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Teacher Perception of Implicit Mindset and its Influence on Math Instruction in Elementary Classrooms

Danielle E. Tamke
Winona State University, dtamke@winona.edu

Teacher Perception of Implicit Mindset and its Influence on Math Instruction in Elementary Classrooms

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Danielle E. Tamke

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The Dissertation Committee for Danielle E. Tamke certifies approval of the following dissertation:

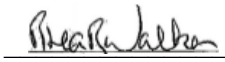
TEACHER PERCEPTION OF IMPLICIT MINDSET AND ITS INFLUENCE ON MATH INSTRUCTION IN ELEMENTARY CLASSROOMS

Committee:

Rhea Walker, PhD, Committee chair

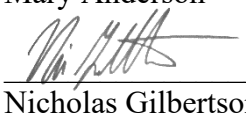
Mary Anderson, EdD, Committee member

Nicholas Gilbertson, PhD, Committee member



Rhea Walker, Chair

Mary Anderson



Nicholas Gilbertson

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Abstract

Math achievement is frequently measured by various assessments. These assessments are then used to determine student and school success, often leading to high stakes decision making. Therefore, it is important to understand ways in which educators can improve student math achievement. Students with a growth mindset, as defined by Dweck (2006), exhibit higher math achievement than students with fixed mindsets. Additionally, teaching practices predict and influence the development of student mindsets. Therefore, one way to improve student math achievement may be through understanding the impact, as well as proper and consistent implementation of growth mindset instructional practices. This qualitative phenomenological study investigates teacher perception of the impact of growth mindset on math instruction, as well as any possible connections between perception and observable practice across five core elementary education teachers in western Wisconsin and southeastern Minnesota. Through document analysis of survey results, semi-structured interviews, and observations, research findings aligned to Sun's (2018) Math Teaching for Mindset Framework (MTMF) suggest that educators believe growth mindset has a positive impact on their math instruction. While educators have a strong understanding of fixed and growth mindset, they report having little to no formal training. Although background understanding is evident, understanding of mindset informed practices seems to be incomplete. Additionally, a connection between perceived practices and observable practices lacks consistency. These themes suggest the need for further professional development specific to mindset informed instructional practices in the elementary math content area.

Keywords: growth mindset, mindset informed practices, elementary math instruction, teacher perception, observable practice, Math Teaching for Mindset Framework.

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Dedication

I am blessed beyond measure to have family and friends who have stood by me, supported me, and encouraged me throughout my educational journey. Specifically, I would like to dedicate this final dissertation and earning of this terminal degree to my parents, Kerry and Bridget, and my fiancé, Nick.

To Mom and Dad - There is no doubt that I would never have found my way to a doctoral degree without you. Thank you for teaching me that education is priceless, learning is never ending, and growth requires passion, dedication, commitment, and a little stubbornness.

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Introduction

In the era of accountability, schools are assessed based on standardized test scores. One of these standardized tests federal and states require to be administered is in the area of mathematics. Math achievement is one of many ways in which students are assessed on a continuous basis. These measures then inform school, state, and national education decision-making (The Education Alliance, n.d.). This impact on education makes these exams high stakes. Any student who has ever participated in one of many frequent math achievement assessments can share the feelings of helplessness that often accompany these high stakes assessments. More concerningly, this anxiety is not felt during high stakes assessments only, but on a daily basis for many students. Math is challenging for students and can create a sense of anxiety (Organization for Economic Cooperation and Development, 2013). This anxiety then may cause decreases in student achievement (Foley et al., 2017).

While high stakes assessments will continue to be required, there are ways in which educators can support student success in math instruction. One way is by supporting the development of growth mindset in students (Park et al., 2016). In order to do so, teachers must understand their own mindset orientation (Bostwick et al, 2020) and become aware of their observable practices within the classroom (De Kraker-Pauw, 2017).

This qualitative, phenomenological research study aimed to understand teachers' perceptions of the connection between their own mindset and their observable practices within their classrooms. Through surveys, semi-structured interviews, observations, and document analysis, the researcher investigated the growth mindset phenomenon and its connection to math instruction of core content educators in public elementary schools in the Midwest.

Problem Statement

Student achievement is constantly assessed across various platforms and comparisons. For example, the Program for International Student Assessment (PISA) is one way student achievement is compared internationally. In 2018, the United States ranked 38th out of 78 countries for average score in mathematics (Organization for Economic Cooperation and Development, 2018). With this data, the problem is that students are not achieving at high levels in mathematics.

Nationally, student mathematic achievement is often compared by the National Assessment for Educational Progress (NAEP). In 2019, according to the NAEP mathematics scale ,47% of Minnesota 4th grade and 55% of Minnesota 8th grade public school students performed below proficient (Minnesota Department of Education, 2019d). This trend was also evident within the Wisconsin and Minnesota statewide assessments with 55.2% of Wisconsin students scoring below proficient in mathematics (Wisconsin Department of Public Instruction, 2019) and 53.8% of Minnesota students not performing at grade level in mathematics content in 2018 (Minnesota Department of Education, 2019c).

While aggregated data were alarming, when disaggregated by socioeconomic and racial/ethnicity subgroups, achievement rates continued to decrease (Minnesota Department of Education, 2019a; Minnesota Department of Education, 2019b; Minnesota Department of Education, 2019c; Minnesota Department of Education, 2019d; Wisconsin Department of Public Instruction, 2019). As Minnesota and Wisconsin elementary classrooms are comprised of varying demographics, it is vital to address the achievement gaps between these subgroups and provide various supports to serve all students. While there are multiple approaches to improving

mathematics achievement, one method to counteract low achievement in mathematics may be through the development of students' mindsets.

Growth mindset, originally presented by Dweck et al. (1995), is the idea that intelligence is malleable and can therefore be developed and improved through effort, perseverance, and continuous practice (Dweck, 2006). Fixed mindset, adversely, is the idea that intelligence is a fixed entity that can only be developed to a limited extent regardless of effort or repeated training. Park et al. (2016) found students with a growth mindset exhibit higher math achievement than students with fixed mindsets. Additionally, teaching practices predict and influence the development of student mindsets (Park et al., 2016), but teacher mindsets do not always equate to more growth-oriented practices (DeKraker-Paux et al., 2017). Therefore, it is important to understand teachers' perceptions of mindset and the teaching practices influenced by their mindsets. Further, it is imperative to observe teaching practices to understand if teacher perception is connected to observable teaching practice. Ultimately, a gap exists in the literature surrounding the connection between teacher perception and observable techniques regarding the implementation of mindset-oriented teaching practices.

Background of the Problem

Math achievement in the Midwestern states of Minnesota and Wisconsin shows need for improvement. The NAEP measures student performance in 4th grade, 8th grade, and 12th grade across the United States in multiple content areas including mathematics (National Center for Education Statistics, 2021). In 2019, 47% of Minnesota 4th grade, public school students performed below proficient on the NAEP mathematics scale, with 55% of 8th grade students performing below proficient (Minnesota Department of Education, 2019d). In comparison, 60% of 4th grade students and 67% of 8th grade students across the nation performed below proficient

on the same scale. These comparisons exhibited improved achievement for Minnesota students, yet also signaled the need for further individualized research to personalize instructional strategies for continuous improvement, as the statewide scores consistently showed no growth, or consistently declined in the case of 8th grade achievement, since 2011.

Although Minnesota student achievement compare favorably to national achievement, the gaps between racial and socioeconomic subgroups are some of the largest across the country (Grunewald & Nath, 2019). According to the Minnesota Department of Education (2019a), 44.6% of all Minnesota students were not meeting math standards in 2019. When disaggregated by race/ethnicity and socioeconomic status, the proficiency level continued to decline with the largest percentage of students at 72.2% of Black or African American students not meeting math standards. Similarly, 65.3% of students receiving free or reduced-price meals were not meeting math standards compared to 35.4% of White students. These trends were also seen in Wisconsin with 46.9% of White students not proficient in mathematics, but 86.5% of Black or African American students and 73.8% of students receiving free or reduced-price meals scoring below proficiency in mathematics (Wisconsin Department of Public Instruction, 2019).

Boaler (2013) stated fixed mindsets hinder the achievement of both minorities and girls, two groups already underrepresented in STEM fields (National Science Foundation, 2021). Not only can this be seen in math achievement for minorities, but also in math anxiety for both subgroups. During completion of the PISA, 35% of girls and 35% of disadvantaged students reported “feeling helpless” when attempting math problems (Organization for Economic Cooperation and Development, 2013, p. 18). Even when performing at equal achievement levels, females reported higher levels of math anxiety than males, as well as less perseverance. This anxiety equated to a 34-point difference in the PISA score, the equivalent of approximately one

year of school achievement. Therefore, math anxiety and math achievement showed a negative connection; students with higher math anxiety had lower achievement (Foley et al., 2017).

Boaler et al. (2016) suggested the use of visual mathematics instructional strategies. Researchers believe these strategies may contribute to equitable instructional and classroom practices as various ideas are more accepted, valued, and encouraged. Boaler et al. (2018) also contributed low math achievement to the way in which it was taught, stating concern with teaching students procedures only, rather than concepts. Additionally, students were taught that only certain people were able to successfully learn mathematics. This belief was considered a characteristic of a fixed mindset and is particularly common within mathematics content and instruction (Jonsson et al., 2012).

These disaggregated levels of proficiency signal the need for research and intervention in regard to equitable practices and closing achievement gaps. One technique to address these needs may be through various instructional strategies and the development of students' mindsets. While there is a history of professional development focused on instructional strategies related to growth mindset, there are limited findings regarding the influence of teacher perception on these teaching strategies. Instructional strategies were not the focus of this study, yet this historical perspective is relevant to the background of the study focus.

A growth mindset, as theorized by Dweck (2014), is the belief that abilities and intelligence are malleable and can be developed with consistent effort and practice, while a fixed mindset is the belief that ability and intelligence are solid entities unable to be improved. People with fixed mindsets are often concerned with other's perceptions of their ability and intelligence, while growth mindset individuals are focused on improvement and believe improvement is possible (Dweck, 2006).

Not surprisingly, fixed mindset beliefs can negatively impact student math achievement (Rattan et al., 2012), often observed through declining grades (Dweck, 2014). Conversely, student achievement increases when students adopt a growth mindset (Boaler et al., 2018), creating hardy and resilient students (Dweck, 2014). Students have more developed persistence and higher academic achievement if they have a growth mindset regarding their ability (Claro et al., 2016).

In regard to achievement gaps, a growth mindset may lead to significant change. The percentage of students decreasing in achievement level or continuously not meeting math standards is higher for all ethnic, racial, and low socioeconomic subgroups, specifically within math content (Minnesota Department of Education, 2019b). According to Grunewald & Nath (2019), socioeconomic status is a consistent determining factor in student achievement, even between White students of differing socioeconomic levels. Students receiving free or reduced-price meals score significantly lower in 4th grade math scores than students who do not qualify for free or reduced-price meals. Compounding, economically disadvantaged students are less likely to hold a growth mindset (Claro et al., 2016). Therefore, economically disadvantaged student achievement may be further hindered by fixed mindset beliefs. Thus, fostering growth mindsets in economically disadvantaged students may be one approach to closing achievement gaps. In conjunction, fostering growth mindsets in all students may lead to increased math achievement for all Wisconsin and Minnesota elementary students.

In regard to student achievement on standardized tests, students with growth mindsets outperform those with fixed mindsets (Park et al., 2016). Park et al. (2016) also stated teacher-reported teaching strategies may impact the development of student mindsets. Similarly, De Kraker-Paux (2017) reported teachers with growth mindsets appreciated and recognized student

improvement more than those with a fixed mindset. However, more of a growth mindset did not necessarily equate to more growth-oriented feedback. This finding suggested that if teachers were made more aware of their mindsets and explicitly aware of their behaviors, they may implement more growth-oriented feedback, thereby developing student mindsets. Thus, teachers' growth orientation could significantly impact student outcomes in math (Bostwick et al., 2020), further improving student achievement for all students (Park et al., 2016).

Teachers in Minnesota and Wisconsin serve students from varying subgroups including gender, socioeconomic status, ethnicity, and race. As discussed, some subgroups show lower math achievement, yet all students in this population may benefit from further supports correlated to mindset and mindset-informed math instructional practices. Therefore, understanding the perspective of these teachers may further inform the impact on all students served in Minnesota and Wisconsin schools.

Purpose of the Study

The purpose of this qualitative study was to better understand core elementary education teachers' perceptions of the influence of their implicit mindsets on their teaching practices in mathematics instruction, as well as to understand the connection of perception and observable teaching practices. Through a phenomenological approach, the researcher utilized semi-structured interviews to understand the phenomenon of teacher perception regarding growth mindset and its influence on instruction. Finally, through observation and document analysis, the researcher investigated the connection between teacher perception and teacher practice as it related to growth mindset. Limited findings for qualitative research approaches specific to math content focus also drove the goals of this study.

Population and Sample

The research population of this study was defined by core education teachers in rural elementary schools in Western Wisconsin and Southeastern Minnesota. These schools also maintained existing partnerships for teacher preparation with Winona State University. Convenience sampling was utilized for feasibility of the study (Merriam & Tisdell, 2016). Each case, or teacher, selected for the research sample had prior experience with growth mindset theory, but may have held growth or fixed mindsets.

The sample for this study consisted of five teachers. Four teachers within the sample were equally distributed across two school districts, while one teacher was employed at a third school district. This sample size was in accordance with Creswell and Creswell's (2018) recommendation within the range of 3-10 participants for a phenomenological study in order to obtain validity and reliability. Names of participants, schools, and school districts were altered or omitted to maintain confidentiality.

Significance of the Study

The improvement of teacher knowledge and adopting growth mindset beliefs regarding mathematics results in increased student achievement, specifically for vulnerable populations such as girls, minorities, and economically disadvantaged students (Anderson et al., 2018). Growth mindset allows students to outperform their past ability levels, as well as their peers who maintain fixed mindset beliefs (Dweck, 2014). Therefore, educators must strive to create growth mindsets that will foster equity among students in order to support all students in Minnesota and Wisconsin elementary classrooms. However, adoption of growth mindsets in teachers does not necessarily equate to an increase in growth mindset teaching practices in classrooms (De Kraker-Pauw, 2017). This intricacy was a main focus of this study. By understanding teachers'

perceptions of the influence of growth mindsets on their own teaching practices and investigating the connection between this perception and observable practice, the researcher provided insight into growth mindset classroom implementation.

While extensive research has been conducted regarding the impact of student and teacher growth mindset on student achievement (Anderson et al., 2018; Boaler et al., 2018; Bostwick et al., 2020; Claro, et al., 2016; De Kraker-Pauw, 2017; Dweck, 2014; Park et al., 2016), limited research has investigated the connection between teacher perception and practices. Additionally, the significant achievement gaps between racial and socioeconomic subgroups in the Midwest require further attention and resources (Grunewald & Nath, 2019). These gaps may be counteracted by growth mindset research, as in the same way, fixed mindsets hinder minorities, girls (Boaler, 2013), and economically disadvantaged students (Claro et al., 2016). Finally, 37.2% of all students in Minnesota showed decreased achievement or continued to not meet math standards in 2019 (Minnesota Department of Education, 2019b), compared to 33.1% for reading standards. This discrepancy showed a need for improved practices in math instruction, the content area focus of this research study.

