Spring 5-10-2024

The Effects of High-Leverage Practices on Teaching Candidates Math Self-Efficacy

Christine Quisley
christine.quisley@smsu.edu

THE EFFECTS OF HIGH-LEVERAGE PRACTICES ON TEACHING CANDIDATES MATH SELF-EFFICACY

by

Christine Quisley
B.A. Iowa State University, Ames, Iowa
M.A. Iowa State University, Ames, Iowa
Ed.S. Drake University, Des Moines, Iowa

A Dissertation Submitted in Partial Fulfillment of the

Requirements for the Degree of

DOCTOR OF EDUCATION

Dissertation Committee:

Michael Coquyt, Ed.D., Committee Chair
Keri DeSutter, PH.D., Committee Member
Kandy Noles Stevens, Ed.D., Committee Member
Tamara Engel Ed.S., Committee Member

Minnesota State University, Moorhead

Moorhead, MN

May 2024

THE EFFECTS OF HIGH-LEVERAGE PRACTICES ON
TEACHING CANDIDATES MATH SELF-EFFICACY

By

Christine Quisley

has been approved.

April 22, 2024

APPROVED:

Michael Coquyt, Ed.D., Committee Chair

Keri DeSutter, PH.D., Committee Member

Kandy Noles Stevens, Ed.D., Committee Member

Tamara Engel Ed.S., Ed.D., Committee Member

ACCEPTED AND SIGNED:

_____
Michael Coquyt, Ed.D.
Committee Chair

_____
Ok-Hee Lee, Ph.D.
Dean, College of Education and Human Services

Dedication

To anyone who has ever been told or believed they cannot do math…read this study.

To my "AEA Math Amigos," who were my first math mentors, thank you.

To Quiz…DITTO!

Acknowledgments

I would like to thank my committee chair, Dr. Michael Coquyt, and my committee members, Dr. Kandy Noles Stevens, Dr. Keri DeSutter, and Dr. Tamara Engel, for their guidance and support throughout this research journey. When taking on any commitment, but especially a Doctoral program, you realize your success is only possible through the support and guidance of others. Each committee member provided me with the exact support, guidance, and words of wisdom when I needed them most. This committee knew when to push me to rethink a concept or idea and how to make sure I was able to collect all the data pieces while still moving the research forward.

Secondly, I would like to thank my current and past colleagues, my current teaching candidates for always asking “if I’m done yet!” and those five amazing student teachers willing to participate in my data research, without whom this work would not have been possible. Each of you will have a wonderful career in education, changing it for the better.

Finally, to my family, I appreciate your support, humor, and reality checks. To our beautiful daughters, Tanna and Julia, believe in yourself, and thank you for believing in me. Embrace the ups and downs of each and every day, and know that you mean the world to me.

Congratulations to all of MSUM Cohort 5. We did it!

Table of Contents

List of Figures

List of Tables

Abstract

The start of each school year should be one of excitement and joy for learning. However, year to year, there is one subject that elementary students and their teachers dread: math. This study focused on collecting data from teaching candidates on their math self-efficacy beliefs and the perceived competence in their ability to implement three specific high-leverage practices (HLPs) during student teaching.

This qualitative case study explores the experiences of teaching candidates enrolled in a university teacher preparation program. Within previous method courses, content focused on the planning, instruction, and assessment of high-leverage practices. The overarching question of this study is: How did implementing three specific HLPs during a twelve-week student teaching experience in an elementary classroom environment impact a teaching candidate's self-efficacy with mathematical content?

A conventional sampling was used to select four to six elementary and/or early childhood teaching candidates for this study. The data collected tracked if teaching candidates' math self-efficacy views changed during the twelve weeks of student teaching. Surveys, interviews, lesson planning, and instruction data were collected and coded to reveal if teaching candidates' instructional comfort and math self-efficacy beliefs changed with the implementation of high-leverage instructional practices. The three HLPs of focus in this study are leading a group discussion, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking.

Chapter 1: Introduction

Background of the Study

Students are exposed to several learning strategies daily in elementary classrooms. The hope is that these strategies, whether they are being introduced or reviewed for the "nth" time, are strategies of merit and value, ones that, when used by students, will continue to enhance the learning process throughout their future middle and high school years and even further. According to Santoro (2011), "individual teachers and the qualities they bring to their classrooms affect their teaching and their students profoundly" (p.6). The idea that individual teachers' strengths or weaknesses of their depth of understanding of teaching and learning practices and how these are implemented influence the students they teach is not new. Kennedy (2010) stated that "the qualities teachers bring with them to their work are not enough to ensure better teaching practices. It is what teachers actually do that is most relevant to student learning" (p.591).

In 2009, Grier and Johnson stated, "teacher identity is based upon the core beliefs one has about teaching and being a teacher" [these beliefs] "are constantly changing and evolving based upon personal and professional experiences" (p. 59). Similarly, Bandura (1977) defined self-efficacy as one's personal conviction of a required behavior they believe they can successfully execute to produce an outcome. Allinder (1994) stated, "Efficacy affects the effort [teachers] invest in teaching…teachers with a strong sense of efficacy tend to exhibit greater levels of planning and organization." If those with higher efficacy spend more time teaching the subjects they enjoy, could the opposite also apply? Might teachers with low efficacy invest less time in preparation and teaching subjects they do not enjoy or feel confident in the content? A constant push exists for today's schools "to be staffed by teachers who are able to bring their best intellectual and emotional commitments to their work if they are to serve their students well"

(Hong et al., 2017). With the ongoing 2022 teacher shortage in the United States, today's teacher preparation programs are responsible for inspiring the next generation of teachers to be equipped with a strong teacher self-efficacy belief in all subject areas.

Teacher education preparation programs are designed to help teaching candidates understand how people learn and how to teach effectively, incorporating both pedagogical and content knowledge. These programs supply teaching candidates with personal and professional experiences by implementing content-specific practices for learning. These practices include the "what" or the knowledge for teaching and the "how" or the pedagogical approaches to teaching. Teaching candidates "must be able to continually learn to address the problems of practice they encounter and to meet the unpredictable learning needs of all their students" (Darling-Hammond 2006, p. 97). According to Webel and Yeo (2021), when teacher preparation programs consistently implement high-leverage practices (HLPs), teaching candidates could experience an increase in personal understanding, which can be transferred directly to K-12 students.

This study was positioned to explore how implementing specific high-leverage practices in the content area of elementary mathematics affects teacher candidates' self-efficacy beliefs. "Foundational courses are meant to impart 'conceptual tools' – the principles, frameworks, or guidelines that [novice] teachers use to guide their decisions about teaching and learning" (Grossman et al., 1999, p. 3). During the teaching candidates' student teaching experience, evidence will be examined to discover how implementing three specific high-leverage practices may affect teaching candidates' perceived belief of their own mathematical ability. The three HLPs of focus in this study are leading a group discussion, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking.

As a former elementary math teacher and state math consultant/specialist, I have worked with many teachers who reluctantly teach mathematics to their elementary students, Kindergarten to sixth grade. These teachers openly confess their anxiety when teaching math and prefer not to teach it. Currently, as an assistant professor at a midwestern university teaching elementary mathematical methods courses, most of my teaching candidates each semester believe that they, too, are unable to solve basic elementary mathematics problems and are reluctant to teach or even learn more about mathematics. Beginning on day one before the first-class meeting, candidates are reaching out wondering if they should pay for a tutor as they are concerned they will struggle with the mathematics we will discuss within this semester-long course. Like many other similar universities, our course follows the recommendations of the National Council of Teachers of Mathematics (NCTM) on how to teach mathematics. NCTM states that mathematical focus is a "belief that mathematical lessons should be centered on engaging students in solving and discussing tasks that promote reasoning and problem-solving" (p. 10). It is the goal that our teaching candidates embrace the importance of "promoting student interactions and discourse, with the goal of helping students make sense of mathematical concepts and procedures" (NCTM, 2014, p. 10). This study will explore whether implementing high-leverage teaching practices can influence a teaching candidate's self-efficacy.

Theoretical Framework

Across the United States, cultural beliefs about who should and can be successful within a mathematical environment exist. Phrases and beliefs such as "mathematics is only for a few clever people (males)" or "your father is a math teacher, so you must be good at math" (Sam and Ernest, 2000) or a phrase once said by an elementary teacher in the mid-1970's, "math really isn't that important so don't worry if you don't understand" (Quisley, 2022). Mathematics has a

reputation for being a subject full of myths and negative connotations (Buxton, 1981; Ernest, 1996). All of us establish our own self-efficacy view on mathematics, which, if you are a teacher, research shows, are passed on to the students we teach (Smolleck et al., 2006).

Bandura's cognitive, social learning theory was chosen as one of the theoretical frameworks for this study. This theory suggests that an individual's motivation is affected by outcome expectations, as well as the individual's own beliefs on how well they will or will not be able to obtain a goal, known as efficacy expectations (Bandura 1977, 1982). Bandura (1993) explains how our perceived self-efficacy affects the goals we set for ourselves: "Personal accomplishments require not only skills but self-beliefs of efficacy to use them well. Hence, a person with the same knowledge and skills may perform poorly, adequately, or extraordinarily depending on the fluctuations in self-efficacy thinking" (p. 119). Correlating this work to education, Hong et al. (2017) describe teacher identity as a professional identity that is recognized as being directly connected to teachers' motivations to "teach and their willingness and ability to sustain commitment" (p. 250). Thus, teachers' sense of personal efficacy affects how they conduct teaching and learning within their classroom environment (Woolfolk and Hoy 1990).

