finished dissertation project for the use of further studies at Lindenwood or its availability through ProQuest (and other university libraries) is something I would consider at the time I defend and if advised to do so by my dissertation committee. Considering this possibility, do I still have granted permission to use/modify these questionnaires?

From: Permission Requests <permission.requests@iea.nl>
Sent: Thursday, January 20, 2022 7:53 AM
To: GREEN, RACHEL M (Student) <RMG570@lindenwood.edu>; Permission Requests <permission.requests@iea.nl>
Subject: RE: permissions to use/modify survey tool

You don't often get email from permission.requests@iea.nl. Learn why this is important

This email originated from outside of Lindenwood University. Do not click links, open attachments, or communicate with the sender unless you know the content is safe and from a reliable source.

Dear Rachel,

Thank you for your prompt response regarding this issue. After evaluating your request, IEA is now pleased to inform you thar permission has been granted for the use of TIMSS English questionnaires the way these were described in your form. Please make sure you use the items according to IEA conditions which include the non-publication, non-distribution to third parties and the correct use of citations. Attached you can find the signed form with the reference number IEA-22-010.

We hope this information suffices for now, but please do not hesitate to come back to us if other.

Warm regards,

Marta

Permission Requests
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IEA Amsterdam | Keizersgracht 311 | 1016 EE Amsterdam | The Netherlands

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From: GREEN, RACHEL M (Student) <RMG570@lindenwood.edu>
Sent: Monday, January 17, 2022 11:53 PM
To: Permission Requests <permission.requests@iea.nl>
Subject: Re: permissions to use/modify survey tool

Marta,

Please see the attached permission request form. I discarded the older version and included the necessary information on the newer and updated form. I also completed the permission request form to request permission to use and modify portions of the most recent TIMSS questionnaire copyrighted 2018 (I accessed these using the link you provided). Thank you for your timely response and I look forward to hearing from you regarding permissions granted. Please let me know if there is anything else you should need from me.

-Rachel Green
Doctoral Candidate
Lindenwood University

St. Charles, Missouri

From: Permission Requests <permission.requests@iea.nl>
Sent: Friday, January 14, 2022 1:42 PM
To: GREEN, RACHEL M (Student) <RMG570@lindenwood.edu>
Cc: Permission Requests <permission.requests@iea.nl>
Subject: RE: permissions to use/modify survey tool

You don't often get email from permission.requests@iea.nl. Learn why this is important

This email originated from outside of Lindenwood University. Do not click links, open attachments, or communicate with the sender unless you know the content is safe and from a reliable source.

Dear Rachel,

Thank you for your detailed email and for your interest in TIMSS. We wanted to check with you if it is possible to include this information in the attached form. We updated the permission request form a few years ago to include some copyright related information as well as some more specific questions for requestors. Another aspect we wanted to check (or confirm with you) is if you would not be willing to request a more recent version of the Teacher Questionnaire. Perhaps this was a conscious decision, but we wanted to make sure you were aware of the availability of this recent version of the questionnaire (the latest one from TIMSS 2019 can be found through this link).

Thank you in advance for looking into our query, and we will hear from you about the questionnaire needed.

Warm regards,
Marta

Permission Requests
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IEA Amsterdam | Keizersgracht 311 | 1016 EE Amsterdam | The Netherlands

From: GREEN, RACHEL M (Student) <RMG570@lindenwood.edu>
Sent: Saturday, January 8, 2022 9:58 PM
To: Secretariat IEA <secretariat@iea.nl>
Subject: permissions to use/modify survey tool

To whom it may concern,

I am a doctoral student from Lindenwood University (Saint Charles, Missouri) writing my dissertation titled, Exploring Perceptions of Math Instructional Practices in Preparation of High Stakes in Preparation for High Stakes Testing under the direction of my dissertation committee chaired by Dr. Sherrie Wisdom, who can be read at swisdom@lindenwood.edu.

I would like to have permissions to use a modified version of the *Mathematics Teacher Questionnaire Main Survey* found at https://nces.ed.gov/timss/pdf/1999_8th_grade_Math_Teacher_Questionnaire.pdf.

I would modify a portion of the survey to make it relevant to explore perceptions that 3rd through 6th grade teachers may have regarding teacher accountability from high stakes testing in relation to their development and implementation of math instructional practices. I would also include a portion that seeks to explore the perceptions that educational leaders may have regarding their supporting teachers in the development and implementation of math instructional practices in preparation for high stakes testing.