Research Questions

Student math achievement in Midwest elementary schools is below proficient by multiple measures, and the gaps continue to widen between underprivileged and White students (Minnesota Department of Education, 2019a; 2019b; 2019c; 2019d; Wisconsin Department of Public Instruction, 2019). Growth mindset has shown to improve student achievement in mathematics (Boaler et al., 2018), and teacher growth orientation may significantly impact this achievement (Bostwick et al., 2020; De Kraker-Paux, 2018).

Merriam and Tisdell (2016) suggested three to four research questions to guide a qualitative study; three research questions guided this study. These research questions were answered through interview responses, observational data, and document analysis.

R1: How do core education teachers describe/perceive their knowledge and experiences about teaching math with a fixed versus growth mindset?

R2: How do core education teachers perceive the influence of mindset on instructional strategies in mathematics?

R3: How do core education teachers' perceptions of the influence of mindset on math instructional practices connect to observed instructional practices in mathematics?

Conceptual Framework

Implicit mindset and teachers' perceptions of possible influence within the elementary math classroom were the basis for this research study. Therefore, this research study was grounded in two works from educational researchers with the first being implicit theories of mindsets by Dweck et al. (1995).

Dweck et al. (1995) stated people hold one of two perspectives, which impact their actions, reactions, and understandings, specifically when confronted with challenging events. The first perspective held by individuals is entity theory, more recently referred to as fixed mindset (Dweck, 2006). These individuals believe that personality traits and intelligence are fixed entities, incapable of being developed or enhanced. The second perspective is incremental theory, also known as growth mindset. People with a growth mindset believe that traits are malleable and can be developed through effort and consistent practice.

Individuals do not necessarily hold only one mindset and may hold differing mindsets in relation to intellect and morality. While neither mindset is to be viewed as correct or incorrect, it

is important to note that they both have consequences for the way in which individuals view the world, perceive actions, and make judgements about other people (Dweck et al., 1995).

The second piece of the conceptual framework that guided this research study was Sun's (2018) Math Teaching for Mindset Framework (MTMF). The MTMF is comprised of four categories: sorting, norm setting, engaging in mathematics, and giving feedback and assessment. Each category contains subsets of specific teacher behaviors for which exhibit growth or fixed mindset messages within the math classroom. The MTMF provides a continuum for which practices can be placed between fixed and growth mindset approaches, allowing for analysis and categorization of teaching practices in relation to teacher mindset in math classrooms. This framework not only provided a conceptual grounding for this study, but also served as the foundation for the observation checklist (See Appendix F) and main data analysis tool. These frameworks are discussed further in Chapter Two.

Limitations/Delimitations/Assumptions

Qualitative research has limitations inherent to the study design and method. Limitations to this qualitative, phenomenological design and methodology were specific to the types of data collected and analyzed (Creswell & Creswell, 2018). Limitations inherent to observations include intrusiveness of the researcher within the research environment, as well as the level of observation skills present in the researcher. Interview limitations include possible bias in participant responses due to researcher presence and varying levels of articulation and observance across participants. Finally, document analysis allows for inaccuracy and lack of authenticity, as well as varying levels of articulation across participants within written formats.

The role as the researcher within this qualitative study presented the additional potential for bias (Creswell & Creswell, 2018). The researcher has a background in teaching and has

previously provided professional development to K-6 colleagues in the use of growth mindset within the school and classrooms. Therefore, it is important to transparently state that the researcher supports growth mindset teaching practices in classrooms. Due to this researcher bias, some interpretations may have potentially been made with a positive connotation. The researcher worked to sustain validity and reliability through data triangulation, rich and thick descriptions, transparent bias, and member checking (Creswell & Creswell, 2018). The researcher documented procedures of the study in a research log to ensure reliability of the results (Merriam & Tisdell, 2016). This log is presented as Appendix A in the final report.

Delimitations of this study included the geographic region, as well as the specific scope and content focus. Additionally, the researcher may have had either personal or prior professional relationships with some members of the research study population. However, none of the participants reported to or worked directly with the researcher at the time of the study. Specific content area, geographic location, and research population of this study were chosen for feasibility, providing a narrowed focus suitable for dissertation research. While this study did have limitations, the research objectives and study design allowed for a broader applicability if extended to various geographic locations, grade levels, content areas, and numerous other parameters as defined by future researchers. To support validity and possible generalization, the researcher provided rich, thick descriptions of the findings in Chapter Four, as well as data triangulation and member checking (Merriam & Tisdell, 2016; Creswell & Creswell, 2018).

Definition of Terms

Research is based on common knowledge of terms, concepts, processes, and defined work. Without a clear understanding, there may be misinterpretations of terms used within this

text. Therefore, the following operationally defines terminology used within the context of this research.

Achievement gap. The discrepancy in academic achievement between differing groups of students. These groups are typically signified by race, gender, ethnicity, or socioeconomic status. Academic achievement is typically measured by standardized test scores at the state, national, and international level.

Core education. Classroom instruction that serves the vast majority of students and does not include individualized services provided by special education instructors. This instruction is typically provided by a general education teacher or multiple teachers in a co-teaching model and includes the basic subjects of mathematics, language arts, science, and social studies.

Elementary. The beginning years of schooling including Kindergarten through Grade 5 instruction. Elementary schools typically serve students age five through age twelve. Students in elementary schools are usually placed in the same classroom for one academic year, then advance to the next grade the following school year.

Entity Theory. The original research study conducted by Dweck et al (1995) which introduced the ideas of growth and fixed mindsets. The researchers state the importance of understanding that there is not a correct mindset but that each mindset impacts how the beholder perceives lived experiences differently.

Fixed mindset. One of two implicit mindsets adopted by individuals, also known as entity theory (Dweck et al., 1995). This theory shares beliefs that intelligence and personality are fixed traits, unable of being improved. Individuals with this mindset often feel they are being judged by others in accordance with their failures (Dweck 2014).

Free or reduced price lunches. A measure of income for educational use. At the time of this study, free lunch was approved for students living at or below 130% of the poverty threshold; reduced price lunch was available for students living within 130-185% of the poverty threshold (Grunewald & Nath, 2019).

Grade levels. A working definition of the subsets within the K-12 systems. Within this study, the K-12 system is further categorized into four grade level categories. Lower elementary refers to Grades Kindergarten-3. Upper elementary includes Grades 3-5. Middle level refers to Grades 6-8. High school refers to Grades 9-12.

Growth mindset. An implicit mindset adopted by individuals which impacts the way in which they perceive the world and react to challenging situations (Dweck, 2014). Also known as incremental theory (Dweck et al., 1995), individuals with this mindset believe that traits and intellect can be improved with consistent practice and effort.

High stakes testing. Typically mandated by state or federal bodies. The outcomes of these tests are used to inform decision making regarding accountability, funding, and other impacting factors on school and student success.

Mathematics Teaching for Mindset Framework (MTMF). A framework created by Sun (2018) which allows researchers to place teacher behaviors along a mindset continuum. This continuum provides insight into whether behaviors lead to more growth or fixed mindset tendencies. This continuum was used in the conceptual framework, methodology, and data analysis.

Minnesota Department of Education (MDE). The governing body for education related laws, rules, and statutes in the state of Minnesota. This department houses state standards, licensing requirements, and advisory boards. The MDE maintains relationships and working

partnerships between government, school districts, and stakeholders (Minnesota Department of Education, n.d.).

National Assessment of Educational Progress (NAEP). Congressionally mandated assessment which measures selected student performance in 4th grade, 8th grade, and 12th grade across the United States. The NAEP assesses content in the areas of mathematics, reading, science, writing, technology and engineering literacy, arts, civics, geography, economics, and U.S. history (National Center for Education Statistics, 2021).

Program for International Student Assessment (PISA). Assessment that measures ability level of 15 year olds to apply content knowledge to real life contexts. This assessment is administered by the Organization for Economic Cooperation and Development (OECD) across the globe once every three years (Organization for Economic Cooperation and Development, n.d.).

Rural. A school classification denoting the type of geographic area in which a school is located. Possible areas of classification include rural, town, suburban, and city. Each classification is further composed of more specific classifications with the rural consisting of fringe, distant, and remote subgroups (National Center for Education Statistics, 2020).

Wisconsin Department of Public Instruction. Governing body in the state of Wisconsin that handles education related items. This department supports educational and library improvements and is led by the state superintendent (Wisconsin Department of Public Instruction, n.d.).

Summary

This section described the purpose of this study, as well as the questions it aimed to investigate. Also discussed was a brief explanation of the study and the conceptual frameworks

used to guide this work. Dweck et al.'s (1995) theory of implicit mindsets and Sun's (2018) Math Teaching for Mindset Framework served as the guiding frameworks for this study. The following chapter provides a review of current literature surrounding growth mindset, math instructional practices, and the influence of teacher perception. The literature review also provides further background about the conceptual framework and methodology used in this study. In summary, the review of literature aims to introduce the reader to the major concepts within this study, providing a foundation for the presentation and discussion of study findings.

Review of the Literature

This study focused on the connection between teacher perception and observable practice, specifically related to growth mindset. Since students in the Midwest underperform in high stakes standardized assessments (Organization for Economic Cooperation and Development, 2018; Minnesota Department of Education, 2019a; Minnesota Department of Education, 2019b; Minnesota Department of Education, 2019c; Minnesota Department of Education, 2019d; Wisconsin Department of Public Instruction, 2019), and Dweck's growth mindset theory has been proven to impact student achievement (Dweck, 1999; Park et al., 2016; Tirri & Kujala, 2016; Boaler et al., 2018), it is beneficial to investigate teacher perception of growth mindset and its connection to observable practice. Findings of this research study may inform implementation of growth mindset practices to improve student achievement.

This chapter discusses research relevant to this study including growth mindset and its impact on student achievement and instructional practices, as well as teacher perception. The MTMF is discussed in detail as a foundational aspect of the conceptual framework and data analysis within this study. The researcher utilized online databases to gather the majority of literature informing this topic. Search terms included the following: growth mindset, mindset informed practices, elementary math instruction, teacher perception, observable practice, Math Teaching for Mindset Framework. The researcher also utilized print books when appropriate and firmly aligned to the study focus.

Growth Mindset

The main focus and foundational aspect of the conceptual framework for this study was growth mindset, an attribution theory contributed to Carol Dweck's research. Dweck's growth mindset is one of many attribution theories proposed by psychologists. Attribution theories seek

to explain how people understand and react to events in their lives (Peterson & Park, 2009). Other attribution theories include work by Heider, Kelley, and Weiner.

Growth mindset is a current topic in education and refers to personal beliefs regarding development of abilities, intelligence, and personality traits. Formerly referred to as the incremental theory (Dweck et al., 1995), growth mindset is the belief that one's abilities can be developed through practice, perseverance, and effort (Dweck, 1999; Dweck, 2006; Dweck, 2014). Adversely, the entity theory, (Dweck et al., 1995), or fixed mindset, is the belief that intelligence and personal traits are nonmalleable and cannot be developed. Dweck et al. (1995) noted that individuals may hold both entity and incremental beliefs. For example, people may hold different theories for intellect and morality. While neither fixed nor growth mindset should be considered bad or good, both have consequences for how the individual views the world, perceives actions, and makes judgements about others (Dweck et al., 1995).

According to Dweck (2006), "The passion for stretching yourself and sticking to it, even (or especially) when it's not going well, is the hallmark of the growth mindset" (p. 7). Those with growth mindsets are more likely to attribute success or failure to their strategies and efforts and are likely to respond with efforts to reach mastery (Dweck et al., 1995). Growth mindset individuals are focused on improvement and the process of learning rather than obtaining the correct answer or superior performance to their peers (Dweck, 2006).

Individuals with fixed mindsets are likely to blame their traits for negative outcomes and will likely respond to negative feedback with helplessness (Dweck et al., 1995). People with a fixed mindset are often concerned with other people's perception of them (Dweck, 2006). For example, students holding fixed mindsets were interviewed after receiving a poor grade on an assignment. When asked what they would do to improve their grade the next time, some students

reported the likelihood to cheat rather than increase the amount of time spent studying. Others looked for peers that performed worse than they did (Dweck, 2014). Following failure, people with fixed mindsets may compare themselves to individuals who performed more poorly, make excuses, or develop blame in order to repair their self-esteem (Dweck, 2006). In conclusion, individuals respond differently to events and circumstances dependent on their mindset beliefs. Table 1 depicts behaviors in reference to fixed and growth mindsets.

Table 1

Fixed vs. Growth Mindset

	Fixed Mindset	**Growth Mindset**
Challenges	Avoid challenges	Embrace challenges
Obstacles	Give up easily	Persist in the face of setbacks
Effort	See effort as fruitless	See effort as path to mastery
Criticism	Ignore constructive feedback	Learn from criticism
Success of Others	Feel threatened by success of others	Find inspiration and lessons in the success of others

Note. Adapted from *Two Mindsets* [Infographic] by N. Holmes in "Mindset: The New Psychology of Success" by C. S. Dweck, 2006, p. 263. Copyright 2016 by Ballantine Books.

Definition of Student Success

Growth mindset impacts academic achievement (Boaler et al., 2018; Dweck, 1999; Park et al., 2016; Tirri & Kujala, 2016) and student success (Brougham & Kashubeck-West, 2018; Dweck, 1999; McCutchen et al., 2016). However, the measure of success is often defined differently depending on the focus of the study. This subsection discusses the impact of mindset in regard to the broad definition of student success.

A common measurement of this impact is in correlation with high stakes, standardized tests. High stakes tests are state and federally mandated to measure academic achievement and inform educational decision making, often including funding determinations (The Education Alliance, n.d.). Therefore, adequate student performance is necessary for school well-being. In a longitudinal study, researchers investigated the impact of mindset on student performance over three semesters with 419 third, fourth, fifth, and sixth grade students. Researchers utilized student questionnaires and standardized test scores. These scores showed an overall decline in student success on standardized tests over the study period. The overall decline in test scores could not be conclusively linked to student mindset. However, in relation to the study focus on mindset, students who began the study with a growth mindset showed a slower decline in standardized scores than students with fixed mindsets (McCutchen et al., 2016). Additionally, Park et al (2016) concluded students with growth mindsets outperform those with fixed mindsets on standardized tests (Park et al., 2016). In both studies, students with growth mindset beliefs benefited more greatly than their peers with fixed mindsets, regardless of the specific student achievement or success.

Another way student success can be measured is through investigation of student experiences. Dweck (1999) investigated the impact of mindset on student success during the transition to middle school. Findings concluded students with a fixed mindset exhibited hopelessness and experienced a decline in class standing. Adversely, students with growth mindset did not exhibit hopelessness nor experience class standing decline. Therefore, mindset impacts student success and transition (Dweck, 1999).

Student success can also be measured through students' personal beliefs. Brougham and Kashubeck-West's (2018) experimental action research study sought to help high school students

in an urban setting improve their personal beliefs about their own potential. The research participants struggled with poor grades, attendance, and graduation rates. Following the growth mindset intervention, findings showed improved growth mindset beliefs, but no effect on core grade point average (GPA). However, researchers concluded that no change in GPA may be due to the short timeframe of study and study design (Brougham & Kashubeck-West, 2018).