Within teacher education preparation programs, novice teachers are establishing professional or teacher identities. As they do, they will need to establish coping skills to manage all the aspects of teaching that can and do take place in elementary classroom situations. Most elementary teachers are responsible for teaching all subject areas throughout their day. As each day or year evolves, teachers establish their identities and discover their personal strengths and struggles. It is this identity that this research is setting out to document that can be influenced or be the influencer of teacher success in core areas of mathematical learning.

The second major framework of this study is the implementation of high-leverage practices within teacher education programs. Ball (1990b) stated that many teaching candidates' own "pre-college mathematics classes are unlikely to be adequate for teaching mathematical concepts and procedures meaningfully" (p. 463). Within the last twenty years, high-leverage practices, also referred to as core practices, "are identifiable components (fundamental to teaching and grounded in disciplinary goals) that teachers enact to support learning" (Grossman, 2021, p. 4).

Teacher education preparation programs continue to transform to improve teacher education quality. These programs are working to make sure theory and practices are connected through the purposeful implementation of high-quality practices and clinical/field placement experiences (Matsumoto-Royo & Ramirez-Montoya, 2021, p.1). Darling-Hammond, in 2006, reflected on 21st-century teacher education and stated that powerful teacher education programs provide opportunities for teaching candidates to learn strategies and practice strategies within an actual classroom setting where they can "retry and improve," allowing candidates to be productive in the application, analyzing, and reflection of their own teaching process (p. 7).

Need for the Study

Teacher education preparation programs are working to fill the teacher shortage and prepare graduate candidates for the increasing challenges of today's classrooms. Many of our current elementary and early childhood candidates have self-identified as having some level of math anxiety. Following the social constructs of self-efficacy, if current teaching candidates believe they are incapable of being productive mathematics teachers, the time spent teaching mathematics will probably be less productive than other core content within elementary classrooms. When the individual teaching mathematics has a low self-efficacy or particular

beliefs about how to teach, how students learn, or the resources that should be used to promote learning, these beliefs may act as a filter through which they will make class/student decisions rather than relying on pedagogical knowledge or curriculum guidelines (Clark and Peterson, 1986). McAnallen (2010) reported that approximately 33% of elementary school teachers in a study of 691 from eight states reported: “They [teachers] had a mathematical anxiety and led to a decreased feeling of enjoyment about mathematics.” This study was undertaken to discover how to influence or increase future teachers’ self-efficacy for teaching mathematics. This study is anticipated to provide teaching candidates with an increase in their own mathematical self-efficacy, thus beginning to end the cycle of fear of teaching mathematics in elementary and early childhood settings.

Purpose of the Study

The purpose of this study is to determine teaching candidates' feelings and perceptions associated with the implementation of high-leverage teaching practices within an elementary mathematical setting. Within college teacher preparation programs, teaching candidates must complete multiple hours of field experiences in which they are in classrooms practicing and learning how to teach using strategies that “must have a considerable impact on student learning” (Kearney, 2015, p. 101). However, for PK-12 students to be impacted by the learning, the teaching candidate must understand the necessary strategies and be able to implement these strategies successfully, purposefully, and meaningfully. If teaching candidates' beliefs and experiences are such that they cannot design, implement, and assess high-leverage practices, then an opportunity to increase these teaching candidates' self-efficacy has been missed. Experiences show that “student teachers’ learning opportunities reflect the orientations and experiences of their instructors and cooperating teachers” (Ball et al., 2009, p. 459). When a teaching candidate

is unaware of an established research-based best practice, the validity of the teacher preparation program is called into question. Ball et al. (2009) stated, “Teacher preparation must help novices learn how to *do* instruction, not just hear and talk about it; yet there is often more emphasis on tools for practice than on practice itself” (p. 459).

Significance of the Study

Educational professionals, whether teachers or university professors, need to be aware of our self-identity and how it can positively or negatively influence those with whom we teach. Gibson and Dembo (1984) found that teachers who have high self-efficacy incorporate strategies and learning styles that support students’ own positive self-efficacy growth. Teachers who have low self-efficacy, in turn, often incorporate strategies that undermine students’ sense of efficacy and cognitive development (p. 578).

Bandura (1993) stated all educators have known students at all grade and ability levels whose low self-identity is believed to play a part in their ability to comprehend a concept or content area. This study will provide the beginning pieces of evidence to discover how deeply a teaching candidate's view of their own self-efficacy influences their understanding of content or if the teaching candidate’s understanding of content influences their self-efficacy.

A secondary piece of this study will provide the beginning evidence showing if the implementation of high-leverage practices can provide teaching candidates with content understanding to increase their overall content understanding and self-identity. This research will focus on the construct that when candidates can have multiple opportunities to practice implementing several high-leverage teaching practices throughout their student teaching experience, these candidates’ own mathematical self-efficacy will be strengthened.

Research Question

This qualitative case study explores the experiences of teaching candidates enrolled in a university teacher preparation program. Within previous method courses, content focused on the planning, instruction, and assessment of high-leverage practices throughout a sixteen-week methods course. The overarching question of this study is: How did the logical and consistent implementation of three specific HLPs during a twelve-week student teaching experience in an elementary classroom environment impact a teaching candidate's self-efficacy with mathematical content?

The sub-questions are:

1. What are teaching candidates' understanding and perceptions of HLPs related to math content?
2. How do teaching candidates describe their self-efficacy beliefs related to their own mathematical content ability?

Definition of Terms

High-Level Practices High-leverage practices vary; however, all consist of the following characteristics: for the purpose of this study, these are the characteristics that will be followed (Grossman et al., 2009).

- Practices that occur with high frequency in teaching
- Practices that novices can enact in classrooms across different curricula or instructional approaches
- Practices that novices can actually begin to master
- Practices that allow novices to learn more about students and about teaching

- Practices that preserve the integrity and complexity of teaching
- Practices that are research-based and have the potential to improve student achievement.

Field-specific methods In accordance with Minnesota Professional Educator Licensing and Standards Board (chapter 8710 part 8710.0310) means differentiated instructional strategies targeting content and pedagogy for a singular licensure area to enable student learning. In reference to this study, elementary mathematical methods terms would be used.

Novice a beginner in learning (Miriam Webster Dictionary, 2022)

Self-Efficacy Efficacy beliefs influence how people feel, think, motivate themselves, and behave. (Bandura, 1993)

Student Teaching In accordance with Minnesota Professional Educator Licensing and Standards Board (RD4576 part 8705.0100a) means when a candidate enrolled in a teacher preparation program assumes teacher responsibilities while working with a cooperating teacher and a supervisor to practice and demonstrate the knowledge, skills, and dispositions necessary to become a teacher. A student teaching experience includes observation, feedback, and evaluation from the cooperating teacher and supervisor.

Teaching Candidate. A teaching candidate is an individual who is enrolled in a teacher preparation program.

Teaching Preparation Program is a program approved by the board or the state where the program resides that trains candidates in educational pedagogy and content-specific pedagogy for any subset of the scope of licensure for students from birth to 21 years of age.

Research Design

According to Pajares (1992), a person's perception of themselves is built by generic knowledge, information, and obtained beliefs that may or may not be true. A qualitative case study approach will examine the teaching candidates' perception of self-efficacy toward mathematics before and after exploring high-leverage practices in an elementary mathematical setting. Creswell and Poth's (2018) fourth edition updated the definition of qualitative research as:

> Qualitative research begins with assumptions and the use of interpretive/theoretical frameworks that inform the study of research problems addressing the meaning individuals or groups ascribe to a social or human problem. To study this problem, qualitative researchers use an emerging qualitative approach to inquiry, the collection of data in a natural setting sensitive to the people and places under study, and data analysis that is both inductive and deductive and establishes patterns or themes. The final written report or presentation includes the voices of participants, the reflexivity of the researcher, a complex description and interpretation of the problem, and its contribution to the literature or a call for change (p.8).

Creswell and Poth's (2018) case study research is a type of design in qualitative research that can be defined as an investigation into "real-life, contemporary bound system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information and reports a case description and case themes (p. 97).

Within this bounded system study, data will be collected through interviews, a collection of teaching candidates' specific lesson plans, video discussions/reflections, and recorded teaching observations. Since case studies are heuristic, teaching candidates can use self-discovery that

employs hands-on, real-life experiences that may not be prescribed or perfect, allowing for the freedom to help the teaching candidates explore and understand the purpose and power of high-leverage practices.

Assumptions

This qualitative case study is grounded in constructivism. Ontological constructivism embraces the idea that multiple realities will be presented within the research findings, based on the participant's own interpretation of reality. Piaget (1952) believed people construct new knowledge by building on known or developed previous knowledge.

The epistemology is social constructivism associated with psychologists Lev Vygotsky (1978) and Albert Bandura (1982), where individuals are active in the process of cognitive development as related to social factors at a cultural and historical level. According to Creswell and Poth (2018), an individual's construction of meaning is not simply imprinted on them at birth; it is formed through constant social interaction with others with whom they associate. Participants and teaching candidates are assumed to have told the truth as part of the interviews and data collection process within this research study. Participants are aware of the researcher's background in connection with the understanding associated with high-level practices and self-efficacy, which will inherently mold the interpretations presented by participants. All participants will be listened to non-judgmentally and openly in order to understand their realities.