I would like the authors' permissions to modify the *Mathematics Teacher Questionnaire Main Survey* under the following conditions:

- I would use the survey only for my research.
- I will cite *Mathematics Teacher Questionnaire Main Survey* when discussing my modified survey instrument.
- If requested, I will send a copy of my completed research study to your attention upon completion of the study.

Please see the attached document.

If you have any questions or would like to visit about my request, please feel free to contact me at any time. Thank you for your time and consideration. I look forward to hearing from you.

Sincerely,
Rachel Green
Lindenwood University Doctoral Candidate
rmg570@lindenwood.edu

Permissions Requesting and Permissions Granted to Modify and Use: *Frequency of Mathematics Instructional Practices Survey*

1/5/22, 1:35 PM Doctoral Candidate Seeking Permission to Use & Modify Survey Instrument

Rachel Green <rgreen

Doctoral Candidate Seeking Permission to Use & Modify Survey Instrument
4 messages

Rachel Green <rgreen@ Sun, Nov 21, 2021 at 7:01 PM
To: Michele Carney <michelecarney@boisestate.edu>

Dear Michele,

I am a doctoral student from Lindenwood University (Saint Charles, Missouri) writing my dissertation titled, Perceptions of Procedural and Conceptual Learning of Math in Preparation for High-Stakes Testing under the direction of my dissertation committee chaired by Dr. Sherrie Wisdom, who can be reached at swisdom@lindenwood.edu.

I would like to have permissions to use a modified version of the *Frequency of Mathematics Instructional Practices Survey* found at https://drive.google.com/open?id=1z0qQkVCtjWysVuHkILPjBVqiGiwwhd7-.

I would modify portions of the survey to make it specific to instructional practices implemented in 5th and 6th grade classrooms. I would use the modified portions in conjunction with other created survey questions that are designed to investigate the perceptions (of 5th and 6th grade teachers) regarding teacher accountability from high stakes testing in relation to their development and implementation of math instructional practices. I would also include a portion that seeks to explore the perceptions that educational leaders may have regarding their supporting teachers in the development and implementation of math instructional practices in preparation for high stakes testing.

I would like author's and/or authors' permissions to modify the *Frequency of Mathematics Instructional Practices Survey* under the following conditions:

- I would use the survey only for my research.
- I will cite when discussing my modified survey instrument: Carney, M.B., Brendefur, J.L., Hughes, G. R., & Thiede, K. (2015). Developing a Mathematics Instructional Practice Survey: Considerations and Evidence. Mathematics Teacher Educator, 4, 1-26.
- If requested, I will send a copy of my completed research study to your attention upon completion of the study.

If you have any questions or would like to visit about my request, please feel free to contact me at any time. Thank you for your time and consideration. I look forward to hearing from you.

Sincerely,
Rachel Green
Lindenwood University Doctoral Candidate
rmg570@lindenwood.edu

Michele Carney <michelecarney@boisestate.edu> Mon, Nov 22, 2021 at 11:17 AM
To: Rachel Green <rgreen@

Hi Rachel,
You are welcome to use the survey and modify it as needed for your project. I wish you luck on your research!
Best,
Michele

Michele Carney, PhD
Associate Professor of Mathematics Education
Boise State University

Regional Math Center - VCAST - ROOT

1/8/22, 1:35 PM Doctoral Candidate Seeking Permission to Use & Modify Survey Instrument

Rachel Green <rgreen@ Thu, Dec 2, 2021 at 7:30 AM
To: Michele Carney <michelecarney@boisestate.edu>

Dear Michele,

Hello, again! Thank you for allowing me to use and modify portions of the *Frequency of Mathematics Instructional Practices Survey*. I wanted to follow up to let you know that my population and sample has expanded to cover elementary grades (not just those specific to 5th and 6th). Considering this new information, do I still have permission to use and modify the instrument? Thank you again, for your consideration.

Sincerely,
Rachel Green
Lindenwood University Doctoral Candidate
rmg570@lindenwood.edu
[Quoted text hidden]

Michele Carney <michelecarney@boisestate.edu> Thu, Dec 2, 2021 at 8:52 AM
To: Rachel Green <rgreen@

Yes, definitely. I assume once I put it into the public domain, others can do what they want with it. But also feel free to email bc it may be that I would have insight related to whether or not there might be potential validity issues with sampling from tha population (which I don't anticipate in your situation).
Michele

[Quoted text hidden]