Finally, student success is often measured in terms of grades and academic achievement within the school setting. Dweck (2014) found that students without growth mindsets show declining grades. Boaler et al (2018) determined increases in student academic achievement when students adopt a growth mindset. In a review of educational, psychological, and neuroscientific research to make connections between mindsets and learning, Tirri and Kujala (2016) not only found an impact on academic achievement, but also the ability to develop mindsets through intervention. Additionally, researchers concluded these interventions can be brief yet still effective. This finding indicates potential for development of teacher education and support in schools.

Impact on Equity

Studies have shown a higher likelihood for fixed mindset beliefs in underrepresented student populations such as minorities, low socioeconomic status, English language learners, and girls (Boaler, 2013; Claro et al., 2016; Snipes & Tran, 2017). Studies have also concluded that growth mindsets positively impact success of these student groups (Anderson et al., 2018; Boaler, 2013; Dweck, 2014; Snipes & Tran, 2017). Dweck (2014) found that growth mindset allows students to outperform their own past abilities, as well as their peers holding fixed mindsets. Therefore, educators must work hard to create these mindsets in students in order to

create equality among students of varying demographics, socio-economic statuses, languages, and ability levels (Dweck, 2014).

In a study of all 10th grade public school students in Chile, researchers analyzed mindset beliefs in correlation with the nationwide standardized assessment (Claro et al., 2016). Findings concluded economically disadvantaged students were twice as likely to hold a fixed mindset than their economically advantaged peers. Researchers also found that holding a growth mindset can limit the impact of socioeconomic barriers on student achievement. Since disadvantaged students are more likely to hold fixed mindsets, their academic success is further debilitated by their beliefs, widening the gap between the advantaged and disadvantaged students. Therefore, by helping students develop a growth mindset, educators can help increase student achievement for those economically disadvantaged, a subgroup showing lower achievement than their economically advantaged peers. In a quantitative study, Yeager et al (2019) sought to find a cost-effective way to increase student outcomes. Findings reported that a brief, online mindset intervention, focusing on teaching that intelligence can be improved, had positive impacts on student achievement specifically for low-achieving students.

Socio-economic status, along with race, ethnicity, language, and achievement level, was also a factor in Snipes and Tran's (2017) survey research. This research focused on growth mindset, performance avoidance, and academic behaviors. While the majority of students and teachers held growth mindset beliefs, students with historically lower achievement, English language learners, and students who are Black scored lower on all three metrics compared to their high achieving, English speaking, White counterparts. Students from lower socio-economic statuses also scored lower on growth mindset and academic behavior indicators. These findings show that students' personal beliefs and attitudes do influence the achievement gap between

varying groups of students. Researchers suggest the possibility for positive intervention in regard to growth mindset practices, specifically for English language learners, low achieving students, and Black and Hispanic students (Snipes & Tran, 2017).

Equity must also be addressed for students receiving special services. In a quasi-experimental study of 6th, 7th, and 8th graders receiving special education services for learning disabilities in reading, researchers aimed to study the effectiveness of a mindset intervention on student self-efficacy and motivation. Results showed improvement in motivation, but not in student self-efficacy. However, researchers noted that an accurate measure of self-efficacy may be difficult to obtain within this research population due to student need and verbal limitations (Rhew et al., 2018).

Teaching Practices

Specific teaching strategies can be used to support growth mindset practices in classrooms. According to Boaler (2013), learning needs to be valued for the process itself. It should not be focused on simply creating or finding the correct answer. Schools need to be supporting mixed ability grouping and approaches to mistakes that are celebrated and viewed as a learning opportunity for all students.

Celebrating mistakes and use of mixed ability groups are two examples of growth mindset-oriented teaching strategies. Other practices include providing praise and feedback, focusing on improvement, and teaching cooperative learning skills. Dweck (2014) cited the importance of providing praise that was based on the learning process rather than praising student intelligence. By praising the process, educators can signify the importance of learning from mistakes and applying perseverance in challenging situations. Praising student intelligence shows students that intelligence is fixed and they are not able to develop it regardless of effort or

practice. De Kraker-Pauw (2017) found that teachers with a growth mindset recognize and celebrate score improvement more than fixed mindset teachers. However, teachers with a growth mindset provided less feedback to students than those with a fixed mindset (De Kraker-Pauw, 2017). While this may seem ineffective, Stanford (2015) stated that growth mindset praise was best used in moderation and with authenticity.

Not only is it important for educators to ensure they provide authentic, growth mindset-oriented praise, but also it is important for educators to consider the emotion for which students exhibit in their communication. Often, specific sayings automatically trigger fixed mindset assumptions, but it is important to analyze student emotion to help determine whether it exhibits growth or fixed mindset. For example, a student saying, "This is hard," could be stated with confidence in approaching a challenging task or could show lack of hope to be successful if stated with a defeated tone. Therefore, it is important for educators to consider emotion before determining intended student mindset (Stanford University, 2015).

Specific skills and strategies can also be taught to students to support growth mindset development and practices. In a mixed methods study of 30 first grade students, students were taught three cooperative learning skills: taking turns, encouragement, and working voice levels (Laurian-Fitzgerald, 2016). Once students had an understanding and practice of these skills, they were assigned a task to complete in partner groups. Findings indicated that young students are willing and able to shift their mindsets from fixed to growth. Additionally, students who began the study with a growth mindset maintained their growth mindset. These findings share a positive implication for the ability of teachers to impact students' mindsets and ability to approach challenges with perseverance. Additionally, teachers have the ability to develop fixed

mindsets in students. Park et al (2016) found competence-based classroom goals and expectations to result in the development of fixed mindsets in students.

The development of teacher mindset and instructional practices that support growth mindset beliefs is also an important factor in supporting student success. Steaton (2018) conducted a mixed methods design evaluating training for the development of teacher mindsets. The study consisted of six training sessions aimed at developing teacher knowledge in relation to growth mindset theory and practices. Results indicated increased knowledge and confidence of teacher participants retained three months after training. This indicates the ability to educate teachers and impact their mindsets and practice (Seaton, 2018).

The ability to educate teachers in relation to mindset and associated practices is important for teachers in all school levels. Survey research indicated lower levels of growth mindset beliefs at secondary school levels compared to elementary school levels (Hanson et al., 2016). Secondary settings show less use of performance-based teaching strategies, lower expectations for student achievement, and fixed mindset perspectives in relation to student ability to improve. Within the study, researchers surmised that lower growth mindset belief scores may have been due to single subject-matter classrooms, increased student to teacher ratios, and lack of parental involvement. Regardless of reason, these factors may not be conducive to developing relationships between students, teachers, and parents.

Mathematics and Growth Mindset

At all levels of schooling, math is often seen as a fixed subject with little space for creative thinking or error (Boaler et al., 2016). Neuroscientists and math teachers are working together to uncover the importance of utilizing visuals within mathematics instruction, highlighting the creative process necessary for student math achievement. Researchers

collaboratively discovered that visual processing is the foundation of mathematical reasoning within the brain. Findings stated that the brain makes multiple connections between visual networks when completing mathematical tasks. These networks were further developed if students were allowed to use visual representations, diagrams, pictures, finger counting, and other visual strategies to complete math tasks. Therefore, mathematical thinking occurred across various parts of the brain, requiring students to have well developed understandings of visuals, numbers, symbols, and words.

Contrary to current practice and curriculum, Boaler et al (2016) suggested allowing the use of finger counting and teaching students to decipher between fingers when using this technique as this supported the development of mathematical thinking through a visual process. Finger counting connected the symbolic representation of the written numerals with the abstract concept of numbers. Similarly, researchers suggested the use of gestures throughout math instruction as another visual representation of abstract number concepts. However, it was vital that students are given opportunities to develop their own gestures in connection to mathematical concepts. By incorporating physical movement and visual representations into mathematics, students of all levels can develop enhanced engagement and deeper understandings, therefore developing stronger connections within the brain.

Boaler et al (2016) provided three recommendations for improved mathematical development in students. First, researchers suggested the celebration and encouragement of visual approaches to mathematical problems, contrary to the common memorization approach. Second, parents and educators should encourage the development of finger discrimination and finger use in mathematical solutions. Finally, and more generally, researchers stated the

importance of transforming math instruction from mental practices to more visual and physical representations.

A leading researcher in the area of mathematics instruction, Boaler (2013) viewed mistakes as opportunities for students to create new connections and increase brain development. She made further recommendations for math teaching strategies that directly relate to growth mindset including student grouping (Boaler, 2013), mindset interventions (Boaler, et al., 2018), and the importance of conceptual understanding (Boaler et al., 2018).

Mathematics and Growth Mindset

Fixed mindset is particularly common within mathematics content and instruction (Jonsson et al., 2012), and fixed mindsets in mathematics can negatively impact student math achievement (Rattan et al., 2012). Additionally, students are often taught that certain individuals naturally understand math, while others will struggle to understand it, or possibly never understand it. Boaler et al (2018) stated the severity of this problem, as well as the concern that students were often only taught procedures to complete standard math problems. In this instructional format, students lacked the understanding of important math concepts and view math as one-dimensional, lacking creativity and the learning process. In recent literature, various strategies were suggested to counteract this one-dimensional fixed mindset math instructional approach. One strategy presented by Boaler (2013) was ability grouping.

Ability grouping is the practice of grouping students together based on past ability or teacher perception of current student ability. Boaler (2013) suggested that ability grouping does not support improvement for any achievement groups; it did, however, support fixed mindset beliefs, which hindered student achievement and participation. According to Boaler (2013), student achievement and engagement improved when teachers employed mixed ability grouping.

Additionally, Boaler (2013) stated that, contrary to common belief, students were aware of inconspicuous ability grouping, further hindering students of minorities and girls, as those student groups were most impacted by fixed mindset messaging. If schools are to address the problem of low participation by women and minorities in science and math fields, then schools need to be supporting mixed ability grouping and approaches to mistakes that are celebrated and learned from. Learning needs to be valued, not simply creating the correct answer. (Boaler, 2013).

Teaching girls about growth mindset improves their persistence in math (O'Sullivan & Riordain, 2017). One way to teach growth mindset, and another way to counteract the damaging effects of fixed mindset math teaching strategies, is through specifically designed mindset interventions. O'Sullivan and Riodain (2017) utilized a mixed methods action research study over six weeks, with 11 female participants ages 15 to 16 years. The study employed a student-centered mathematics instructional approach in order to understand the impact of this intervention on student mindset. Following the six-week instructional period, students approached challenges with more perseverance. Student mindsets also shifted toward growth orientation (O'Sullivan & Riordain, 2017). Another mindset intervention, studied via quantitative methods, found that a brief, online mindset intervention, focusing on teaching the malleability of intelligence, increased enrollment in advanced mathematics classes in secondary settings (Yeager, et al., 2019). This increased enrollment was most likely due to an improvement in student growth mindsets, allowing students to believe they were capable of higher-level mathematics.

In a California study, Boaler et al (2018) studied 1,090 students across four school districts in California. The study investigated the impact of an online course to improve student

mindset towards math. Students who received the online course showed improvement in engagement, class discussion participation, growth mindset beliefs, and viewing math as an interesting and creative subject. These students also reported less fear and better perseverance in regard to math. These increases likely explain achievement increases as well, supporting the findings of past research regarding the connection of student mindset and achievement (Boaler et al., 2018). This study showed the importance of changing student and teacher beliefs, as well as teacher practices, in order to improve math achievement.

Some research suggested the impact of teacher mindset and knowledge of growth-oriented teaching practices on student achievement (Anderson et al., 2018; Boaler et al., 2018; Bostwick et al., 2020; Tirri & Kujala, 2016). If teacher mindset does impact student achievement, then it is vital to educate teachers on the importance of growth mindset teaching practices. Further research has been completed on the impact of these teacher-directed interventions. For example, Anderson et al (2018) conducted a mixed methods study of 40 teachers across eight United States school districts. These school districts provided professional development titled “Mathematical Mindset Approach.” This approach provided information about brain science with the goal of removing fixed mindset beliefs regarding mathematics instruction and achievement in their students. Results showed the improvement of teacher knowledge and adopting a growth mindset belief regarding mathematics. This shift in teacher mindset and improved teacher understanding led to increased student achievement for vulnerable populations, in particular, girls, English learners, and economically disadvantaged students (Anderson et al., 2018). However, not all research shows the significance of teacher mindset or growth mindset knowledge.

Sun (2015) investigated teachers' influence on student mindsets through mixed methods study including survey data, semi-structured interviews, classroom observations, and document analysis. Sun's (2015) survey data findings suggested that teacher mindset had little to no effect on student mindset. However, teachers who provided math instruction with a growth orientation through specific teaching practices did have an impact on student mindsets. Additionally, through qualitative data, Sun (2015) found that teachers who verbally endorsed the rhetoric of growth mindset often employed teaching practices that supported a fixed mindset approach. Observations and interviews indicated four main areas of teaching practice that differed based on mindset approach. These areas included grouping strategies, classroom norms, math tasks utilized, and assessment and feedback.

Through Sun's (2015) observations and interviews, specific practices aligned to both mindsets. Fixed mindset practices often grouped students based on past academic success, indicating lower expectations for previously lower achievers, and high expectations for previously higher achievers. This exhibits the lack of malleability of intelligence to students, whereas growth mindset classrooms group students based on what students can provide to their classmates in regard to strategies, techniques, and approaches to completing tasks. This grouping strategy valued student effort and various ways of thinking. Fixed mindset practices in relation to praise often focus on speed and accuracy, therefore more frequently acknowledging higher achieving students. Growth mindset praise focuses on the processes, strategies, and effort exhibited by students. While students in a fixed mindset classroom are corrected when wrong and given a single chance to find the correct answer, a growth mindset classroom asks students to explain their thinking, are provided feedback to help students find the next step in task completion and are given multiple opportunities to submit work with changes and corrections.

Sun's (2015) survey data revealed that self-reported teaching mindset did not always equate to correlating instructional strategies. Although teachers may support the idea of growth mindset, their observable practices did not always align with these statements. Therefore, Sun utilized these findings to develop a framework that supported growth mindset practices in mathematics classrooms. This framework served as part of the conceptual framework for this study and is titled the Math Teaching for Mindset Framework (MTMF).

Math Teaching for Mindset Framework

Sun's (2018) MTMF is comprised of four categories: sorting, norm setting, engaging in mathematics, and giving feedback and assessment. Each category contains subsets of specific teacher behaviors for which can exhibit growth or fixed mindset messages within the math classroom. The MTMF provides a framework for which practices can be placed on a continuum between fixed and growth mindset approaches, allowing for analysis and categorization of teaching practices in relation to teacher mindset in math classrooms.

The first category, sorting, is comprised of three main practices. The first practice, expectations, refers to the expectations for achievement that teachers hold for their students. Within this practice, teachers who believe all students can contribute to and be successful in the math classroom exhibit growth mindset teaching practices, while teachers who hold different expectations regarding students' ability for mathematical success exhibit more fixed mindset teaching practices. The second practice within the sorting category is grouping strategies. Teachers utilizing fixed mindset practices create groups upon ability and performance while growth mindset practices allow for multidimensional groups that may focus on varying perspectives and approaches within each student group. The final practice in the sorting category is comparative structures. This practice refers to the way in which educators share the success of

their students with the class. For example, an educator who posts student work publicly based on rank of achievement is exhibiting a fixed mindset approach. An educator who posts student work publicly based on the process for completion or various approaches tried exhibits a growth mindset approach to math instruction.