Limitations

Limitations within this study consist of the number of participants willing to participate in a study during one of the busiest semesters of their college education, the student teaching semester. A second limitation might be that the overall teacher candidate population regarding men versus women could be skewed. The third limitation would be that the population of

participants will be only those who have taken the sections of the elementary mathematics methods course during the Fall of 2021, Spring 2022, Fall 2022, or Spring 2023.

At this time, there is only one delimitation within this study. It consists of the focus group being elementary education or early childhood education majors. This study would not include teaching candidates seeking a middle school or high school teaching license who may have a different level of self-efficacy.

Summary

Teaching candidates who have an aversion to teaching mathematics may, in turn, pass that aversion, intended or not, on to the students they teach (Santoro 2011, p.6). This study explores how self-efficacy can be improved by implementing specific high-leverage practices in elementary math. This chapter has provided the overall view of what this study will entail and how the possible outcomes may help to fill a need within the elementary education teacher preparation programs. As an educator with over 30 years of classroom experience, I have seen first-hand fellow teachers and young students with low self-efficacy in mathematics. Many of these students push aside a dream of a particular career choice as they do not feel they are capable of obtaining it because of the understanding of the mathematics involved. As a researcher, I hope that by conducting this study, I will be gain the knowledge to be able to provide future teachers with the tools to strengthen their mathematical ability and math self-efficacy, which hopefully will also inspire the young people they teach to have a higher self-efficacy in mathematics.

Chapter two will provide greater detail regarding the research literature in the areas of self-efficacy, teacher preparation programs, and high-leverage practices related to elementary mathematics. The study's methodology, chapter three’s focus, will be laid out, including how

participants will be gathered for the study as well as the details of the overall process. Chapters four and five will present the results from the study and the implications for teacher preparation programs and wishing to support individuals with low self-efficacy in mathematics.

Chapter 2 Literature Review

Introduction

This study examines teacher preparation candidates' self-efficacy in an elementary mathematics classroom and whether the learning and candidate's implementation of high-leverage practices impact their self-efficacy. An overview of the literature on self-efficacy and high-leverage practices is included to lay the foundation for this work. The review begins with the basics of self-efficacy, what influences it, and why it is essential for teaching candidates to possess strong self-efficacy in mathematics. The second piece describes how three specific high-leverage practices can impact mathematical learning development in elementary classrooms. These three high-leverage practices are: explaining and modeling content, eliciting and interpreting student thinking, and building collective student knowledge through group or class discussions. The final piece will describe how implementing high-leverage practices can improve a candidate's self-efficacy. This is the missing link to improving teacher candidates' beliefs that they can never be successful at mathematics (Grier and Johnson 2009, p. 59). If high-leverage teaching practices are not addressed in the teacher preparation curriculum, ineffective math teaching practices will continue on to future generations of educators. This may perpetuate the cycle of low mathematical self-efficacy and, in turn, low mathematical achievement for students.

Methods of Searching

This study began by researching high-leverage practices and their impact within elementary education content areas. The initial search was to discover what research exists beyond the work associated with the National Council Teachers of Mathematics (NCTM) 2014 *Principles to Actions Ensuring Mathematical Success for All* Publication and other NCTM Position Statements (2012, 2016). The Minnesota State University Moorhead Livingston Lord Library services were used to search EBSCOhost and access a vast array of databases, including Academic Research Complete, Academic Research Primer, Business Source Primer, EBSCO megaFILE, Education Research Complete, ERIC, Professional Development Collection, APA Psyc Articles, APA Psych Info, SocINDEX, and Teacher Reference Center. Search terms included high-leverage teaching practices, meaningful distributed teaching practices, and teaching strategies. Precursors were added, such as "elementary," "mathematics," and "impact of."

I was trying to understand how self-efficacy and the degree of implementation of teaching strategies, specifically high-leverage practices, are intertwined. Does a person's mathematical self-efficacy affect their use of mathematical practices, or can the implementation of specific high-leverage practices influence one's mathematical self-efficacy? Again, search terms such as self-efficacy, teaching beliefs, teaching attitudes, student teachers, and novice teachers were all researched using the Livingston Lord Library services.

As empirical and professional articles and books were collected, each reference was cross-examined to find additional articles and resources. These references were acquired through the interlibrary loan system. For additional research, Research Gate and Google Scholar were searched using titles and authors' names. The website *TeachingWorks.org* was also searched for

other specific high-leverage practice research.

Theoretical Orientation for the Study

This qualitative research is grounded in the work of Bandura (1991;1993) and Ball (2009) to provide a framework and overview of the theory and assist with data analysis. Bandura's (1993) research found how people's beliefs about their capabilities influence the results they would achieve in their own lives. "Efficacy beliefs influence how people feel, think, motivate themselves, and behave" (p. 118). Self-efficacy is one's belief in their capacity to carry out the behaviors needed to produce specific results. "The stronger the perceived self-efficacy, the higher the goal challenges people set for themselves and the firmer is their commitment to them" (Bandura & Jourden, 1991 p. 942). It is the belief of this research and others that routine practices, such as high-leverage practices, are a means to help strengthen teaching candidates' self-efficacy.

High-leverage practices are not new to education. While referred to by different names, their purpose remains the same: to provide a classroom environment where teachers and students model research-based teaching and learning. Three high-leverage practices will be included in this study: explaining and modeling content, eliciting and interpreting student thinking, and building collective student knowledge through group discussions. These student-centered learning strategies support and build students' understanding of concepts. Ball et al. (2009) found that student learning was likely to increase when teachers established and focused on implementing high-leverage practices.

Bandura's Self-Efficacy Theory

This qualitative research consults Bandura's Self-Efficacy Theory as the theoretical framework within this case study. Bandura's research discussed how one's beliefs about their

capabilities affect their success or failure in each situation (Bandura, 1993). Self-efficacy beliefs concern how people feel, think, motivate themselves, and behave in specific situations. Four significant self-efficacy processes emerged in research: cognitive, motivational, affective, and selection. Each of these processes will be described in greater detail.

The cognitive process of self-efficacy develops as a purposive process regulated by goal setting and influenced by one's self-appraisal of capabilities. Individuals of all ages possess either functional or inherent learning mindsets. In relation to functional perspectives, individuals, young or old, see errors as a part of the learning process with little to no impact on their cognitive ability (Bandura, 1993). These mistakes or errors are used to measure improvements. Those possessing inherent mindsets see all success or failure based on their intellectual capacity. The counter belief is that one fails because they are not "smart" enough and lack basic intelligence. Those who hold this later mindset see others' success as belittling their perceived ability (Bandura, 1993).

According to Bandura (1991), the second of the four processes is that self-beliefs of efficacy play a vital role in the self-regulation of motivation. Motivation guides actions anticipated by the forethought of success or failure within an activity. Learners set goals for themselves and plan action steps to realize future success. If one views themselves as having high self-efficacy, their failure is seen as insufficient effort and will not play into the next learning opportunity. In comparison, those with low self-efficacy will attribute their failures to low ability and pursue lower-ability activities in the future. Gibson and Dembo (1984) "found that teachers who have a high sense of instructional efficacy devote more classroom time to academic learning" (p. 140). Within this learning environment, teachers provide all students with the help they need to succeed. Students are recognized for their accomplishments. In contrast,

“teachers with low instructional efficacy spend more time on nonacademic pastimes, readily give up on students if they do not get quick results, and criticize them for their failures" (p. 140).

The final two pieces are the affective and selection processes. When looking into the affective process of self-efficacy, individuals who view the environment as “scary or difficult” worry about potential threats to success, which rarely happen. According to Bandura, 1993, "perceived efficacy to exercise control over stressors plays a central role in anxiety arousal” (p. 133). Individuals often develop increased heart rates, suffer from higher blood pressure, and often activate stress-related hormones. While the research believes that individuals, teachers, and students experience physical effects related to low self-efficacy, this study will not address research concerning this area.

This leads to the last process of self-efficacy, selection. If the individual believes they are incapable of success at higher/challenging tasks, these tasks are avoided. For example, in an elementary classroom, if a teacher feels incapable of solving fraction problems, they may choose not to teach these types of problems to their students or teach a very simple low-level type of fractional situation problem to their students. On the other hand, those teachers who hold a higher level of self-efficacy concerning fractional understanding will present problems of all types and levels to their students to continue to build a sense of fractional understanding for their students. Teachers with a positive mindset believe they can exercise control over threats and not conjure up disturbing thought patterns (Bandura, 1993, p. 132). “They have shown less stress and depression when experiencing threatening or difficult situations” (Bandura, 1993, p. 132).

High-Leverage Practices

High-leverage practices (HLPs) are not new to education; they are the foundation for each lesson. Lowenberg Ball and Forzani (2009) stated that “high-leverage practices comprise

the essential activities of teaching; if teachers are unable to discharge them competently, they are likely to face significant problems" (p.43). Cohen (2015) stated, "These [HLPs] have been defined as research-based teaching moves, which have the potential to improve student achievement" (p. 2).

In 2009, Grossman, Hammerness, and McDonald offered a set of six criteria to identify core teaching practices based on common characteristics across the field. These criteria are 1) the practice occurs with high frequency in teaching, 2) novice teachers can enact [the practice] in classrooms across different curricula or instructional approaches, 3) novice teachers can begin to master the practice, 4) novice teachers are able to learn more about students and teaching 5) [the practice] preserves the integrity and complexity of teaching, 6) [the practice(s)] are research-based, and have the potential to improve student achievement (Grossman et al., 2009 p. 466). The three focus practices within this study, explaining and modeling content, eliciting and interpreting student thinking, and building collective student knowledge through group or class discussions, do meet the criteria presented by Grossman et al. 2009 (p. 466).

No matter what the age or grade level, teachers are tasked with unpacking a concept and making it accessible to students in ways that they can learn and apply it to multiple situations. Teaching "demands not only skills in a given domain but also the ability to take that skill apart so others can learn it" (Loewenberg Ball & Forzani, 2009, p. 41). For most novice teachers, this can feel like a very unnatural learning experience, often very different from their expectations about being elementary or early childhood teachers. Teacher preparation programs are developed with a clear vision of teaching and learning, focusing on content procedures and behavior strategies (Grossman et al., 2009, p. 15). High-leverage practices assist teacher candidates in building an understanding that good or great teaching does not just happen; it is a constant ebb

and flow of specific teaching practices implemented with fidelity. Collins et al. (2019) described how instruction "can communicate the culture of expert practice by teaching and modeling the behaviors, strategies, and dispositions of "real" practitioners" (p. 459). When teacher candidates can model or provide explicit, strategic instruction about how to approach academic tasks, they will learn how these internal metacognitive processes are of value and thus be able to implement them in their future classrooms. "In doing so, theoretically, [teaching candidates] develop a greater sense of metacognitive awareness, a capacity for reflecting on their approach to academic tasks"(p. 459).

Review of Literature

This qualitative case study was positioned to explore how a teaching candidate's self-efficacy might influence the extent to which specific high-leverage teaching practices are implemented. The overall topic of the review of literature begins with the history of teacher preparation programs. The importance of teaching content, pedagogy, and field experience practice prepare today's candidates for their future classrooms. Next, the history of core practices is presented, with three specific high-leverage practices explored. This is followed by exploring self-efficacy and teacher candidates' views toward mathematics, specifically in the majors of elementary education and early childhood education.

History of Teacher Preparation Programs

In 2007, then-candidate Barack Obama stated,

> From the moment our children step into a classroom, the single most important factor determining their achievement is not the color of their skin or where they come from; it is not who their parents are or how much money they have, it is who their teacher is. (Green, 2014)

With the ongoing shortage of teachers, many state education departments are changing requirements for teaching licenses. Thus, a push for the recruitment of individuals with specialized content is on the rise to become teachers. However, Hiebert and Morris (2012) argue,

> Evidence suggests that the U.S. should increase efforts to improve teachers by improving their teaching -particularly through annotated lesson plans and common assessments- rather than by recruiting more talented people or raising standards to enter the field. (p.94)

This led many in higher education to look closely at teacher preparation programs. Many teacher preparation programs have followed a traditional curriculum that focused on teaching through lecturing about teaching. Education faculty taught teaching candidates how they were taught, focusing on theory. It was not until the 1990s that educational pedagogy in higher education began to change. John (2002) reported,

> Grossman's (1990) case study was an important step in charting the influence that teacher educators can have on the practice and thinking of [teaching candidates]. She described how a cohort of student teachers learned and developed pedagogical content knowledge alongside the careful promptings of an expert teacher educator. (p. 323)

Historically, the educational preparation curriculum has been divided between foundation courses and methods courses. During the 1980s and 1990s, much of the focus in teacher preparation courses was on foundational knowledge, and there was very little "use" of this knowledge within a sustained practical methods course (Kennedy, 1999).

In 2009, the National Governors Association and the Council Chief State School Officers began discussing a Common Core of State Standards (CCSS) within a similar time frame. (Ball et al., 2009) noted in their research a goal focused on having teachers implement high-leverage

practices or teaching practices where the implementation is likely to lead to increased student learning. In 2015, 42 states adopted, in some part, English language arts or mathematics or both of the common core state standards. This action step was intended to help increase and support student learning in all areas of the United States.

Change does not happen overnight, and implementing HLPs, as stated within the CCSS, is still a perfect example of a work in progress. In 2023, eight years after the 42 states adopted the CCSS movement, teacher education programs and K-12 educational settings are still struggling to embrace the importance of high-leverage practices by purposefully embedding them within their daily instruction. As stated previously, high-leverage practices include but are not limited to the following strategies: explaining and modeling content, eliciting and interpreting student thinking, and implementing norms and routines for classroom discourse and work.

This literature review highlights what teaching candidates are learning in teacher preparation courses and what they are experiencing in their classroom field experiences. “Many education researchers have noted that effective teacher preparation programs provide [teacher candidates] clinical experiences in order to engage in specific research-based practices” (Weiland et al. 2013, p. 330). While some classroom teachers are not yet fully onboard with implementing lessons that include these high-leverage practices, teaching candidates need to be prepared in accordance with research and best practice for student learning. This is not a one-way interpretation. Several K-12 school districts embrace high-leverage practices and host teaching candidates with very little or no experience with these practices. Kearney (2015) poses the question of “What exactly makes a practice effective?” and “Researchers must ensure the systematic and rigorous design of investigations into these practices” (p. 102). There is a

growing list of high-leverage practices, each reflecting various degrees of rigor. This literature review aims to research how the purposeful implementation of high-leverage teaching practices within elementary mathematics education preparation methods courses can strengthen a teaching candidate's self-efficacy.

Not all teaching candidates receive exposure to high-leverage practices until they are in their final field experience placement, if at all. "A lack of a shared curriculum inhibits progress in preparing teachers for practice" (Ball et al., 2009, p. 459). Multiple researchers promote the shift in teacher education programs moving toward full implementation of HLPs within all education courses of study. Webel & Yeo (2021) completed work with teaching candidates in elementary math classrooms focusing on eliciting and responding to elementary student thinking. They concluded that when teaching candidates can experience HLPs consistently, an increase in understanding is gained and can be transferred directly to K-12 students (p. 97). While each teacher preparation program is designed to follow its own state's educational standards in relation to the number of hours for licensure. It is not until candidates have the opportunity to be in classrooms, often referred to as field placement weeks or lab experiences, that they are finally presented with situations to apply this learned knowledge. "This theory-into-practice view of teacher education is increasingly being challenged for its many limitations and inadequacies" (Korthagen et al., 2006, p.1021). Recent research on education programs from Matsumoto-Royo and Ramírez-Montoya (2021) showed that "several teacher education programs have transformed to improve teacher education quality" (p. 1), which often experienced a gap between theory and practice. Teacher preparation programs must focus on preparing teachers who "are skilled at teaching, not just studying and analyzing schools and classrooms" (Forzani, 2014, p.357). According to the Council for Accreditation of Teacher Education Programs (CAEP),

teacher preparation programs should be designed to include “high-quality clinical practices that are central to preparation so that candidates develop the knowledge, skills, and professional dispositions necessary to demonstrate a positive impact on P-12 students’ learning” (Singh, 2017, p. 179). In their study, Matsumoto-Royo and Ramírez-Montoya (2021) found that teacher education preparation programs are beginning to change and highlight the pedagogy of practice (p.11). Loughran (2008) defined teacher pedagogy as “a knowledge of teaching about teaching and a knowledge of learning about teaching and how the two influence one another” (p. 1180). When teaching candidates consider the pedagogy of learning purposefully and meaningfully, they can enhance their skill set by implementing specific high-leverage practices, thus enhancing their initial effectiveness and increasing the likelihood of maintaining a long influential career in education (Darling-Hammond, 2009).

Teaching is often thought of as an ongoing process that uses rules, plans, structures, and procedures to lead to students' successful learning, yet most teachers will tell you that teaching is much more. A successful teacher is not something that can be defined; it involves planning, instructing, and assessing each and every day. Often measured by one’s own success in how well their students’ progress throughout the school year. Successful teaching is a goal to which all teachers aspire and one to which they ebb and flow in and out daily and yearly. However, critical pieces of effective teaching rise to the forefront when the discernment of educational researchers such as Francesca Forzani, Pam Grossman, and Deborah Ball is applied. These leaders' research focuses on developing a framework of practices that should be embedded in teacher preparation programs to help novice teacher candidates. “This framework identified three elements that make it possible to understand a pedagogy of practices fundamental to organizing and focusing the work of teaching: decomposition of the practice, representations of the practice and

approximations of practice" (Grossman, Compton et al., 2009 and Grossman, Hammerness et al. 2009). Teaching is messy; the strategies that worked yesterday may not work today. For example, when focusing on the core practice of leading a classroom discussion, teacher candidates need the experience to know how to guide and facilitate discussions. In reference to this idea, Grossman, Hammerness, and McDonald (2009) stated,

> Leading classroom discussions is a complex practice which may take teachers years to master; however, within teacher education, novices might focus on developing on some of the instructional routines that constitute the practice of leading discussions, including identifying generative questions or choosing rich problems to discuss, as well as learning to take up, or revoice, student ideas in the midst of a discussion. (p. 277)

Grossman, Compton, et al. (2009) stated that foundation courses provide disciplinary knowledge for teaching, which would include knowledge of learners and learning, purposes of school, history of education, and knowledge of schools and classroom structure (p. 274). Where methods courses generally focus on specific practice, "including courses related to the teaching of particular subject matter, classroom management, and assessment" (p. 274). In many of today's teacher preparation programs, methods courses provide teaching candidates with high-leverage practices and opportunities to develop and apply their pedagogical thinking. Today's candidates are asked to plan, implement and reflect on specific research-based strategies and then submit evidence through performance-based, subject-specific assessments such as the edTPA.