The second category within the MTMF is norm setting. This category is comprised of explicit mindset messaging, valuing the process, handling mistakes, struggle, and risk taking. Explicit mindset messaging refers to the amount and depth of discussion regarding brain growth and its connection to math instruction and learning. An educator utilizing fixed mindset messages will explicitly discuss math ability as a fixed trait, while growth mindset messages involve the opportunity for brain growth within mathematic learning. The next practice, valuing the process, shares the importance of the learning process with a fixed mindset educator focusing on outcomes and solutions and a growth mindset educator placing more significance on the learning process than the final outcomes. Handling mistakes refers to the way in which educators handle and value mistakes. An educator who values mistakes and the opportunities for growth they provide is sharing growth mindset messages with their students. These educators engage students in the process of sense making, instilling perseverance in their students. An educator who provides answers when students make mistakes and does not value student mistakes is sharing fixed mindset messages in regard to mathematic learning. The next practice, struggle, is evident in the way in which the educator teaches their students to handle frustration and failure. The fixed mindset educator will teach students to avoid struggle and failure, while the growth mindset educator will teach persistence and its importance in understanding mathematical concepts. Finally, risk taking refers to the way in which an educator supports or discourages risk taking in the math classroom. The growth mindset educator understands and shares the

importance of student risk taking in the math classroom in order for students to experiment with various ideas and approaches to mathematical problems. The fixed mindset educator values one-dimensional ways of solving problems, therefore discouraging students from taking risks in trying new ideas and approaches for solutions.

The third category is engaging in mathematics and is comprised of two practices – focus of the math task and driver of the math task. Focus of the math task refers to the way in which teachers accept or deny multiple approaches to solutions. The growth mindset teacher provides various approaches, valuing the process of reasoning, sense making, and justification involved in multi-dimensional math work. The fixed mindset educator sees math practice as procedural only, allowing for single solutions and approaches. Driver of the math task involves recognition of teacher-led or student-led math tasks. Teacher-led math classrooms are typically seen by educators with fixed mindset approaches, while student-led practices are highly valued by growth mindset teachers, working as facilitators of the learning and providing guidance when needed.

The final category of the MTMF is comprised of four teaching practices and is titled giving feedback and assessing. Verbal praise is the first practices and involves the use and focus of oral feedback provided to students. Fixed mindset educators will focus on speed and accuracy while growth mindset teachers will explicitly celebrate effort, multiple approaches, engagement, and mathematical reasoning. Similarly, written feedback, the second practice in the fourth category, focuses on teacher feedback provided to students in a written format. Oftentimes, a fixed mindset educator will not provide specific feedback but will contain a negative connotation. Growth mindset feedback is specific, allowing students to visually see in written format the reassurance of their work and effort. The third practice is opportunities for extra help.

This practice is in regard to the availability for extra support outside the math classroom. Teachers with fixed mindset practices rarely offer extra support while growth mindset educators will provide various opportunities for additional support and feedback. Finally, grading policies differ greatly between fixed mindset and growth mindset educators. Growth mindset educators allow students multiple opportunities to show growth and understanding of the material while fixed mindset educators allow single opportunities, which focus on mastery rather than improvement (Sun, 2018).

Teacher Perception, Practice, and Impact

The MTMF provides a framework for educators and administrators to better understand teaching practices aligned to growth mindset. The improvement of teacher knowledge and adopting a growth mindset belief regarding mathematics can increase student achievement for vulnerable populations (Anderson et al., 2018). Therefore, it is important that all educators increase their awareness of these teaching practices in order to help all students. Additionally, student, teacher, and parent mindset have potential impact on future student success (Tirri & Kujala, 2016).

The mindset of an entire classroom has also been shown to impact the success of students. In a quantitative study conducted by Bostwick et al (2020), researchers used a Likert scale to measure mindsets of students and teachers within math classrooms. Findings suggested that mindset has impact on the success of varying levels within the classroom hierarchy. A classroom growth mindset and teacher growth mindset were shown to positively impact classroom achievement. Therefore, teachers' mindsets could significantly impact student outcomes in math.

Similar to growth mindset beliefs, teachers' internal values and practices may also have an effect on student performance. In a quantitative study of seven schools in rural Tennessee, researchers concluded that teacher motivation has an impact on student achievement. Researchers reported intrinsic teacher motivation is directly correlated to student achievement. This means as internal teacher motivation increases, so does student achievement (Cunningham & Farmer, 2016)

According to another study (Sun, 2018), teachers may hold a fixed mindset about mathematics ability, yet utilize practices that lend to growth mindset approaches. The alternate was also true. Teachers may have growth mindset beliefs but still implement fixed mindset teaching practices. De Kraker-Pauw (2017) found that teachers with a growth mindset appreciated and recognized student improvement more than those with a fixed mindset. However, more of a growth mindset did not equate to more growth-oriented feedback. If teachers were made more aware of their mindsets and explicitly aware of their behaviors, they may implement more growth-oriented feedback.

In a mixed method, quasi-experimental study, Truax (2018) investigated the impact of growth mindset feedback and language used by the teacher on student writing motivation in second and third grade. Findings concluded that student writing motivation increased with use of growth mindset language and objective feedback provided by the teacher. Also, students were shown to progress towards more of a growth mindset throughout the course of the study due to these teaching, language-specific, strategies. Researchers utilized weekly student reflections to measure growth mindset progression. At the initiation of the study, one student was focused solely on their mistakes, but then recognized the ability to improve as a writer in week five. By week seven, this student recognized their writing improvement due to the effort they applied.

This qualitative data showed student progress towards a growth mindset, as was seen in the majority of the sample population, due to the teacher's use of growth-oriented feedback and language (Truax, 2018).

Similarly, Rau (2016) used a qualitative multi-case study approach to investigate the impact of a growth mindset classroom on student mindset, specifically focused on the use of teacher language. The study sample consisted of two fourth grade boys and one fourth grade girl in a rural Midwest public elementary school. Results from classroom observations, student reflections, and student interviews showed an increase in student use of growth mindset language and an increase in growth mindset practices among students over the study timeframe. Therefore, use of teacher growth mindset language positively impacted student mindsets and practices (Rau, 2016).

De Kraker-Pauw (2017) suggested providing awareness of teacher language practices to help educators increase their use of growth-oriented feedback, as was evidenced to support student achievement in Rau's (2016) study. This could also be true of the implementation of more growth-oriented teaching practices such as classroom goals. Park et al (2016) found teacher-reported teaching strategies impact the development of student mindsets, including classroom goals. Competence based classroom goals and expectations resulted in the development of fixed mindsets in students within that classroom. When comparing student performance on standardized tests, the students with growth mindsets outperformed those with fixed mindsets. The competence-based classroom goals and expectations may have contributed to students' fixed mindsets and therefore lower student achievement (Park et al., 2016).

While multiple research studies show a positive impact on student achievement, other studies found no connection, or even a negative impact of teacher perception, mindset, and belief

on student achievement. Harbin and Newton (2013) completed a qualitative study including observations, reflections, and interviews of upper elementary teachers. Findings showed little connection between teacher perceptions and math instructional strategies implemented in the classroom. While teachers may have shared specific beliefs that suggested either a fixed or growth mindset, their observable practice did not connect to these beliefs. Instead, teachers were more likely to teach as they were taught as students. Researchers titled this the "teaching as I was taught" phenomenon (Harbin & Newton, 2013).

The negative impact of teacher fixed mindset can be seen in Patterson et al's (2016) study. Researchers sought to investigate effects on student achievement from the teacher perspective by gathering online questionnaire data. Results indicated that teachers with fixed mindsets viewed instructional practices to have minimal impact on student achievement (Patterson et al., 2016). This is important to understand because teachers with fixed mindsets may be less willing to use effective teaching practices that require larger amounts of effort such as supporting higher level thinking, providing feedback focused on the learning process, and instructing via multiple delivery modes.

Teacher beliefs also differ across grade levels and content areas. Survey research focused on growth mindset, performance avoidance, and academic behaviors for teachers and students showed lower growth mindset scores on average for upper grade teachers than was observed for lower grade teachers (Snipes & Tran, 2017). Additionally, teachers with fixed mindsets viewed some subjects as more ability based, or with a fixed mindset lens, versus process based, a growth mindset lens. For example, teachers reported mathematics as being ability based while the arts and sports were viewed as less influenced by intelligence (Patterson et al., 2016). Teachers of mathematics are more likely to hold a fixed mindset than their peers teaching language, social

sciences, and practical disciplines (Jonsson et al., 2012) This is important to understand because it may inform the benefits, or lack thereof, of interventions focused on changing teacher beliefs. As teachers view various domains with different mindsets, interventions aimed at impacting overall teacher belief may not be consistently impactful in every content area (Patterson et al., 2016).

Teacher beliefs impact their teaching, specifically in the activities they provide, the conversations they facilitate, their response to student errors, how they choose to assess learning (Chapman & Mitchell, 2018), the grouping strategies they use (Boaler, 2013), the language they use (Rau, 2016), and the feedback they provide (Truax, 2018). To help support the use of growth mindset-oriented teaching practices, educators need to understand what these practices are and how they can be incorporated into the classroom. Chapman and Mitchell (2018) suggested a coaching cycle for principals to support development of a math mindset in their teachers. Chapman and Mitchell (2018) referred to a mathematical mindset as understanding that math achievement was based on growth and the user's willingness to learn and think about new concepts.

According to the researchers, mindset can be developed through inquiry with the use of four steps in the coaching process. These steps included (1) facilitate conversations about math mindset, (2) plan an investigation of math mindsets through action research, (3) work together to gather data, and (4) reflect as a collaborative partnership. These steps can help develop teacher understanding of math mindsets. In conjunction with the MTMF, teachers can begin employing growth mindset teaching practices in their instruction.

Theoretical Framework

This qualitative study investigated teacher perception of growth mindset and how it connected to their observable practice. The researcher utilized document analysis of survey responses, semi-structured interviews, and teaching observations to understand teacher perception and connection to practice. The theoretical frameworks that guided this study are Dweck's (2014) growth mindset theory, as well as Sun's (2018) MTMF. As discussed in length in Chapter Two, Dweck's (2014) growth mindset theory served as the foundation and main focus of this research study as all research questions tied to this attribution theory. Sun's (2018) MTMF served as part of the theoretical foundation as it provided a way to understand growth mindset teaching practices. It also served as a research tool for creation of the observation checklist. Finally, the MTMF was used to support coding of all data in the data analysis phase of research. This is further discussed in Chapter Four.

Summary

Growth mindset has been shown to positively impact student success (Boaler et al., 2018; Dweck, 1999; Park et al., 2016; Tirri & Kujala, 2016). As math is a content area often viewed with a fixed mindset (Boaler et al., 2016; Jonsson et al., 2012;), it is important for teachers to understand mindset-oriented teaching practices, as well as how to implement them in their classrooms (Boaler, 2013; De Kraker-Pauw, 2017). While an educator focus was utilized for this study, it is important to recognize the efforts of researchers to make an impact on a national level. Rattan et al (2015) provided policy suggestions based on the use of growth and belonging mindsets to improve student learning and achievement across the United States. Policy recommendations included funding for development and implementation of mindset interventions, increasing importance of mindset discussions in the Department of Education, testing interventions to implement statewide, integrating mindset teaching into content, careful

selection of learning materials that integrate mindsets, development of teacher training materials, and addition of mindset materials in the Department of Education's What Works Clearinghouse (Rattan et al., 2015).

Chapter Two highlighted important literature relevant to this study including growth mindset, math instruction, and teacher practices and perceptions. Chapter Three discusses the methodology used to investigate the connection between these focus areas. This discussion includes information regarding research approach, sampling technique, data collection, data analysis, and other key points to ensure a valid and reliable qualitative study.

Research Methodology

This qualitative study sought to understand teacher perception in regard to growth mindset and its influence on instructional practices through investigating the connection between teacher perception and observable practice. This chapter discusses the research methodology used to answer the research questions. Research methodology specific to this phenomenological approach utilized convenience sampling to support feasibility of the study. Data triangulation of document analysis, semi-structured interviews, and observations was utilized to ensure validity of findings. Specific steps regarding data collection and analysis are also discussed in this chapter.

Research Design

As discussed in Chapter One, students in the Midwest underperform in mathematics achievement, according to standardized state and federal assessments (Minnesota Department of Education, 2019d; Wisconsin Department of Public Instruction, 2019). Students also report high levels of anxiety and helplessness when completing international standardized assessments (Organization for Economic Cooperation and Development, 2013). A teacher's growth mindset has been shown to impact academic achievement and perseverance of their students (Bostwick et al, 2020). Therefore, it is important to understand teachers' perspectives regarding growth mindset and the influence it may have on their mathematics instruction.

A qualitative phenomenological research approach was chosen for this study for multiple reasons. According to Merriam and Tisdell (2016), the phenomenological approach investigates the foundation of a phenomenon. In this study, the phenomenon investigated was growth mindset and its influence on mathematics instruction from teachers' perspectives.

Additionally, limited research findings were available from qualitative approaches specific to this phenomenon and content area. While quantitative approaches provided correlational and causal relationships between variables (Creswell & Creswell, 2018), qualitative allows for the rich and thick descriptions about classroom influence and implementation that can only be provided from the teacher perspective (Merriam & Tisdell, 2016). A quantitative approach was ill-suited for capturing teacher descriptions and perspectives, as investigated in this study.

A phenomenological approach was chosen for this study due to research focus of teacher perception; multiple qualitative research methods including grounded theory, phenomenological approach, and narrative inquiry were all considered for completion of this study. The phenomenological approach allows for study of participants' personal experiences and perspectives (Merriam & Tisdell, 2016). Grounded theory seeks to develop theory from the acquired data (Merriam & Tisdell, 2016). The initial data collection from this phenomenological study provided a foundation for which grounded theory may be applied in future studies. However, at the time of this study, there was not enough data or in-depth understanding specific to this focus to effectively apply grounded theory. Narrative inquiry uses stories as the primary data source (Merriam & Tisdell, 2016). While participants may share stories as a means of articulating perception, stories do not provide the detailed and specific reflection of instructional practice necessary to answer the specific research questions posed in this study. As this study focused on teacher belief, perspective, and practice, the phenomenological approach was well-suited to provide this interpretation and was better suited than other qualitative methods such grounded theory or narrative inquiry.

The researcher adopted a constructivist worldview for this study. A main belief of social constructivists is that people actively seek to make sense of their surrounding world and environment (Creswell & Creswell, 2018). Relative to this study, the surrounding world consists of diverse classroom climates and student demographics. Therefore, a constructivist worldview recognizes the need to support all learners from various demographics and backgrounds. The intended audience and potential impact of this research was core elementary classroom teachers and other individuals within K-12 education decision-making. Therefore, a constructivist worldview sought to uncover the complexities of teachers' perspectives in regard to the research questions, rather than place them into limiting categories (Creswell & Creswell, 2018). While entity theory is often discussed in limited terms of either growth mindset or fixed mindset, teacher's views may range in complexity when discussed in relation to their own classroom practices.

Research Questions

The purpose of this qualitative study was to better understand core elementary education teachers' perceptions of the influence of their implicit mindset on their teaching practices in mathematics instruction. The researcher also sought to understand the connection of perception and observable teaching practices in rural Midwest schools. It was guided by the following research questions:

R1: How do core education teachers describe/perceive their knowledge and experiences about teaching math with a fixed versus growth mindset?