The edTPA is a nationally available performance-based assessment that measures teaching candidates' readiness to teach specific content, in this case, elementary mathematics. Teaching candidates are evaluated on fifteen five-point rubrics that measure pedagogy, identifying and designing lessons to meet a variety of students' learning needs, use and

application of research theory, and the analysis of student learning through evidence in order to meet the goals and objectives of the content. Assessments, such as the edTPA, are used by teacher preparation programs to measure the skills and knowledge of teacher candidates before they enter their own classrooms. As those of us who are the professors teaching these educational preparation programs, it should make sense that how we prepare tomorrow's teachers to embrace the continuum of learning requires equipping each teacher candidate with the ability to be flexible and adapt to classroom situations.

Within this research, teaching candidates learning will focus on elementary mathematics methods and implementing strong, flexible strategies. Grootenboer and Jorgensen (2009) stated that today's teaching candidates need to possess multiple components, including "strong knowledge of mathematics, knowledge about student development and potential misconceptions in problem-solving" (p. 36), which serve to be critical pieces in developing positive mathematical classrooms. As teaching candidates work within their field placement experiences, the young elementary students they work with are still developing and building their understanding. These five to twelve-year-old students are like sponges; they absorb different strategies and experiences daily. It is important that the strategies and experiences presented by the teaching candidates allow these young students the opportunity to embrace knowledge and understanding. These candidates will assist the students they work with evolve to their highest potential. This review of literature will provide ample evidence of the importance of incorporating high-leverage teaching practices into elementary math classroom environments. The premise is to discover if a teaching candidate's views of their own mathematical success influence the students they teach. If our goal is to create stronger mathematical elementary students of tomorrow, then our teacher education programs of today must implement research

practices shown to achieve this goal. This begins with quality teaching at the undergrad level. When quality teaching is a goal of educator preparation programs, education professors must address the degree to which potential candidates incorporate high-leverage classroom practices. (Valli et a., 2012).

In 1999, Grossman et al. wrote the following about teacher preparation for undergraduate courses. “Foundational courses are meant to impart ‘conceptual tools’ – the principles, frameworks, or guidelines that teachers use to guide their decisions about teaching and learning” (p,14). They continue by defining conceptual tools as those that “facilitate teachers’ framing and interpretations of practice, but [these tools] do not offer specific solutions for negotiating the dilemmas that arise in interactions with students” (p. 14). Within past-generation traditional education preparation courses, teaching candidates were provided with a vast amount of educational theory but little practice of implementation (Grossman et al. 1999). Many of today’s teacher preparation programs focus on aligning theory with purposeful practice and then measure the results by tracking candidates’ overall scores on performance-based or summative exams. When teacher candidates are able to implement and refine core practices within teacher education programs, they are provided an “opportunity to address teaching as a complex task while also enabling [these candidates] to focus on key components with novice teachers” (Grossman et al., 2009, p. 6).

History of High-Leverage Practices

In 2012, education faculty from several universities across the United States joined to form The Core Practice Consortium (CPC). This team of professionals represents multiple educational disciplines, all working toward developing better teacher preparation programs. According to the CPC, “The consortium’s work creates a space for focused ongoing learning

through teacher educators' collaborations and negotiations in constructing artifacts, tools, and pursuing research" (Core Practice Consortium, 2023, "About" section). Members of this consortium are many of the key research leaders concerning the work of core teaching practices. Some of the more well-known are Pam Grossman of the University of Pennsylvania and Francesca Forzani and Deborah Loewenberg Ball from the University of Michigan. In the next few sections, these prominent educators' contributions to the development of the core practices of teaching specifically the subset of three specific high-leverage teaching practices, will be highlighted.

A driving purpose of the work of the CPC is to ensure that teachers are significantly prepared "to create intellectually and emotionally engaged disciplinary learning for all of their students" (Core Practice Consortium, 2023, "Home" section). These educational programs focus on "practices that help novice teachers counter longstanding inequities in the schooling experiences of children, particularly youth from communities that continue to be marginalized in the US" (Core Practice Consortium, 2023, "Home" section). According to Grossman 2021, core practices consist of strategies, routines, and moves that teachers can unpack and learn. McDonald et al. (2014) "argue that teaching is and should be a central element to the learning to teach, particularly as teacher education once again turns toward practice" (p. 500). Today's teacher preparation programs are beginning to concentrate on presenting and defining core teaching practices more than ever before. With this move comes the obligation to ensure that practices are purposeful and meaningful and that teaching candidates can easily implement within the classroom. These core practices of teaching are defined as "identifiable components that teachers enact to support learning" (Grosser-Clarkson and Neel, 2019, p.466). Grossman, Hammerness, and McDonald (2009) compiled a set of criteria based on common characteristics that are

considered core teaching practices. These characteristics define core teaching practices as practices that:

1. Occur with high frequency in teaching.
2. Novices can enact in classrooms across different curricula or instructional approaches.
3. Novice teachers can begin to master.
4. Allow novice teachers to learn more about students and teaching.
5. Preserve the integrity and complexity of the teaching.
6. Are research-based and have the potential to improve student achievement.

Grossman et al. (2009) propose that core teaching practices be implemented over time within teacher preparation programs, allowing candidates to learn how specifically these practices can connect to students' cultural, personal, and community assets and how practices with these characteristics can shift to bridge the gap between knowledge for teaching and knowledge from teaching (McDonald et.al, 2014, Loewenberg Ball & Forzani, 2009, Grossman et al. 2009, Zeichner, 2012).

Also, within this preparation of practice, teaching candidates “learn about how students learn and how one assesses learning; understanding cultural differences among students and developing a sense of how students typically come to understand and misunderstand key topics in particular subject areas” (Grossman et al., 2009, p. 9). “While teacher candidates had rich opportunities to develop pedagogical thinking, including the ability to reflect on their work, they had fewer opportunities to try out the work of teaching prior to entering the classroom” (Grossman 2018, p. 4). How teacher preparation programs view the art of teaching is critical to understanding the importance of implementing core practices within teacher education programs. “It requires teacher education programs to do more than increase the amount of time candidates

spend in clinical field placements" (McDonald et al. 2014, p. 501). What and how teaching preparation programs structure a candidate's learning must be at the forefront.

In 2012, Dr. Deborah Loewenberg Ball and colleagues developed an initiative called *TeachingWorks* to improve the quality of the teacher preparation program at the University of Michigan. This work eventually led to the organizing framework for the university's elementary teacher education program for novice teachers (*Teaching Core Practices in Teacher Education (Core Practices in Education Series)* 2018, p. 5). As a continuation of Ball and Forzani's work on the CPC, they identified 19 overall practices as high-leverage practices.

When defining the difference between core practices and high-leverage practices, (*Teaching Core Practices in Teacher Education (Core Practices in Education Series)* 2018) cited the CPC's initial definition as "identifiable components of teaching that teachers enact to support learning. These components include instructional strategies and the subcomponents of routines and moves. Core practices can include both general and content-specific practices" (p. 184). The nineteen *TeachingWorks* high-leverage teaching practices are specific practices used across subject areas, grade levels, and contexts. The premise of this study will incorporate the first three TeachingWorks high-leverage practices: 1) leading a group discussion, 2) explaining and modeling content, and 3) eliciting and interpreting individual students' thinking. To support the move to implement high-leverage practices, Forzani (2014) states,

> If teaching is viewed as the direct transmission of ideas from teacher to pupil, for example, then the classroom practices such as explaining and lecturing are critical, discussion and small group work must be less important, and learning to teach often relatively straightforward. If teaching is instead conceived of interactive work in which students' ideas and questions figure centrally, then teachers must learn more complex and

> improvisational practices (p. 359).

Teacher preparation programs are beginning to incorporate experiences that allow candidates to work through multiple cycles of effective teaching centering on intended teaching, enacted teaching and the impact of teaching on student learning. According to Forzani, (2014)

> Much of the recent work on core practices has focused on understanding the practices teachers engage in to help all students reach ambitious learning goals and on designing and sequencing experiences that will help novices develop proficiency with those practices (p. 359).

Newmann et al. (1996) posit that these authentic experiences or authentic pedagogy provide value beyond school (p. 284). “The goal of these teaching practices is to make visible the kinds of thinking process that help [P-12] students develop habits and dispositions of interpretation and sensemaking” (Resnick, 1988, p. 58). Forzani (2014) describes the core-practice approach as an approach that must be represented as an intentional and specific exchange in which teachers use student thinking as a primary resource (p. 365). Grossman et al. 2018, stated,

> although the instructional exchange and teacher moves are visible when a novice [teacher candidate] simply watches a discussion, the opportunity to decompose the practice with expert guidance provides the professional reasoning that guides the visible moves, thereby allowing novices to see name and eventually enact elements of the targeted practice” (p. 4).

Impact of High-Leverage Practices

During their careers, teachers eventually realize that “learning about teaching and growing in our teaching [practice] are two very different processes” (Hurlburt & Krutka, 2020, p. 169). Many teacher preparation programs continue to use “tools, norms, rituals, and resources”

that “are aimed at maintaining teacher-dominated discourse, textbook-based lessons, and coverage as the main curricular principle” (Sykes et al. 2010, p. 465). When teaching, candidates can focus on the understanding that, as stated by Luciano-Beltramo (2017), “teaching is as much about teaching-learning, as it is student learning; that is, to deeply engage students in meaning-making by responsively adapting class content and activities” (p. 327). Within the implementation of content through high-leverage practices, teacher preparation programs begin to disrupt inequity in education practices and classroom practices across the United States today.

As teaching candidates enter classrooms, they must be prepared “to practice in ways that challenge inequity” (TeachingWorks, 2020). A study conducted by Mizala et al. (2015) noted,

> The perception bias caused by socioeconomic status shows a direct association largely consistent across studies: teachers tend to have higher expectations for students of high socioeconomic status and lower expectations for students from disadvantaged backgrounds. This phenomenon has been observed in grades as young as preschool (Speybroeck et al., 2012), first and second grade (Rist, 2000) (p. 71).

Following the premise that how students are treated in classrooms has a crucial impact on developing their social, emotional, and academic identities or self-efficacy, high-leverage practices are a pedagogical method to counteract any perception biases.

When teacher education programs embed high-leverage practices within a teacher preparation curriculum through intentionally focusing on content, teaching practices, and equity issues, teaching candidates can begin to provide equitable teaching and learning opportunities as part of their daily practice within classrooms. Teacher candidates, in turn, can practice implementing high-leverage practices to develop the mindset of how important it is to “constantly learn about who their students are moment to moment and what their students can

and want to do with guidance from their teacher, and how and what their students think about the content" (Luciano-Beltramo, 2017, p. 327).

The work of Ball and Forzani (2009) and three of their nineteen high-leverage practices will be explored in this research study. These three high-leverage practices, which will be explored through the lens of elementary mathematics content, are: leading a group discussion, explaining and modeling content, and eliciting and interpreting individual student's thinking. In 2014, the National Council of Teachers of Mathematics (NCTM) published *Principles to Actions Ensuring Mathematical Success for All;* this work describes how high-leverage practices are key to effective teaching and learning in mathematics,

> Student learning of mathematics depends fundamentally on what happens inside the classroom as teachers and learners interact over the curriculum. Teachers need to identify and work together toward the implementation of a common set of high-leverage practices that underlie effective teaching. These high-leverage practices are at the heart of the work of teaching that are most likely to affect student learning. (p. 8)

Leading a group discussion

When applying the aspects of high-leverage practices of leading a group discussion in a classroom, teacher candidates must do more than ask questions and have students answer them. Teaching candidates and students work in tandem to promote each other's thinking. The purpose is to build collective knowledge and capability in relation to specific instructional content. Students work on all aspects of a discussion, not just speaking, but listening intently, interpreting content, and agreeing or disagreeing using an appropriate response.

As teaching candidates apply this practice to elementary mathematics, they learn to focus on identifying and selecting appropriate tasks that allow for discussion, anticipate students'

thinking, and monitor and facilitate discussions to promote an exchange of ideas and methods. "Effective teaching of mathematics facilitates discourse among students to build shared understandings of mathematical ideas by analyzing and comparing student approaches and arguments" (National Council of Teachers of Mathematics, 2014, p. 29). When conducting a mathematical discussion, it is important that teaching candidates incorporate verbal, visual, and written communication between themselves and students, as well as student-to-student discussions. These discussions allow for all students to share ideas and clarify understandings, helping to have a free and fair exchange of ideas. Students propose ideas and defend solutions to tasks while teaching candidates to work towards disrupting patterns of inequity. NCTM 2014 Access and Equity Principle for school mathematics states, "All students have access to high-quality mathematics curriculum, effective teaching and learning, high expectations, and the support and resources needed to maximize their learning potential" (p. 5).

Explaining and modeling content

The high-leverage practice of explaining and modeling content is intended to promote explicit content and practices that may be subtle. Teaching candidates determine which strategies are appropriate to model within this high-leverage practice. The focus is to connect ideas brought forward by students and through demonstration work through the content, practice, or strategy in real-time in front of the students. Teaching candidates practice how to represent and scribe elementary students' thinking correctly. Using different representations is "like examining the concept through a variety of lenses, with each lens providing different perspectives that make the picture (concept) righter and deeper" (Tripathi, 2008, p. 439). By explaining and modeling students' thinking, teaching candidates are able to connect representations making explicit connections between the problem and students' understanding, clearly articulating each

mathematical representation as it happens. Teaching candidates are able to purposefully articulate and define terminology connected to the model or representation presented.

Eliciting and interpreting individual students' thinking

Within this high-leverage practice, questions are posed that create openings for students to share their thinking. Teacher candidates use evidence of students' thinking to progress learning forward. The questions posed are an essential component of meaningful mathematical discourse. These questions allow teaching candidates to notice patterns of practice or possible misconceptions of content and adjust the lesson within the moment of learning. While teaching candidates will often use a variety of questions, not all types of questions are as effective as others. "Skillful questioning of student thinking can provide the teacher with essential knowledge about students developing mathematical ideas, knowledge which might otherwise be inaccessible"(Martino & Maher, 1999, p.54). The questions should advance students' understanding by asking questions that build on an idea or concept but do not funnel students' thinking. Herbel-Eisenmann and Breyfogle (2005), define funneling questions as ones that "occur when the teacher asks a series of questions that guide the student through the procedure or to a desired end" (p. 485). In these situations, teaching candidates have the highest cognitive activity within the problem or situation, while the students are often just answering low-level questions and are passive participants. In contrast, when implementing a high-leverage practice of eliciting and interpreting, teaching candidates use a more focused pattern of questioning. Within this questioning pattern, teaching candidates listen to students' responses and then use those responses to guide and facilitate the learning toward the mathematical goal or objective. This practice asks teaching candidates to develop general open-ended questions specific to the needs of their students. When necessary, the pace of the lesson may be adjusted to meet students

where they are in the learning process.

Strong teaching habits depend on developing a flexible collection of high-leverage practices, strategies, and techniques. Incorporating high-leverage practices into teacher education programs demands teaching candidates to have authentic opportunities to plan, instruct, and assess daily lessons where these high-leverage practices, a set of specific strategies, routines, and activities (Ball & Forzani, 2009), can be unpacked to enhance both the P-12 student learning as well as the teaching candidate's learning and teaching process. Forzani (2014) explains that when teaching candidates to experiment with different instructional activities, competency-based teacher educators may see it as "improvisational practice where candidates pursue their own inquiry into the effects of particular instructional moves in the classroom instead of simply following the prescription of the teacher educator" (p. 365). Thus, it is important that within teacher preparation programs, teaching candidates understand the benefits and research behind high-leverage practices.

Self-Efficacy in Teacher Education

According to Pajares and Miller (1994), "self-efficacy is a context-specific assessment of competence to perform a specific task, a judgment of one's capabilities to execute specific behaviors in specific situations" (p. 194). In relation to this study, mathematical self-efficacy will be the focus. Hackett and Betz (1989) stated that,

> Mathematics self-efficacy can be distinguished from other measures of attitudes toward mathematics in that mathematics self-efficacy is a situational or problem-specific assessment of an individual's confidence in her or his ability to successfully perform or accomplish a particular task or problem. (p. 262)

Teaching candidates' attitudes and beliefs about their abilities have been shown to influence how

they later teach in their classrooms. Lau (2021) states that teaching candidates "enter universities with diverse beliefs and understandings of teaching and learning; yet, they may not be aware of how these conceptions are related to their epistemological and efficacy beliefs" (p. 1157). Kahle (2008) stated,

> In general, in America, it is socially acceptable to fear or dislike mathematics, and this attitude toward mathematics affects our schoolchildren. This socially acceptable but poor attitude toward mathematics may be reflected in our schools by various individuals who tell their stories of mathematical woe. (p. 18)

DeMink-Carthew et al. (2017) found that when implementing high-leverage practices within their classroom, they "gained a deeper understanding of how any given practice may be enacted depending on the underlying values brought to this practice by teachers" (p. 99). For years, school buildings have been filled with conversations and beliefs concerning teachers' capabilities related to specific content knowledge and performance expectations. Some of these beliefs may include girls performing lower in STEM-based content courses than boys and students of culturally diverse backgrounds being enrolled in less challenging core curriculum classes, to name just a few. Duffin (2012) reported that "based on the abundance of research showing the strong influence self-efficacy has on human behavior (Bandura, 1997), critics agree that the concept of teacher efficacy should be aligned with Bandera's theoretical perspective" (p. 828). Pajares' (1992) research states that "the beliefs teachers hold influence their perception judgments which in turn affect their behavior in the classroom" (p. 307).

Teachers' self-efficacy beliefs have been shown to influence the learning outcomes of students' potential (Rubic-Davis et al., 2012). Wheatley 2002 found that "teachers with a positive sense of self-efficacy believe they can influence student outcomes, whereas teachers with a less

positive sense of teacher efficacy believe there is little that can be done to affect student outcomes or that they lack the skill to do so" (p. 6). Tschannen-Moran and Hoy (2001) concluded that this low self-efficacy belief affects teachers' efforts to prepare lesson plans and set student outcomes toward specific disciplines. In short, if teachers do not believe they can understand a specific concept, they will likely spend less time teaching it to their students. Thus, our youngest students' minds are being stunted by the teacher's low self-efficacy in teaching mathematics. NCTM 2014 noted how the lack of student confidence leads to the development of a view of mathematics as "something far beyond their grasp and that they can never hope to understand" (p. 62). NCTM (2014) goes on to further state,

> Parents may unwittingly reinforce this notion by excusing low performance by their children as genetic destiny (saying, for example, "I was never good at math either"). Furthermore, educators may reinforce this misconception by sorting students by ability, believing that some can "do math" and others cannot. (p. 62)

Woolfolk and Hoy (1990) stated, "People who hold these beliefs seem to be saying that schools can do little to counteract the effects of students' family backgrounds or to change inherent ability" (p. 89).