R2: How do core education teachers perceive the influence of mindset on instructional strategies in mathematics?

R3: How do core education teachers' perceptions of the influence of mindset on math instructional practices connect to observed instructional practices in mathematics?

Population and Sample Selection

This study sought to gain a better understanding of core elementary teacher perception of growth mindset and how their own implicit mindset may influence their math instruction. The growth mindset focus of this study intended to inform core elementary teachers, as well as administration with decision-making roles in rural elementary schools in southeastern Minnesota and western Wisconsin. Schools were chosen by the following criteria: public, rural, elementary setting, and Winona State University partner.

The sampling criteria and final research participants were chosen for feasibility of the study. Schools within the sample maintained working partnerships with Winona State University. These partnerships increased feasibility of the study. Also, the study population was limited to rural elementary schools as a way to further limit the size and focus of the qualitative study. Future implications of the study related to study population and sample are discussed in Chapter Five.

Sampling Method

This qualitative phenomenological study utilized convenience sampling. This sampling method was chosen for feasibility of the study (Merriam & Tisdell, 2016). While not as desirable as random sampling or other probability sampling methods, convenience sampling served the timeframe of this study and supported feasibility. The researcher selectively chose participants within the sampling criteria to thoughtfully cover the scope of elementary grades and geographic location of the study.

Sample Size

Creswell and Creswell (2018) suggested a range of three to ten participants for phenomenological research. This study utilized a sample size of five participants. These five participants were employed across three school districts. Therefore, the study sample consisted of two core elementary teachers from each of two school districts, with a third school district represented by one participant in the study sample. Repetition of two teachers in each of two districts allowed for comparison of data within and outside of each district. This comparison had the potential to provide findings specific to school district practices or beliefs and their influence on teacher perception regarding mindset.

Sampling Criteria

Sample participants met specific criteria of the study to ensure information-rich cases were investigated (Merriam & Tisdell, 2016). To be eligible, sample participants were core education teachers in elementary settings. More specifically, participants were employed as teachers in core education classrooms within grades Kindergarten through Grade 5. Chosen participants also self-reported prior knowledge of fixed and growth mindset. Finally, participants reported interest in participating in the research study, which consisted of one 60 minute interview and one observation, also with a maximum of 60 minutes. As previously stated, sample participants represented three different school districts across the population and were as evenly distributed across grade levels as possible.

Informed Consent and Confidentiality

Informed consent was obtained from participants prior to data collection to ensure ethical research was conducted (Creswell & Creswell, 2018; Merriam & Tisdell, 2016). Research

participants provided informed consent with signature prior to administration of the initial survey. The initial survey was administered using Qualtrics.

As this study focused on teacher perception, student data were not collected. Therefore, school districts did not need to approve collection of data from vulnerable populations (Creswell & Creswell, 2018). Interview and observation data were specific to teachers collected within schools. Thus, permission to use premises and obtain data of practicing teachers within districts was obtained from each district with a teacher participant. Following this approval, application to complete the study was submitted to and approved by the Institutional Review Board at Winona State University by the researcher (See Appendix B).

As this study was dependent on interview and observation data, anonymity of participants was not possible (Merriam & Tisdell, 2016). Therefore, confidentiality of research participants was held at the utmost importance. To maintain confidentiality, names of all participants, schools, and school districts were changed or omitted. The researcher assigned and used pseudonyms when necessary for discussion of findings.

Validity and Reliability

As qualitative research is based on assumptions by researchers, it is vital that validity and reliability are at the forefront of methodology planning (Merriam & Tisdell, 2016). To ensure validity of the study, the researcher utilized data triangulation (Creswell & Creswell, 2018). Document analysis, interviews, and observations were utilized within this study. The findings from each data collection step were systematically compared to ensure findings were consistent across each data type. Additionally, the researcher provided rich and thick descriptions (Creswell & Creswell, 2018). Rich and thick descriptions have the possibility of sharing teacher

perspective through details regarding the setting. This can create a more realistic interpretation by readers, therefore enhancing validity of findings.

Finally, the researcher was forthcoming about potential bias and assumptions (Creswell & Creswell, 2018). The researcher had a background in teaching and led colleagues in the use of growth mindset within the school and classrooms and supported growth mindset teaching practices. Therefore, some interpretations may potentially have been made with a positive connotation. The researcher worked to sustain validity and reliability through data triangulation, member checking, rich and thick descriptions, and transparent bias (Creswell & Creswell, 2018). Additionally, the researcher knew some participants either personally or from past professional positions. None of the participants reported to or worked directly with the researcher at the time of the study.

Reliability of qualitative research ensures the practices and steps taken by the researcher are consistent across the discipline, various researchers, and different studies (Creswell & Creswell, 2018). The researcher maintained reliability through presentation of a research log (Merriam & Tisdell, 2016) as a way to document procedures and steps completed during research (Creswell & Creswell, 2018) (See Appendix A). Additionally, the researcher ensured careful checking of transcripts and codes to avoid any errors in data entry or analysis (Creswell & Creswell, 2018).

Data Collection Procedure

Teaching practices are shown to predict and influence the development of student mindsets (Park et al., 2016). However, teacher mindsets do not always equate to more growth-oriented instructional practices (DeKraker-Paux et al., 2017). Therefore, it is important to understand teachers' perceptions about mindset and the influence of mindset on their teaching

practices. Further, it is important to investigate whether teacher perception is connected to observable teaching practices. Understanding this connection may inform further research and practices regarding growth mindset and instructional strategies.

This qualitative phenomenological study utilized three types of data including document analysis, semi-structured interviews, and observations. By utilizing three types of data, the researcher was able to implement data triangulation, a common strategy used to ensure validity (Creswell & Creswell, 2018) and reliability (Merriam & Tisdell, 2016) of findings. Additionally, each type of data collected informed the next stage of data collection. For example, findings from the semi-structured interviews informed the researcher of specific practices to view during observation. The details of this scaffolded approach are further discussed in proceeding sub-sections. See Table 2 for alignment of data collection instruments and research questions.

Table 2

Instrumentation and Research Question Alignment

Data Collection Instrument	Research Question Alignment
Mindset Belief Survey	R1; R2; R3
Semi-Structured Interview	R1; R2; R3
Observation	R3

Document Analysis

Document analysis was the first stage of data collection. Data collection began with survey responses based on Sun's (2018) Mindset Belief Survey (see Appendix C). This tool allowed participants to self-report their own implicit mindset beliefs based on a set of six statements. Through use of a Likert scale, respondents reported "Strongly Disagree" to "Strongly Agree" in response to mindset statements with a higher mean score equating to a growth mindset

and a lower mean score equating to a fixed mindset. This survey was administered through Qualtrics. Each participant received an individualized email with a hyperlink to complete the survey. Individualization of each survey through panel creation was utilized. This allowed for direct address of each participant by name, as well as additional security measures to ensure validity of respondents. Responses from the selected participants were analyzed to understand self-reported mindset. This self-reported mindset was used to analyze findings relative to fixed and growth mindset teacher beliefs and the connection to observable practice following interviews and observations.

This survey was administered to all study participants prior to semi-structured interviews and observations. Survey responses are stored in a university protected Qualtrics account. Responses from participants will be stored in the protected Qualtrics account for seven years following study completion. After seven years, the results will be deleted.

Semi-Structured Interviews

The second phase of data collection contained semi-structured interviews. As this study focused on teacher perception, interviews allowed the researcher to understand the feelings and interpretations of participants (Merriam & Tisdell, 2016). Semi-structured interviews were guided by a list of questions to help focus the discussion, but additional questions were added as deemed necessary by the researcher. For use specific to this study, each participant was asked the same foundational interview questions (See Appendix G); additional questions were posed if further clarification was needed from respondents. Each interview was limited to one hour to maintain study feasibility, as well as respect participants' time.

Interviews were audio and video recorded for transcript creation and data analysis. The researcher utilized recording software and cloud software for electronic recording storage; both

software are protected by Winona State University security measures, as well as password protection. Following analysis and creation of transcription, video and audio data were destroyed. Transcriptions and analyses are stored in cloud storage, which is university secured and two-step authentication protected.

Observations

The final stage of data collection utilized observations. Observation is a vital piece of qualitative research because it provides a firsthand account of the phenomenon being studied (Merriam & Tisdell, 2016), in this case, connection between teacher perception and instructional practices. As the influence of growth mindset on personal teaching practices can be difficult to enunciate, observations allow for study of the topic that is not limited by participant explanations. Additionally, the third research question sought to understand the connection of teacher perception and observable practice. This connection could only be investigated through observation.

To ensure results were valid, the researcher implemented systematic practices (Merriam & Tisdell, 2016). The use of an observation checklist ensures that observations are guided by the research questions, and that each observation investigates specific behaviors across multiple participants. The observation checklist specific to this study was based off Sun's (2018) MTMF but is further developed to answer the study's research questions (See Appendix H). As the study focus sought to understand connection of personal perspective and individualized practices, the observation checklist contained a foundational section of observable items relevant to all participants. It also contained a section specialized for each participant based on data collected during interview responses. This individualized section included behaviors referenced by the teacher during interviews where the teacher felt they utilized those specific practices linked to

growth mindset. This differentiated section provided insight specific to research question three of this study.

Observations were conducted during each participants' scheduled math instructional time. These observations were audio and video recorded to allow for transcription and further analysis. All recordings focused only on the teacher and did not include student behaviors, images, or observations. Additionally, no student data dialogue or actions were transcribed. This purposeful technique ensured vulnerable populations were not included in the research study. Recordings were stored in university protected cloud storage until the completion of the study, upon which all video and audio recordings were destroyed. Transcriptions are stored in university protected cloud storage for seven years after completion of the study. All cloud storage utilized for this study are password and two-step authentication protected.

Security of research data is a vital component of ethical research (Creswell & Creswell, 2018). Therefore, the researcher implemented various protective measures and protocol for data security. First, any video and audio recordings were analyzed and transcribed. Following transcription and analysis, the raw data was destroyed. All data compiled from the research study is stored electronically in cloud storage for seven years following the completion of the study, protected by Winona State University security measures. At the conclusion of the seven-year period, all data will be destroyed.

Data Analysis

It is important to note that data analysis during a qualitative study occurs simultaneously with other aspects of the research (Creswell & Creswell, 2018). This aspect allows for continuous shaping and molding of the research study in correspondence with data findings. Therefore, data analysis steps were modified as needed throughout the research process. To

ensure reliability of findings, the researcher noted any changes in data analysis procedures in the research log. All data were also subject to member checks (Creswell & Creswell, 2018). Additionally, qualitative research seeks to consolidate findings to a limited number of themes in order to aggregate data, analyze findings, and understand possible implications of findings. Therefore, not all data were included in the final research report, but all data were analyzed. This analysis informed the final research report.

Qualitative research often involves layers of coding and analysis (Creswell & Creswell, 2018). The researcher followed five steps, as proposed by Creswell and Creswell (2018), for data analysis. The first step of the initial data analysis process was organizing and preparing the data. This included creation of transcriptions, organization of field notes, and sorting of all data to prepare for coding. The second step was to gain a general overview of the data by reading or looking at all data. The researcher wrote notes in margins and began recording general thoughts about the data collected. The third step initiated the coding process. This process involved organizing all data into general categories and providing a label, or code, for each category. When appropriate, the researcher applied in vivo coding to capture participant perception. The researcher implemented hand coding for this study but utilized spreadsheets and tables to support the analysis. Through color coding, filters, and conditional formatting, the researcher assigned codes to each piece of data. The researcher utilized Sun's (2018) MTMF to develop the codebook specific to this research study (See Appendix I). These codes were then analyzed and aggregated to identify themes across the data set, as completed in step four of Creswell and Creswell's (2018) process. Finally, in step five, the researcher determined how to represent the descriptions, themes, and overall findings in the final report. These themes are further discussed

in Chapters Four and Five. All data analysis steps were included in the research log to ensure reliability of analysis and findings.

Summary

The phenomenological approach was chosen for this study as it allowed for understanding of participants' personal experiences and perspectives (Merriam & Tisdell, 2016). As this study focused on teacher perception and its influence on individual practice, this approach was suitable for this study. Additionally, various steps of qualitative study often occurred simultaneously with other aspects of the research (Creswell & Creswell, 2018). This aspect allowed for continuous shaping and molding of the research study in correspondence with data findings. The design of the qualitative approach allowed for scaffolding necessary in this study. As each type of data informed the next stage of study, as discussed in the data collection process, this scaffolded approach and flexibility of the research process was vital to the study design. In following chapters, data findings are discussed, as well as possible future implications for this research focus.

Analysis and Results

The purpose of this chapter is to articulate the findings of the study. Findings are organized by research question. Within each research question, results are further explained according to each data source, and culminated with a results section within each subheading. Limitations and delimitations are discussed in the final section. This chapter strives to prepare the reader for further discussion and future implications within Chapter Five.

Research Questions

As suggested by Merriam and Tisdell (2016), three research questions guided this qualitative study. These research questions served as the consistent driving factor throughout study design, data collection, and data analysis. Each section of this chapter is also organized by these research questions to ensure clarity of results and opportunity for discussion in subsequent chapters.

R1: How do core education teachers describe/perceive their knowledge and experiences about teaching math with a fixed versus growth mindset?

R2: How do core education teachers perceive the influence of mindset on instructional strategies in mathematics?

R3: How do core education teachers' perceptions of the influence of mindset on math instructional practices connect to observed instructional practices in mathematics?

Data Collection

Phenomenological research seeks to understand personal perceptions of a specific phenomenon (Merriam & Tisdell, 2016), specifically in this study participants' perceptions of growth mindset and its influence on math instruction. In order to understand this perception, semi-structured interviews, observations, and document analysis of participant-reported beliefs

and practices were utilized. The validity and reliability of qualitative research was vulnerable to subjective analysis and researcher bias (Creswell & Creswell, 2018). Therefore, the researcher implemented multiple strategies to increase validity and reliability, as discussed in the collection process throughout this section.

Following analysis of current research, selection of the conceptual framework, and completion of methodological design, the researcher applied for approval from the IRB at WSU. Approval from an IRB ensures all research conducted is safe and ethical. This study was granted approval with an exempt status, allowing the researcher to begin data collection. Each step of the following data collection process can be viewed in the research log (See Appendix A).

The first step in the data collection process was initial contact of cooperating institutions and potential survey participants. Survey participants were chosen via convenience sampling to ensure feasibility of the study. Prior to contacting research participants, the researcher contacted school administrators within the school districts who employed potential research participants. The researcher requested consent from the school district to allow research within the school building during school hours, specifically focused on and limited to the school's teaching staff. Approval was signified by the return of the signed Cooperating Institution Letter on school letterhead (See Appendix C). In order to protect confidentiality of the participants, actual cooperating letters are withheld from this report.

Initial contact was made with research participants via email (See Appendix D). Participants were asked to return the signed consent form (See Appendix E). Once the consent form was received, the researcher immediately sent the Mindset Belief Survey (See Appendix F).

Following completion of the survey by individual participants, the researcher scheduled semi-structured interviews and observations. Both interviews and observations were conducted

in-person in the participant's classroom and were audio and video recorded for transcription and further analysis. Observations were scheduled to commence approximately one week after the completion of the participant's interview. All interviews and observations for the study were completed in a three-week time period with approximately one week span between each participant's interview and observation.