Wheatly (2002) reported that teachers' self-efficacy is sometimes divided into general and personal categories. "General teacher self-efficacy means teachers' beliefs in the ability of teachers in general to influence student outcomes; personal teacher efficacy means teachers' beliefs about their ability to affect student outcomes" (p.6). Within the same study, it was found that if "one's efficacy regarding the teaching of specific subjects or use of specific teaching methods, can foster negative teaching attitudes" (p. 7). This interferes with students learning and reduces the implementation and differentiation of new teaching approaches that would meet all

learners' needs within the classroom. Wheatley also suggests, “We often teach to our strengths, and in the areas of our teaching practices where we doubt our efficacy, we may avoid teaching that content or using those teaching methods” (p. 7). In a similar study, Rubie-Davis et al. (2011) found,

> if teachers have low efficacy and they are more structured in their approach to teaching students in low socio-economic areas, and [students] lack experience, the combination of these teacher factors may have greater implications, for student learning than if for example, the teacher lacks teaching experience. (p. 271)

Duffin’s (2012) research supported these findings and suggested that within teacher preparation programs,

> monitoring pre-service teacher efficacy beliefs during teacher preparation will allow teacher education programs to act upon the findings and create learning opportunities for pre-service teachers that will build the knowledge, skills, and efficacy beliefs necessary to be successful practitioners in the field upon programs completion. (p. 829)

It is essential to highlight that self-efficacy can be task and context-specific (Wheatley, 2002, p. 4). While a candidate might have a strong self-efficacy when conducting literacy lessons with students, the opposite may be true when teaching mathematics to the same students. All educators have strengths as they teach. For subjects that they enjoy teaching more than others, this is natural. This becomes an issue when the teacher’s preference interferes with student learning. Does a teacher’s preference stem from their self-efficacy beliefs concerning specific subjects, and can that belief be impacted and changed?

Math Self-Efficacy

If self-efficacy is, as Wood and Bandura (1989) defined it, the “ability with which people

approach complex decision-making," and this belief "has a substantial impact on self-regulatory mechanisms that govern performance attainments" (p. 412). Then, a person's mathematic self-efficacy would impact their beliefs about their ability to perform mathematical tasks related to understanding. Teaching candidates with low self-efficacy may also be categorized as having varying degrees of math anxiety. Bandara (1993) reported that

> perceived efficacy to exercise control over stressors plays a central role in anxiety arousal. People who believe they can exercise control over threats do not conjure up disturbing thought patterns, but those who believe they cannot manage threats experience high anxiety arousal (p. 132).

It is not uncommon to be in a mathematical learning environment within an elementary classroom and hear phrases such as "I am not good at math, I do not have the math gene to be good at math, no one likes math." Schifter and Fosnot's (1993) study found that "elementary teachers are the products of educational systems they are being asked to change" (p.13). In another study, Jackson and Leffingwell (1999) found that only 11 teaching candidates, or 7% of the 157 individuals seeking an elementary education degree, "had only positive experiences in their mathematics classes from kindergarten through college" (p. 583). As the authors investigated the responses of the remaining 146 teaching candidates attempting to discover which approximate grade level their math anxiety occurred, the authors found that 16% of the teaching candidates identified third and fourth grade as the time they first noticed a heightened anxiety level related to mathematics (p. 583). This would equate to a low math self-efficacy level. "Self-efficacy has been found to predict [teaching candidates] motivation and accomplishments," and those "teachers with high self-efficacy demonstrated more satisfaction in their work and less burnout as well as teach [content] at higher and deeper levels (Patkin &

Greenstein, 2020, p. 503). When teaching candidates have low self-efficacy, there is a higher probability that they will not spend the required time teaching mathematics as NCTM (2014) recommends.

> With a systemic commitment to all students and expectations that all students can meet or exceed grade-level standards for mathematics, educators can more easily move away from past practices, such as tracking that separated students, and instead develop productive practices that support learning for all. (p. 65)

Sandford professor and noted mathematics educator Jo Boaler (2015) supported this argument by stating,

> Over the years, school mathematics has become more and more disconnected from the mathematics that mathematicians use and the mathematics of life. Students spend thousands of hours in classrooms learning sets of procedures and rules that they will never use in their lives or in their work. (p. 27)

Education preparation programs vary from institution to institution. Ball et al. (2009) stated,

> There is no established pedagogy for the teaching or structures for learning practices. Thus, instructors are left on their own to figure out the ways to teach effectively… even when postsecondary educators possess the experience of having taught as K-12 teachers, teaching how to teach is different from teaching science or math, and little support exists to help [teaching candidates] develop their practice. (p. 459).

As these teaching candidates work to develop, the art of teaching who they learn from is just as important as whom they will teach in the future. If postsecondary instructors possess any anxiety toward specific subjects, such as mathematics, those views have the potential to be passed on to a future generation of teachers. (Clark-Meeks, Quisenberry, and Mouw 1982, as cited in Rule and

Harrell, 2006), "reported that early childhood, elementary, and special education majors often express fear, dislike, and insecurity in relation to mathematics" (p. 241). Postsecondary institutions continue to select their teacher education faculty from those with experience. In that case, it stands to reason that there will be instructors with apprehension, low self-efficacy about mathematics, or some form of mathematical anxiety. Bursal and Paznokas (2006) reported in their study that: "the preservice elementary teachers' lack of knowledge in mathematics and science resulted in their negative attitudes toward these areas" (p.173). As teacher preparation programs continue to educate the elementary math teachers of tomorrow, we must remember our influence on teaching candidates.

Summary

Educators want to help their students be successful and enjoy the process of learning. In turn, P-12 students want to feel like classrooms are places where they have opportunities to explore ideas and build concept understanding without fear of ridicule. Current and future teaching candidates pursuing early childhood, special education, and elementary education degrees can change the future of how individuals view mathematical education. When teaching candidates can improve their self-efficacy related to learning and teaching mathematics, phrases such as "I am not good at math" hopefully will be replaced with "math, I can do that." This leads to the question of how high-leverage practices impact a teaching candidate's self-efficacy with mathematical content. Can the implementation of the three HLPs, which are the focus in this study: leading a group discussion, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking, provide a measurable increase in teaching candidates' math self-efficacy? These are the questions this study aims to answer.

Synthesis of the Research Findings

Bandura's work continues to stand the test of time. His views on teacher self-efficacy and how people construct their own beliefs about how well they will be able to complete a specific task (Bandura, 1977). This study will use Bandura's (1991; 1993) self-efficacy theory on the relationship between teacher self-efficacy and teaching practices. The frameworks of Ball and Forzani's (2009) high-leverage practices will provide the mathematical pedagogical framework for this study. When focusing specifically on the teaching impact of self-efficacy, Bandura (1993) noted, "teachers who lack a secure sense of instructional efficacy show weak commitment to teaching and spend less time on academic matters" (p.134). "Thus, a major goal of formal education should be to equip students with the intellectual tools, self-beliefs, and self-regulatory capabilities to educate themselves throughout their lifetime" (p. 136).

Several studies support Bandura's statements. Bekdemir's 2010 study on "pre-service teachers' mathematics anxiety related to the depth of negative experiences in mathematics classrooms while they were students" used a mixed method exploratory approach using both quantitative and qualitative analysis (p. 314). The study showed that mathematically anxious teacher candidates have a good chance of becoming teachers who lack confidence in their mathematical ability (p. 314). This study attempted to prove how a teacher with math anxiety may transfer that anxiety onto their students (p.314). This study took place in Turkey and involved 167 elementary teaching candidates, 67 female and 100 male. The participants were randomly selected from 664 elementary teaching candidates. The Mathematics Anxiety Scale (MANX) was used. The MANX scale used 45 Likert-type items: 1=never; 2=sometimes; 3=equals very often; 4=equals always. The items describe test and evaluation anxiety, apprehension of lessons, use of mathematics in daily life, and self-efficacy in mathematics

requiring mathematical thought or tasks. They are rated as the degree of anxiety respondents perceived they would experience in the given situations. Scores range from 45 to 180. A higher score indicated a higher level of math anxiety; the instrument was administered to all participants within the study at week six of the spring semester. “The analysis MANX scores revealed that 53% of the participants are placed in the moderate category while 6% are put into an anxious or high anxiety category” (p. 324).

Bekdemir’s (2010) study provides context to the premise of this future research study that teachers with mathematical anxiety or low self-efficacy related to teaching and learning mathematics will pass these same traits onto their elementary students, continuing the mathematical cycle. This research study will seek to discover if the implementation and focus on three specific high-leverage practices within elementary math methods courses suspend or lessen teaching candidates’ self-efficacy and the beliefs in their own mathematical ability.

Bekdemir’s (2010) study revealed the following results: (1) math anxiety is present in many teaching candidates; (2) self-efficacy beliefs affect how well these candidates implement content lessons related to their area of high anxiety/low self-efficacy; (3) math anxiety in students is linked to their teacher’s behavior and teaching approach. The instructional methods of teaching candidates with low self-efficacy are more prevalent to be teach-and-drill methods, which contradict promoting a mathematics classroom environment of engaging students in meaningful learning, collaborative experiences, high expectations and supporting all learners.