Semi-structured interviews were guided by the predetermined interview questions (See Appendix G). Questions were added as needed for clarification or additional information during the interview. All predetermined questions were posed to all participants; not all participants received additional clarifying questions. Interviews were conducted in the participant's classroom. Only the researcher and the participant were present at the time of the interview. Interviews were scheduled to complete within one hour. Actual duration of each interview is provided in Table 3. While the researcher did investigate demographic similarities between participants and interview lengths, no commonalities such as years of experience, age, or mindset score could be identified as contributing factors.

Table 3

Interview Duration Organized By Participant

Participant	Interview Duration
Participant A	33:57
Participant B	17:42
Participant C	36:44
Participant D	33:51
Participant E	19:55

Note. Interview duration is measured in minutes and seconds. The maximum duration allowed was 60 minutes.

Observations were scheduled to commence approximately one week after the completion of a participant's semi-structured interview. The observation checklist served as a unified data collection tool across all participants. However, following semi-structured interviews, the researcher modified each participant's observation checklist by adding instructional practices explicitly stated by the participant during interviews, specifically question 18. These checklists were then used as a guide during observations. All observations were held in the participants' classrooms during the scheduled daily math lesson and were audio and video recorded. The participant, researcher, and students were all present during the observation. In some classrooms, supporting staff members employed by the school district may have also been present. Instructional observations were a maximum of one hour in length. Actual duration of each lesson is provided in Table 4. Differences in lengths of observation were due to variation in scheduled time for math instruction within each classroom.

Table 4

Observation Duration Organized By Participant

Participant	Observation Duration
Participant A	55:03
Participant B	48:46
Participant C	29:58
Participant D	50:41
Participant E	38:53

Note. Observation duration is measured in minutes and seconds. The maximum duration allowed was 60 minutes.

Following completion of observations, the researcher initiated the transcript process; transcription process is further discussed in following sections. Due to the focus on educators, no student data were transcribed from the interviews or observations. Interview transcripts were then sent to participants for member checking. Once all participants provided affirmation of member checking, the researcher began data analysis. In alignment with the process for interview transcripts, no student data were included in analysis of the observation data. Data analysis procedures are discussed in following sections.

Description of Sample

Five participants were chosen for this study. This enrollment remains within Creswell and Creswell's (2018) suggested range to achieve validity and reliability within a phenomenological study. Convenience sampling was utilized to ensure feasibility of the study. While anonymity was not possible within this study, the researcher incorporated multiple measures to ensure confidentiality of participants. These measures included but were not limited

to omission or modification of participant, school, and district names, secure data storage practices, and alignment with ethical research procedures, as deemed appropriate by the WSU IRB.

The five participants had similarities and differences. All participants were core elementary classroom teachers within an elementary school setting, teaching within the grades of Kindergarten through Grade 5. All teachers were employed full time by the school district for which they taught. All schools for which the participants taught were classified as rural schools within southeastern Minnesota or western Wisconsin. Additionally, all school districts for which the participants were employed maintained a partnership with WSU at the time of the study.

While the participants shared the aforementioned similarities, they also varied across grade levels and years of experience. At the time of the study, two participants had over 15 years of teaching experience, while the remaining three had less than ten years of experience. When examining teaching placements across grade levels, one participant had experience teaching at three grade ranges, two participants had experience teaching at two grade ranges, and two participants had experience in only one grade range.

Preparation of Raw Data

In preparation for data analysis, semi-structured interviews were transcribed using both transcription software and manual editing. Interviews were recorded using a recording software with a transcription software embedded. After interviews, the researcher reviewed the transcriptions in alignment with the video recordings. Any errors made by the transcription software were manually corrected by the researcher. Then, transcriptions were formatted in a Word document to allow for note taking and analysis. Transcripts were double-spaced with a

larger margin on the right-hand side to allow for notetaking; line numbers were inserted to allow for efficient navigation throughout each transcript (Merriam & Tisdell, 2016).

Following transcription corrections, the researcher initiated member checking via email. Each participant received their interview transcript for review. Once the participant reviewed their transcript, each had the opportunity to present any errors to the researcher. If errors had been reported, they would have been corrected in partnership with the participant. However, no errors or misrepresentations were reported by the participants to the researcher. Once the researcher received confirmation from all participants, the researcher began data analysis.

Data Analysis

This section states the method of data analysis followed by the results for each research question. When appropriate, data are shared in a table format. Table 5 is utilized to support alignment of data tools to the research questions informed by each data tool.

Table 5

Research Question and Data Tool Alignment

Research Question	Data Collection
R1	Document Analysis of Mindset Belief Survey Semi-Structured Interview
R2	Document Analysis of Mindset Belief Survey Semi-Structured Interview
R3	Document Analysis of Mindset Belief Survey Semi-Structured Interview Observation

This qualitative study utilized the assignment of codes and themes across data sets. Sun's (2018) MTMF served as a structure for analyzing data, as well as assignment of codes (See Appendix I). First, codes were assigned to pieces of data within each set. Next, pieces of data were analyzed in relation to their placement within Sun's (2018) MTMF continuum. Finally, the researcher reviewed the codes and continuum placements to assimilate themes within each research question. These themes are shared in the following sections. Discussion of findings and future implications based on these results are discussed in Chapter Five.

Research Question One

Research question one addressed teachers' perceptions regarding their own knowledge and experiences in relation to teaching math with fixed or growth mindsets. Specifically, it was stated as the following: *How do core education teachers describe/perceive their knowledge and experiences about teaching math with a fixed versus growth mindset?* Document analysis, interview, and observation data all informed this research question.

Document Analysis. Participants completed the Mindset Belief Survey (Sun, 2018), which was administered via Qualtrics. Participants received a personal email for completion of the survey. Within the survey, participants were asked to select the Likert response most appropriate to their own beliefs in relation to each statement provided within the survey. A higher mean score resulted in more of a growth mindset, while a lower mean score signified more of a fixed mindset. Document analysis data were prepared for analysis by downloading survey responses into a spreadsheet, reviewing responses, and calculating mean scores based on those responses.

The Mindset Belief Survey (Sun, 2018) was based on a six-point scale, ranging from one to six. All participants received a mean score closer to six than one, therefore signifying more of

a growth mindset than a fixed mindset. Collectively, the study sample scored 4.67. Table 6 exhibits disaggregated mindset scores.

Table 6

Mindset Belief Survey Mean Scores

Participant	Mean Score
A	4.33
B	4.17
C	4.83
D	5
E	5
Study Sample	4.67

Semi-Structured Interviews. Semi-structured interviews provided information to inform research question one. Interview questions were written purposefully to inform specific research questions; Table 7 shows this alignment.

Table 7

Interview and Research Question Alignment

Research Question	Interview Question
R1	2-13; 15; 17
R2	2-12; 14; 16; 18
R3	5-12; 16; 18

Semi-structured interview data were prepared for analysis through the creation of transcripts. Transcripts were originally completed via transcription software, then edited manually by the researcher. The researcher inserted line numbers and created space for note taking through the transcript by increasing the size of margins and line spacing.

Research Question One Results. Analysis of survey results and interview responses yielded multiple findings. While qualitative study does provide specific and rich findings, it is important to note that a small sample size does not provide the basis for overall generalizations based on disaggregated data. Therefore, all connections and trends can only be applied to the specific sample within this study.

First, interview responses regarding self-reported mindsets matched survey submissions. All participants' mean scores from document analysis showed growth mindsets, which corresponded with interview responses as well. In further review of the document analysis, there did not seem to be an obvious connection between grade levels and mindset. However, there may have been a connection between place of employment and mindset. Participants from the same school districts scored similarly on the mindset survey. Additionally, results may signify an inverse relationship between the number of years of teaching experience and mindset score.

Secondly, all participants exhibited strong understanding of the definitions of growth and fixed mindset through verbal explanations. Examples of participants' statements exhibiting strong understanding of growth mindset included "Growth mindset is we can always move forward. There's always room for improvement. Can't do it **yet**," and "…growth mindset…I think of the power of yet. You don't know it **yet** or we aren't there **yet**." Examples of participants' statements exhibiting strong understanding of fixed mindset included "Fixed mindset – can't do it. I'll never be able to do it," and "…fixed mindset is…you only think one

way and are not really open to other ideas. You don't think you can do anything." Although participants exhibited strong understanding of mindset, as shown in these examples, all participants reported little to no recent professional development regarding mindset in general, and no training on mindset informed teaching practices at any time.

When analyzed in correspondence to the MTMF (Sun, 2018), teachers shared knowledge and expertise most within feedback and assessment. For example, participants stated, "I've had some that I know they can do better [on an assessment] and so I pulled them in before they go out for recess [to look at it again]. I always make a big deal if it's a celebration of learning," and "…if we're really struggling, I say 'Let's relook at this and show me where we went a little wrong.' They go back and fix it, and if it's still wrong, then I'll go over it individually."

Sorting practices modeled more fixed mindset strategies due to grouping strategies, specifically ability grouping practices. For example, when explicitly asked through the follow-up question "Do you group them in similar ability groups?" one participant responded, "Yes, I do." Another participated stated, "Usually, I'll have a stronger kid with a lower kid to help them." Another participant received the follow-up question "So your…groups are made of students that are at similar levels?" for which the participant responded, "Yes."

Norm setting practices within the MTMF included various aspects: explicit mindset messaging, valuing the process, handling mistakes, valuing struggle, and the importance of risk taking. Similarly to sorting practices, norm setting practices also showed more evidence of fixed mindset practices due to the lack of discussion regarding these various aspects. Participants shared the importance of using mistakes as learning opportunities with statements such as "…you fix your mistake and we learn from it," and "I believe that my classroom should be a place where there is no mistakes…I'm a big believer in 'Let's learn from those mistakes. Let's

see what we did wrong.'" However, minimal responses referenced the value of struggle, value of the learning process, or importance of risk taking to the learning process.

Research Question Two

Research question two investigated teachers' perceptions of the influence of mindset on math instruction. Research question two was stated as the following: *How do core education teachers perceive the influence of mindset on instructional strategies in mathematics?* This research question was informed by document analysis and interview responses.

Document Analysis.

As previously discussed, all participants completed the Mindset Belief Survey. Survey results were then analyzed by calculating average mean and further analyzed by comparison to the six-point scale. Analyzed results indicated growth mindsets across all participants. These results are shown in Table 6. To inform research question two, these scores were viewed in relation to themes found from interview data.

Semi-Structured Interviews.

Interview responses were analyzed in alignment with Table 7 to inform research question two. Semi-structured interview responses were coded and themed to locate any findings specific to research question two. Participants discussed multiple instructional strategies that aligned with mindset informed practices, but participants often did not directly state they were aligned to mindset. For example, all participants noted the use of additional opportunities for help and allowing students to make further attempts in the grading process, such as "After the whole group lesson, they work independently. If they need help, I sit at the back table," and "Students are allowed to make corrections on their assessments. It takes extra time, but I want them to see

that they learn from correcting their mistakes." While participants did state the use of these practices, most participants did not reference these practices as mindset informed practices.

When asked directly in interview question 16, interview responses indicated all participants believed mindset did have an influence on their math instruction. All participants provided specific examples of this impact within their instruction. Participants' statements included, "Having a growth mindset allows me to see the potential in all my students and try different strategies to teach them," and "I believe each child in here is capable of learning and growing, so that is a product of my growth mindset…and just trying to encourage them to reach their full potential." However, the amount of detail and further explanation varied across participants.

Research Question Two Results.

Findings from document analysis of survey responses and semi-structured interview responses provided themes relevant to research question two. First, it was clear that all participants, regardless of age, experience, mean survey score, or other demographic factors, perceived mindset to have an influence on math instruction. Further, all participants conveyed a positive influence on their math instruction.

Findings also suggested that instructional strategies and teacher practices shared throughout interviews were not specifically stated by participants as mindset focused but were indeed aligned to mindset informed practices. When asked directly in interview question 18, participants shared different strategies than previously stated in interview responses. An example of participant responses to question 18 that varied from previously stated interview responses included "…we also set goals and really lay out what we're working on and what we're trying to learn." Another participant stated, "Growth mindset I think could be the feedback I give…just

working on the corrections…really focusing on 'You're getting there, you're almost there…I believe in you and you can do this.'" Directly stated practices that were perceived to influence math instruction, such as the aforementioned examples, were aligned to mindset informed practices, but were not previously stated in instructional strategies. This could signal a lack of awareness regarding instructional strategies aligned to mindset, or a lack of alignment between frequently used instructional practices and instructional practices perceived to be influenced by mindset.

Research Question Three

Research question three investigated connections between teachers' perception of instructional practices and observable practices. Research question three was stated as the following: *How do core education teachers' perceptions of the influence of mindset on math instructional practices connect to observed instructional practices in mathematics?* Analysis of findings from document analysis, semi-structured interviews, and observations informed research question three.

Document Analysis.

After analysis of survey responses, all participants received mean scores signaling more developed growth mindsets than fixed mindsets. Regardless of demographics and background experiences, all participants were categorized as holding growth mindsets. These findings were then reviewed alongside semi-structured interview responses and observational data to identify themes within teachers' perceptions of stated instructional practices and observable instructional practices.

Semi-Structured Interviews.

Semi-structured interviews were audio and video recorded within the participant's classroom. Only the participant and the researcher were present during the interview. Interview responses were analyzed by applying codes, then locating themes across the coded data. Participant responses were coded in alignment with Sun's (2018) MTMF. As qualitative research allows for creation of the analysis process during data collection (Merriam and Tisdell, 2016) the interview responses were utilized to individualize observation checklists specific to each participant. Explicitly stated instructional practices, according to participants' interview responses to question 18, were then added to each participant's individualized observation checklist. For example, one participant explicitly stated their use of the statement "Let's learn from this mistake." This statement was then added to the participant's individualized checklist. This individualization of observation checklists provided a tool to guide the researcher during observation analysis.

Analysis of interview responses indicated teacher perceived instructional practices across all MTMF categories. However, not all practices within each category were referenced across the study sample. Frequency of categories referenced varied. Comparative structures of posted student work was the only practice neither implicitly nor explicitly referenced. Practices referenced most frequently included expectations of students, handling of mistakes, focus of the math task, driver of the math task, opportunities for help, and grading policies.

Observations.

Observations were scheduled approximately one week after completion of the semi-structured interview. Each observation was audio and video recorded, then transcribed. Instructional observations took place during the classroom math time and were a maximum of 60

minutes. The researcher utilized observation checklists to guide the collection of observation data. Observation data were then transcribed and the recording destroyed.

When reviewing possible connections between teacher perception and observable practices, themes occurred within the various categories of Sun's (2018) MTMF. First, the sorting category contained two instructional strategies not observed across all participants during the observations, but may have been referenced by participants in interviews. Interview responses indicated use of equal expectations across all participants, whether explicitly stated or not. Evidence of equal expectations included, "I would say I have high expectations and that everybody's able to grow as a learner…they've got to be willing to try and not get frustrated or give up. So we work through that frustration sometimes that 'No, you can do it,' and help each other learn," and "All students are capable of showing growth, but how much and how they get there depends on where they're starting from, how they learn best, and how much reteaching they need." However, no participant was observed explicitly stating expectations of students during observations. In relation to comparative structures, no participants explicitly or implicitly stated the use of comparative structures, and this strategy was not observed by the researcher because no participant posted student work specific to math content in their classrooms. Therefore, results within category one indicated no connection between teacher perception and observable practice. In the case of comparative structures, findings showed lack of participant knowledge or awareness specific to this practice as no participants discussed posting of student work and no classrooms displayed student work.

In category two, norm setting, three instructional practices elicited one shared theme. Explicit mindset messaging, handling mistakes, and struggle were sporadically stated and observed by participants. Across these three practices, no connection could be derived between

teacher perception and observable practices. Participants observed utilizing these practices did not always explicitly stated these within interview responses. Examples of practices observed but not explicitly stated in interviews included recognizing the importance of struggle through class discussion and providing extra opportunities for help throughout the lesson. In other instances, participants explicitly stated the use of these strategies, but they were not observed by the researcher. For example, participants stated the use of the statement "You just don't know **yet**," but this statement was not observed during any instructional observations. In short, category two indicated inconsistences in teacher perception and observable practices in regard to norm setting.

Category three encompassed engagement in mathematics. Both practices within this category, focus of the math task and driver of the math task, were explicitly stated and observed by all participants. Therefore, category three indicated that participants recognized these practices as mindset informed instructional strategies. However, participants utilized these strategies in various places on Sun's (2018) MTMF continuum. All participants exhibited a mixture of growth and fixed practices within this category. For example, the focus of math tasks may have allowed for multiple approaches, but multiple solutions were not shared. Or, math tasks were given by the teacher, but then completed by the students. These practices exhibited a mixture of growth and fixed mindset practice.

Category four represented feedback and assessment, encompassing the codes for verbal feedback, written feedback, opportunities for extra help, and grading policies. Verbal feedback was observed by all and explicitly stated by most participants. For example, one participant stated "…during class, we use our math boards and markers quite a bit and they'll have practice problems. And so just by circulating around the room and seeing what they're working on and providing that feedback right there." This participant was observed employing this feedback

approach. Written feedback could not be observed within the study parameters, so no results can be derived for this instructional strategy. All participants were observed utilizing growth mindset approaches to providing opportunities for extra help, as well as grading policies, and most participants explicitly stated their use of these instructional practices. An example of opportunities for extra help was seen with the following participant statement: "I'm very lucky to have a para (paraprofessional) during math. So having them support those learners that I know are going to struggle with that, just by close proximity and watching their independent work too is another strategy I will use." Evidence of this practices was seen by the researcher during the instructional observation. A grading policy example included the following participant statement: "They will do their [fluency practice]…I check to see how they did. If I notice that some of them have the red stop sign…I'll go and talk with them and say 'Hey, I saw you got a red today, let's see if we can get that up by tomorrow.'" This grading policy was observed in practice. Therefore, category four signified a strong connection between teacher perception and observable practice.

Research Question Three Results.

Research question three sought to uncover any possible connections between teacher perception of the influence of mindset informed practices and actual observable practices in the classroom. Participants provided explicit behaviors, as well as implicit behaviors through interview responses. The researcher then utilized these responses to guide observation data collection and analysis.

Document analysis, interview responses, and observation findings showed multiple themes. Overall, all participants were observed utilizing either a mixture of growth and fixed mindset strategies, or practices fully aligned to growth mindset. Some of these practices were

explicitly stated by participants, but some were not. No participants were observed utilizing all instructional strategies they explicitly stated from interview question 18; this ranged from 25-69% of explicitly stated practices observed. When comparing observable practices across participants, results indicated participants with less teaching experience showed strong connections between observable practices and explicitly stated practices. Conversely, participants with more teaching experiences were observed utilizing more mindset informed practices, but explicitly stated less of the observable practices within their interview. Additionally, when comparing document analysis, interview responses, and observation data, participants with mean survey scores that related more to a growth mindset exhibited less observable mindset informed instructional practices but had explicitly stated these practices during interview responses more frequently than participants who scored a lower mean score.

Results

Results of this study suggested that participants were knowledgeable about implicit mindset theory overall. Participants' perception of their own personal mindset directly aligned to their measured mindset, as determined through data analysis of survey responses and interview responses. While participants were knowledgeable about mindset, they did not report receiving professional development on the subject. Additionally, participants reported growth mindset having a positive influence on their instruction. However, participants' knowledge of instructional practices aligned to mindset was less developed, as determined through analysis of interview responses in alignment to Sun's (2018) MTMF. Finally, participant perception of the influence of and use of mindset informed practices within their instruction did not consistently align to observable practices. Participants employed mindset informed practices, but often times these practices had not been explicitly stated by the participant themselves. When these practices

were used, participants consistently utilized either a mixture of growth and fixed practices, or entirely growth-oriented practices.

It is important to understand that qualitative research provides findings specific to the research population and can therefore be difficult to apply to other samples. Additionally, limitations and delimitations may be evident in the study. This study was limited by the types of data collected, intrusiveness of the researcher within the classroom environment, level of observation and interview skills of the researcher, teacher bias on responses due to presence of the researcher, varying levels of articulation among participants, and the researcher's own bias (Creswell & Creswell, 2018). This study also had delimitations including the duration of the study, time limitations for interview and observations, geographic region, scope and content focus, and the sample parameters and size as chosen by the researcher (Creswell & Creswell, 2018). The researcher aimed to mitigate the impact of these factors through various validity and reliability measures including data triangulation, member checking (Creswell, & Creswell, 2018), and a research log (Merriam & Tisdell, 2016).

Summary

This chapter provided objective presentation of results through description of data collection and data analysis procedures. Each research question was addressed with findings specific to the question focus and data collection tools. Finally, overall results were briefly shared to prepare readers for discussion of findings and future implications, as discussed in Chapter Five.

Discussion and Conclusions

The purpose of this phenomenological qualitative study was to investigate teacher perspectives regarding implicit mindset and its impact on instructional practices. Additionally, the study aimed to identify any possible connections between teacher perception and observable practices in regard to mindset informed teaching practices. Data collection and analysis included document analysis of survey responses, semi-structured interviews, and observations. This chapter discusses possible conclusions from the research findings, as well as future theoretical and research implications relative to the study.

Discussion and Conclusions

This study investigated three research questions. As this study sought to understand teacher perspective, a phenomenological approach was utilized. The research questions were as follows:

R1: How do core education teachers describe/perceive their knowledge and experiences about teaching math with a fixed versus growth mindset?

R2: How do core education teachers perceive the influence of mindset on instructional strategies in mathematics?

R3: How do core education teachers' perceptions of the influence of mindset on math instructional practices connect to observed instructional practices in mathematics?

Dweck's (2014) research into growth mindset and Sun's (2018) MTMF were utilized for conceptual frameworks, due to the focus of implicit mindset theory on math instruction. Dweck's (2014) research served as the base for general understanding within this topic. Sun's (2018) framework guided the math instructional implications, as well as data collection and analysis

procedures. The conceptual framework and research questions combined sought to better understand teacher perception of mindset and its influence on instructional practices.

Research question one sought to understand teachers' perception of their own knowledge of teaching math with a specific mindset. This question was stated as the following: *How do core education teachers describe/perceive their knowledge and experiences about teaching math with a fixed versus growth mindset?* The overall findings for research question one indicated that participants had a solid understanding of fixed and growth mindset. All participants reported having little to no professional development in this area outside of their teacher preparation program; no participants referenced professional development in the last year. Additionally, participants also exhibited accurate self-reflections of their own mindset, as measured by the Mindset Belief Survey (Sun, 2018).

These findings may indicate that, despite the lack of recent or thorough professional development in the area of growth and fixed mindset, participants have an accurate and sufficient understanding of implicit mindset theory in general. This is consistent with the idea that educators can be taught growth mindset practices and retain the knowledge over an extended timeframe (Seaton, 2018).

Research question two addressed teachers' perceptions about the influence of mindset on their instructional practices. Research question two was stated as the following: *How do core education teachers perceive the influence of mindset on instructional strategies in math?* According to interview response data, all participants believed mindset to have an influence on math instruction. More specifically, participants felt holding a growth mindset had a positive influence on their math instruction.

When participants were asked to share strategies for which they employed and perceived to be aligned to mindset, responses exhibited misunderstandings or partial understandings. In relation to research question two, these findings indicate the desire by participants to use mindset informed practices in order to positively influence their instruction. However, these aims may be misguided due to lack of knowledge regarding mindset informed practices.

Sun (2015) reported an impact on student mindsets when teachers employ growth orientation instructional strategies in math. Additionally, research suggests that student achievement increases when students adopt a growth mindset (Boaler et al., 2018; Dweck, 2000; Park et al., 2016; Snipes & Tran, 2017; Tirri & Kujala, 2016). In review of prior research and findings significant to this study, professional development, specific to mindset informed instructional practices in math, may be both desired and warranted for educators within the research sample parameters.

Research question three investigated any possible connection between mindset informed practices that teachers perceived to be in their instructional practices and observable instructional practices. Research question three was stated as the following: *How do core education teachers' perceptions of the influence of mindset on math instructional practices connect to observed instructional practices in math?* Research findings specific to research question three suggested that teacher perceived instructional practices did not consistently align to observed instructional practices. This is consistent with other research shared in Chapter Two, specifically the work of Harbin and Newton (2013) and De Kraker-Pauw et al (2017).

Results also showed a connection between practices for which participants presented more knowledge and their observable practices. Practices for which participants portrayed to be more knowledgeable about in interview responses were also more often seen in observations.

Consistently across all participants, the mindset informed practices that were utilized were aligned to either a growth mindset or a mixture of growth and fixed mindset orientations. This leads to two conclusions. First, participants have the desire and intent to deliver instruction aligned to a growth mindset. Second, participants may simply be unaware of which practices actually align to mindset informed instruction, as stated within the theoretical framework for this study. Together, this may show the need and demand for further professional development and teacher training specific to mindset informed teaching practices in math instruction.

Theoretical Implications

When considering theoretical and practical implications, it is important to note the strengths and weaknesses within the research methodology. A strength of this study is the narrowed focus utilized to close a gap in the literature specific to the scope, content, and geographic parameters. Qualitative research findings specific to growth mindset in elementary math instruction, specifically in rural schools, is limited. Additionally, the study presents findings that may inform practical implications for schools examining growth mindset.

Weaknesses of this study included the limited time frame and opportunities for data collection. Reliability of findings may be increased by collecting data over multiple observations rather than a single occurrence. Additionally, a pilot study (Merriam & Tisdell, 2016) or pilot testing (Creswell & Creswell, 2018) of data collection instruments would further increase reliability due to effective revision of interview questions and observation checklists. Validity could also be improved through purposeful sampling (Creswell & Creswell, 2018; Merriam & Tisdell, 2016). This would ensure information rich cases across all participants. Finally, increased time between interviews and observations would help remove participant bias or the impact of the researcher upon teacher practices. In other words, participants would be less likely

to recall their interview responses if further time was given between their interview and observation.

Practical Implications

Qualitative study provides findings specific to a set and small population. While generalizations may be made for similar populations, it is difficult to propose theory based on a single qualitative study. However, the findings of this study may suggest that educators who identify as growth mindset strive to utilize growth mindset aligned instructional strategies. While this may be true, there may be knowledge gaps limiting the consistent use of growth mindset aligned instructional practices, specifically in the content area of math.

Findings of this study suggest practical implications to be employed by teachers, school districts, and teacher preparation programs in order to improve math instruction, and therefore student math achievement. First, the findings of this study indicate the need for professional development in the area of mindset informed practices. More specifically, educators may benefit from training specific to mindset informed math instructional practices.

The researcher recognizes that this is only one approach to improving math achievement and that multiple factors impact math achievement. According to multiple measures, the achievement gap continues to widen for students in underrepresented populations (Minnesota Department of Education, 2019a; Minnesota Department of Education, 2019b; Minnesota Department of Education, 2019c; Minnesota Department of Education, 2019d; Wisconsin Department of Public Instruction, 2019). While these findings may help to improve equity among diverse students, it does not mitigate the need for systemic change in order to further support students in overcoming these barriers.

Recommendations for Future Research

After reviewing findings, the researcher suggests further research within the general focus of this study. Specifically, correlation studies may validate and enhance findings from this qualitative study. Correlation studies seek to determine the degree to which two or more variables relate to one another (Creswell & Creswell, 2018). This would be beneficial to this area of research due to some specific findings. Findings of this study indicated a possible direct correlation between years of teaching experience and mindset practices. Additionally, there may be an indirect relationship between mindset score, as measured by the Mindset Belief Survey (Sun, 2018), and observable mindset informed practices, as well as years of teaching experience and a stronger connection between perceived instructional practices and observable instructional practices. It was not possible to derive correlation findings from this methodology. Therefore, correlation research would be beneficial to determine any verifiable findings.

The researcher also suggests further research within this focus by expanding the region and scope of the study to include urban schools and secondary schools. As stated by Grunewald and Nath (2017), urban schools often exhibit lower graduation rates. Conducting this research in urban schools may improve math instruction and therefore graduation rates. Additionally, Hanson et al (2016) noted that secondary schools often maintain more fixed mindset beliefs. By increasing the research scope to include secondary schools, growth mindset practices may be further employed at this level. Additionally, further research specifically focused on gender may advance the current understanding of the impact of growth mindset on girls, as referenced by Boaler (2013), Anderson et al. (2018), and O'Sullivan and Riordain (2017).

Lastly, there may be research implications relative to Sun's (2018) MTMF. The MTMF provides general descriptions of mindset informed practices across a fixed-to-growth mindset

continuum. However, this tool may be more beneficial to practitioners if detailed descriptions of specific mindset informed practices were aligned to the four categories within the MTMF. By providing more extensive detail, educators could more accurately align their instructional methods to a growth mindset model. Extensive qualitative and quantitative research would be needed to ensure accuracy of the updated framework.

Recommendations for Future Practice

Participants within this study shared a positive perspective on the impact of growth mindset on instructional practices. Therefore, teachers in general may be interested in increasing their knowledge and awareness of mindset informed practices. Because growth mindset has shown to improve student achievement (Boaler et al., 2018; Dweck, 2000; Park et al., 2016; Snipes & Tran, 2017; Tirri & Kujala, 2016), school districts and administrators should provide professional development with the focus of implicit mindset, but more significantly, mindset informed practices to be utilized in elementary math classrooms. Independently, teachers may choose to utilize professional development books specific to mindset informed practices such as those authored by Boaler (2016), Ricci (2013), and Brock and Hundley (2016) to make changes within their own math classrooms.

Summary

Growth mindset improves student success, as measured by various indicators. Additionally, it has been shown to positively impact students who may already be disadvantaged. By supporting growth mindsets in our classrooms through teacher modeling and mindset informed practices, teachers have the opportunity to help students grow to their full potential. Teachers can employ strategies that help all students see and achieve their full potential. These strategies may include high expectations for all students, multidimensional grouping strategies,

and explicit mindset messaging. Teachers should discuss the importance of the learning process and handling mistakes, the value of struggle, and the encouragement of risk taking in the learning environment. Students should be given multidimensional math tasks that are student driven and teacher supported. Teachers should provide verbal and written praise that is effort and process focused, communicates high standards, and is specific. Finally, students should be given numerous opportunities for extra help with multiple opportunities to show their learning. Dweck (2006) stated, "There was a saying in the 1960s that went: 'Becoming is better than being.' The fixed mindset does not allow people the luxury of becoming. They have to already be (p. 25)." Employing mindset informed teaching practices provides an environment in which students are allowed to grow into their full potential, becoming lifelong learners in the process.

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Appendix A: Research Log

11/17/2021

Received IRB approval as Exempt status. Research may begin.

11/18/2021

Emailed 4 participants with request to return consent form. Requested any recommendations of additional participant (snowball sampling) from 2 participants.

11/23/2021

Emailed 1 additional participant gained through snowball sampling.

11/19/2021 - 11/30/2021

Consent forms received from all participants. Initial survey is sent to participants via Qualtrics mailer, ensuring security of participant data, as well as valid survey submissions. Survey completion reminders were needed for two participants.

11/23/2021 - 12/6/2021

All surveys collected. Interviews and observations are scheduled with all participants.

11/30/2021 - 12/7/2021

All interviews completed. Audio and visual recordings are utilized. Transcription of interviews initiated. Creation of individualized observation checklists begins. Observations are scheduled for approximately 1 week after completion of interview. No changes to interview process, as explained in Chapter Three, original research methodology.

12/07/2021 – 12/13/2021

All observations completed. Audio and visual recordings are utilized. Observation times increased depending on scheduled time for math instruction. This change was made to ensure no

connections between teacher perception and observable practice were omitted due to time restraints. Actual length of interviews and observations are provided in Table 3 and Table 4.

1/22/2022 – 1/24/2022

All interview transcripts are sent to participants for member checking.

1/24/2022 – 1/28/2022

All member checking approval received from participants. Data analysis begins.

1/28/2022 – 2/08/2022

Interview transcripts and observation recordings are reviewed and coded within Word and Excel. All coding is then analyzed within the parameters of each research question. The researcher utilizes tables to organize findings during data analysis process.

2/08/2022 – 2/18/2022

All analysis findings are reviewed and presented within Chapter Four. The researcher considers further implications and overall conclusions within Chapter Five.

Appendix B: IRB Approval

Winona State University Institutional Review Board (IRB)
Human Protections Administrator
Maxwell 161
Winona, MN 55987
507.457.5519 or bayers@winona.edu

DATE:	November 17, 2021
TO:	Danielle Tamke
FROM:	Winona State University IRB
PROJECT TITLE:	[1828821-1] Teacher Perception of Implicit Mindset and its Influence on Math Instruction in Elementary Classrooms
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF EXEMPT STATUS
REVIEW TYPE:	Exempt Review

Thank you for your submission of New Project materials for this research study. The IRB has determined this project is exempt according to 45 CFR 46.101(b). You may begin your research.

While your project is exempt from further review, you must report to the IRB any significant modifications in your protocol, consent form, and/or data collection tool(s). All serious and unexpected events, non-compliance, or complaints must also be reported to this office.

For all reports, please use the report form in IRBNet Forms and Templates Document Library and refer to the "How to Do Everything" document for instructions.

We will retain a copy of all your submitted materials and a copy of this correspondence within our records.

If you have any questions, please contact the Human Protections Administrator at 507.457.5519 or bayers@winona.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within the Winona State University IRB records.

Appendix C: Cooperating Institution Letter

To whom it may concern:

(School District Name) has given Danielle Tamke permission to conduct research involving its employees, specifically classroom teachers. As a condition for conducting the research, *(School District Name)* guarantees that a subject's decision whether to participate or not participate, or to withdraw from the study, will not affect the subject's current or future relationship with *(School District Name)*. We understand that a statement to that effect will be included in all informed consent documents or verbal informed consent procedures used by the investigators conducting the study.

Appendix D: Initial Email to Participants

Dear (*Participant Name*),

My name is Danielle Tamke. I am a doctoral student in the Education Doctorate program at Winona State University. You are receiving this email as a formal invitation and request to participate in my doctoral research study titled *Teacher Perception of Implicit Mindset and Its Influence on Math Instruction in Elementary Classrooms.*

The purpose of this qualitative study is to better understand core elementary education teachers' perceptions of the influence of their implicit mindsets on their teaching practices in mathematics instruction, as well as to understand any possible connection of perception and observable teaching practices. Through a phenomenological approach, the researcher will utilize semi-structured interviews to understand the phenomenon of teacher perception regarding growth mindset and its influence on instruction. Finally, through observation and document analysis, the researcher will investigate the connection between teacher perception and teacher practice as it relates to growth mindset.

Attached you will find a consent form specific to you and this research study. This consent form provides further information regarding your participation in the study, time requirements of participants, potential risks and/or benefits of participation, your rights as a participant, and contact information should you have further questions. If you choose to participate, please complete the bottom portion of the attached consent form and return to me at your earliest convenience.

Thank you for your time and consideration. I look forward to your response.

Sincerely,

Danielle E. Tamke

Appendix E: Participant Consent Form

Consent Form: ***Teacher Perception of Implicit Mindset and its Influence on Math Instruction in Elementary Classrooms***

What is this research study about?
You are invited to participate in a research study designed to study the influence of teacher implicit mindset on instructional practices. We hope to learn how teacher mindset influences teaching practices, as well as how teacher perception connects to observable practice in relation to growth or fixed mindset.

What activities will this study involve?
If you decide to participate, you will be asked to complete the following short survey. After completion of the survey, you will be asked to participate in a single one hour interview. Following the interview, participants' math instructional practices will be observed within the classroom setting. This single observation is a maximum of 60 minutes.

How much time will this take?
The study will begin on November 22nd and end on April 1st. We estimate participating in the study will require 2-3 hours of your time.

What will be done with the data collected during this study?
The information you give will be analyzed as part of this study. As this study is dependent on interview and observation data, it is not possible to collect this data anonymously. Therefore, your confidentiality is held at the utmost importance. To maintain confidentiality, names of all participants, schools, and school districts will be changed; the researcher will assign pseudonyms for the discussion of findings. Any identifiable information obtained through video or audio recording will not be transcribed for use in data analysis or presentation of findings.

All information collected will be stored in university protected Cloud storage accounts. When the study is completed, all video and audio recordings from interviews and observations will be immediately destroyed. All other data will be stored for seven years in university protected Cloud storage. Following the seven-year period, all data collected during this study will be destroyed.

Are there any risks for participating?
The risks associated with this study are professional reflection of teaching practices. These risks will be minimized by confidentiality practices and secure data management. Additionally, the (school district name) has given the researcher permission to conduct research involving its employees. As a condition for conducting the research, the (school district name) guarantees that a subject's decision whether to participate or not participate, or to withdraw from the study, will not affect the subject's current or future relationship with the (school district name).

Are there any benefits for participating?
There are no appreciable benefits from participating in this study.

What are my rights as a participant?
Participation in this study is voluntary and you may stop at any time. You may decide not to participate or to discontinue participation at any time without penalty or loss of benefits. A

decision not to participate or withdraw will not affect your current or future relationship with Winona State University or the (school district name).

Who can I contact if I have questions or concerns about this study?
The main researcher conducting this study is Danielle Tamke, a doctoral student at Winona State University. The faculty advisor for this study is Dr. Rhea Walker, 507-457-5353, rwalker@winona.edu. You may ask any questions you have about the study and your participation now or later during the study.

Who can I contact if I have questions about my rights as a participant?
If you have questions or concerns about your participation in the study, contact the Human Protections Administrator Brett Ayers at 507-457-5519 or bayers@winona.edu. This project has been reviewed by the Winona State University Institutional Review Board for the protection of human subjects.

You will be given a copy of this form to keep for your records.

Agreement to Participate

Participation in this study is voluntary. You may withdraw at any time. Your signature indicates that the study has been explained, you have had an opportunity to ask questions, and you have decided to participate.

Your signature: _____ Date_____

Your name (printed): _____

Signature of person obtaining consent: Danielle E Tamke Date: 11/18/2021

Name of person obtaining consent (printed): Danielle E. Tamke

Appendix F: Mindset Belief Survey (Sun, 2018)

Mindset Belief Survey Items: 1 (Strongly Disagree) to 6 (Strongly Agree)

• There are limits to how much people can improve their basic math ability.

• You have a certain amount of math intelligence, and you can't really do much to change it.

• In math class there will always be some students who simply won't "get it."

• Some students have a knack for mathematics and some just don't.

• Some students are not going to make a lot of progress this year, no matter what I do.

• In my class(es), students who start the year low performing tend to stay relatively low performing.

*Item responses are reverse coded. Therefore, a higher score corresponds to having more of an implicit mindset consistent with growth mindset. Mindset scores are calculated by averaging the responses to the six items.

Appendix G: Semi-Structured Interview Questions

1. Tell me about your teaching experience including how long you have been a teacher, what grades you have taught, what made you become a teacher, etc. (Demographic Info)
2. Tell me about your teaching philosophy. (R1; R2)
3. What is your favorite subject to teach? Least favorite? Why? (R1; R2)
4. How do you set expectations and norms at the beginning of the school year? (R1; R2)
5. Are there specific expectations or norms for math time in your classroom? (R1; R2; R3)
6. Tell me what a normal day in your math class looks like. (R1; R2; R3)
7. How do you group students during math? (R1; R2; R3)
8. Tell me the top three practices you employ in your math instruction? (R1; R2; R3)
9. How do you approach and solve challenging math problems with your students? (R1; R2; R3)
10. Tell me about your process and practices for providing feedback to your students. (R1; R2; R3)
11. Tell me about your grading policies and practices. (R1; R2; R3)
12. In one or two sentences, describe your overall expectations for your students and your classroom. (R1; R2; R3)
13. What do you know about growth mindset and fixed mindset? (R1)
14. What is your opinion about growth and fixed mindset theories? (R2)

15. In general, do you think you have more of a fixed mindset or a growth mindset? (R1)
16. Do you think mindset influences how you teach math? Why or why not? (R2; R3)
17. What are your experiences with mindset informed math teaching practices? (R1)
18. What are some specific instructional practices you use in math that you perceive to be connected to a fixed or growth mindset? (R2; R3)

*Other questions will be added as needed for further explanation and/or clarification of participant responses.

Appendix H: Observation Checklist

Demographic Information			
Teacher		**Grade**	
District		**School**	
Date		**Time**	

Teaching Practice		Observed?	Notes
Sorting	*Grouping of students?*		
	Student work posted?		
	**Teacher-reported practices from interview data*		
Norm Setting	*Talks about the brain?*		
	Talks about learning process?		
	**Teacher-reported practices from interview data*		
Engaging in mathematics	*Multiple solutions/approaches are discussed?*		
	**Teacher-reported practices from interview data*		
Giving feedback and assessing	*Verbal praise provided?*		
	Written feedback provided?		
	Opportunities for extra help?		
	Correction of mistakes allowed?		

	**Teacher-reported practices from interview data*		

List to Guide Observation

Sorting	Expectations of Students	*Equal or not?*
	Grouping Strategies	*How are students grouped?*
	Comparison of Student Work	*Is posted/recognized work chose based on multiple criteria?*
Norm Setting	Explicit Mindset Messaging	*Is ability discussed as innate or malleable?*
	Value of Learning Process	*Is the process of learning valued verbally?*
	Handling Mistakes	*How are mistakes viewed and discussed?*
	Struggle	*Is struggle valued?*
	Risk Taking	*Is risk taking encouraged?*
Engaging in mathematics	Focus of Math Task	*Multi-dimensional or procedural?*
	Driver of Math Task	*Student led and teacher led?*
Giving Feedback and Assessing	Focus of Verbal Praise	*Ability or effort focused?*
	Focus of Written Praise	*Level of standard? Consistent? Assurance provided?*
	Opportunities for Help	*Frequency of opportunities?*
	Grading Policies	*Resubmissions allowed?*

Appendix I: Data Analysis Codebook

Themes	Codes
Sorting	Expectations
	Grouping
	Comparison
Norm Setting	Messaging
	Process
	Mistakes
	Struggle
	Risk
Engaging in Mathematics	Focus
	Driver
Giving Feedback and Assessing	Verbal
	Written
	Help
	Grading

Continuum Placement:

F = Fixed

B = Both

G = Growth

Vitae

DANIELLE E. TAMKE

TEACHING AND RELATED EXPERIENCE

Winona State University

Assistant Professor – Early Childhood and Elementary Education **2021-Present**
Create and instruct in-person coursework; Support and monitor student achievement and wellbeing; Develop partnerships with K-12 schools

Student Teaching Supervisor **2020-Present**
Supervised, supported, and evaluated Elementary/Early Childhood Education Teacher Candidate; Fostered school partnership

Adjunct Faculty **2020-2021**
Create and instruct synchronous and asynchronous online coursework; Support and monitor student achievement and wellbeing

Assistant Director of Assessment **2019-2021**
Establish and maintain an effective assessment ecosystem; Facilitate PERCA submissions and other accreditation requirements

Gale-Ettrick-Trempealeau School District

General Education Teacher **2012-2019**
Planned and implemented daily instruction in all discipline areas; Provided academic interventions with mathematics focus; Grade 4

PBIS Tier One Building Coach **2013-2019**
Planned and facilitated universal behavior interventions and supports; Supported student and teacher behavior management needs; PreK-12

Building Technology Expert **2015-2019**
Assisted staff with technology needs and provided representation at district level; Promoted and piloted educational technology initiatives; PreK-5

Mathematics Curriculum Committee Representative **2015-2017**
Guided district in mathematics curriculum development; Piloted multiple mathematics programs; Provided professional development to educators

Summer School Teacher **2012-2016**
Planned and implemented daily math instruction to diverse learners; Documented student improvement and concerns; Grades K-6

Professional Development Facilitator **2015-2019**
Designed and led professional development in math instruction and intervention, technology, classroom management, and data; PreK-12

Educator Effectiveness Coach **2014-2015**
Assisted staff through mandatory evaluation process; Supported improvement through mentorship and guidance; PreK-5

Innovative Educator Consulting

Education Technology Specialist **2017**
Created and facilitated professional development in technology integration for educators; PreK-12

Arcadia School District

Summer School Teacher **2012**
Created and provided daily instruction in all discipline areas with emphasis in math; Grades K-6

Substitute Teacher **2012**
Provided daily instruction in areas of general classroom and music content; Grades 1-12

Winona State University Children's Center

Assistant Teacher **2010-2011**
Provided daily care and learning activities; Fostered home-school connection; Ages 18 months-4 years

EDUCATION

Winona State University – Winona, MN
Education Doctorate **Expected 2022**

Viterbo University – La Crosse, WI
Professional License – Director of Instruction **2016**

Viterbo University – La Crosse, WI
Professional License – K-12 Principal **2016**

University of Wisconsin – La Crosse – La Crosse, WI
Master of Education – Professional Development **2015**

Winona State University – Winona, MN
Bachelor of Science - Teaching **2011**
Early Childhood/Elementary Education

PUBLICATIONS

Tamke, D. E., Boulton, B., & Baule, S. (2021). *The old guard and the new hire: 4 ways to welcome new academics.* eCampus News

The doctoral journey: Exploring institutional and student factors for success. In *On Becoming a Doctoral Scholar: Exploring Context, Culture, and Expectations*. [In press, 2021]. Education Doctorate Books.

Review of *What Makes a Star Teacher: 7 Dispositions that Support Student Learning*, by V. Hill-Jackson, N. D. Hartlep, & D. Stafford. [Manuscript in preparation]. Education Review.

Teacher retention and attrition in the wake of COVID-19 [Manuscript in preparation]. Journal of Advancing Education Practice.