Beilok et al. (2010) studied whether female teachers' math anxiety affected girls’ math achievement. It was reported in this study that

> children are more likely to emulate the behavior and attitudes of same-gender versus opposite-gender adults. Because early elementary school teachers in the United States are

> almost exclusively female (>90%; 91% across elementary schools and even higher in elementary levels) and gender is a highly salient feature to children at early elementary school age, girls may be more likely than boys to notice their teachers negatives and fears about math thus, in turn, may have a negative impact on girl's math achievement. (p. 1861)

This study began by collecting data at the beginning of the school year to measure the relationship between teachers' math anxiety and students' math achievement where (*r)* represents teachers math anxiety and (*P*) represents students math achievement.

> The results show there was no significant relation between teacher's math anxiety and student's math achievement at the beginning of the year (girls: $r = -0.13$, $P = 0.31$ boys $r = 0.12$, $P = 0.40$.): however, by the end of the year the higher a teacher's math anxiety, the lower the girls ($r = -0.28$, $P = 0.022$ but not the boys $r = -0.04$ $P = 0.81$) math achievement. (p. 1862)

The authors of this study did note that the effects reported in this work, however significant, are small, noting that there are many influences on math achievement over and above teachers' current anxieties. Some listed in the research were "previous teachers, parents, peers, and siblings who either do or do not model traditional academic gender roles may play an important part in shaping girls' gender abilities and beliefs and their math achievement more generally" (p. 1863).

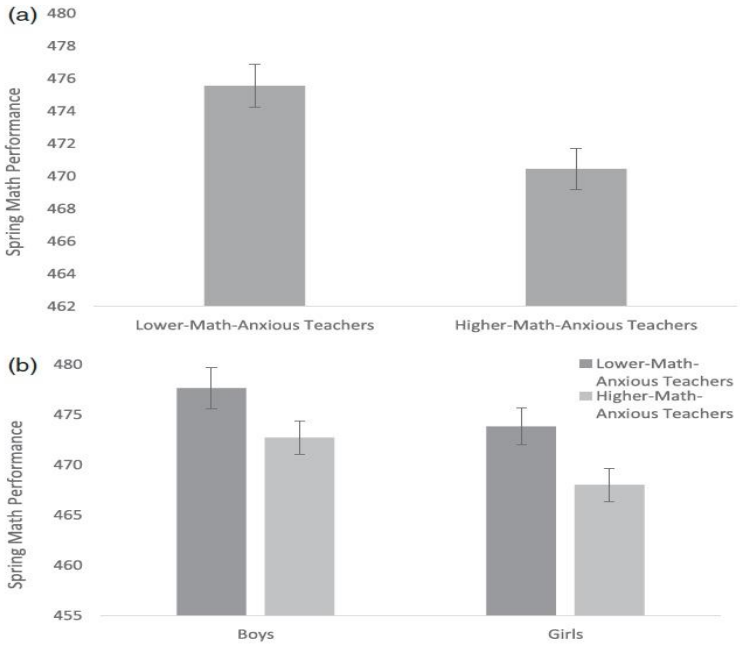
A more recent 2021 quantitative study by Schaeffer et al. also measured elementary teachers' math anxiety concerning student learning. This study was conducted using a larger student sample size of 551 students. Even with a larger sample size, the results showed a "negative relation between teachers' math anxiety and students' math achievement for both girls

and boys, even after accounting for teachers' math ability and children's beginning of year math knowledge.” According to the author “these findings strengthen the support for the hypothesis that teachers' math anxiety is one factor that undermines children's math learning and could push students off-track during their initial exposure to math in early elementary school” (p. 1). Within this study, Schaefer et al. (2021) examined whether there was a relationship between teachers' math anxiety and students' beginning-of-the-year math achievement. This is a significant question because it is established that students had no math issues at the beginning of the year. The data could be collected at the end of the year to see if their teachers' math anxiety affected their achievement. Schaefer et al. (2021) data shows the

> relationship between teachers' math anxiety and students' beginning-of-the-year math achievement. This finding is important in that it gives us confidence that any relation between teachers' math anxiety and children's math knowledge at the end of the year is the result of interactions with children over the school year and not a result of low-performing children coincidentally being placed in a higher math anxious teachers classroom. (p. 3)

The data showed that “teachers' math anxiety was negatively associated with children's math achievement at the end of the school year, showing the higher a teacher's math anxiety was, the less math their students learned over a school year” (p. 3). Figure 2 shows this relationship. These results support the study by Beilock et al. (2010) demonstrating the influence of a teacher’s math anxiety on the students within their classroom.

Figure 1 **Students' Math Learning in Relation to Teachers' Math Anxiety**



Note. From *Elementary School Teachers' Math Anxiety and Students' math learning: A large-scale replication* by Schaeffer et al, 2021, *Developmental Science*, 24(4).

Portion a) in the figure above shows children within the study's math learning as a function of teachers' math anxiety. Portion b) shows students' math learning across the school year as a function of the teacher's math anxiety, split by gender (Schaeffer et al., 2021, p. 4).

Ross et al.'s 1996 study focused on providing teaching candidates with course knowledge, including understanding how the course structures, concepts, and principles influence a teacher's efficacy. Similar to the work of Ball (2009) and Grossman (2018), Ross states that "the most critical aspects are pedagogical content knowledge are being able to anticipate student misconceptions and having strategies for transforming them into more accurate understandings" (p. 387). This pedagogical knowledge includes helping teaching candidates understand the importance of correctly and precisely representing student strategies to illustrate their thinking visually for the class. This would align with two of the three specific

TeachingWorks high-leverage strategies, which are a part of the research of this study: explaining and modeling content and eliciting and interpreting individual student thinking. The work conducted by Ross et al. (1996) concluded that,

> Adequate [teacher] preparation might influence teacher efficacy by reducing teachers' uncertainty about their ability to perform the teaching behaviors required by the course. [The authors] predict that teachers would feel that their prior training and expertise provided better preparation for some courses than others and that they would have higher teacher efficacy when they felt well prepared. (p.387)

As teaching candidates begin their teaching career in their first classroom, they will encounter mathematical situations where it will be up to them to decide "how should I teach this" or "how do I help my students understand this math concept." These teaching candidates will rely on a few options: do what they have been taught, or do what is comfortable. For some candidates, this is the same outcome; however, for others, those with low self-efficacy, it will be a debate within themselves. "Because many [teaching candidates] probably themselves learned [elementary mathematics] by memorizing and executing procedures," following guidelines set forth in teacher preparation programs may seem foreign to most candidates. (Saclarides and Lubienski, 2021, p. 257)

In a study by Jenset (2018), qualitative research methods with small sample sizes were used to focus on summarizing teacher education programs and what and possibly how candidates' opinions within these programs may influence current and future teacher education programs. Janset (2018) also described how the National Council for Accreditation of Teacher Education [NCATE] believes that the current educational system for teacher candidates "needed to be turned upside down" (p. 2).

There is a lack of qualitative case studies concerning teaching candidates' self-efficacy and high-leverage practices. Much of the research has a quantitative focus, especially concerning elementary mathematics classroom environments. Klassen and Tze (2014) work specifically notes that “case studies and qualitative studies were excluded”(p. 62). within their research concerning teacher’s self-efficacy. Lau's (2021) study was focused specifically on teaching candidates and their beliefs and understandings of teaching elementary mathematics; however, quantitative data was again collected. Within the conclusions of Lau’s (2021) work it states,

> Future studies should address some limitations of the present research; qualitative data should be collected from teaching candidates and analyzed to interpret the quantitative results of the multiple regression analysis also understanding how teaching candidates’ teaching and learning concepts develop with respect to their epistemological and efficacy beliefs over time is paramount… finally, some other mathematical affect such as emotions and attitudes may be included as predictors of teaching candidates teaching and learning conceptions in future studies. (p. 1158)

Critique of Previous Research Methods

The selection of literature reviewed for this study was from research that included both quantitative and qualitative articles. The quantitative and mixed methods studies (Bekdemir 2010, Beilok 2010, Schaeffer 2021, Ross et al. 1996) utilized surveys to understand better teachers’ and teaching candidates’ perceptions of self-efficacy and its influence on future P-12 students and their pedagogical growth. Within each study, the surveys seemed reliable, and the sources and instruments were explained adequately. The data analysis presented in the quantitative studies seemed to align with the recommendation of Frankel et al. (2015), as they were presented comprehensively and understandably for the reader. The surveys were reliable

and valid, and the sources of instruments were stated.

The qualitative studies (Grossman 1990, Martino and Maher 1999, John 2002, Wheatley 2002, Loewenberg-Ball and Forzani 2009, Rubie-Davies et al. 2011, Mizala et al. 2015, Kabab et al. 2021, Hugehes et al. 2023) provided more of an analysis of teacher candidates' and teachers' perceptions collected through a mix of interviews and observations. Many of these studies are connected with teacher preparation programs that are looking to improve teaching candidates' pedagogical understanding and focus on the implementation of mathematical strategies.

Data analysis was in line with Creswell and Poth (2018). Many studies reported collecting interview data and documents relying on these for a majority of their findings.

This will be a qualitative case study. Qualitative research provides insight into participants' current ontology and a descriptive account of the phenomenon studied. The benefit of this case study is that the researcher will work directly with teaching candidates as they conduct their “field” placements. This will allow for the transfer of first-hand knowledge from the researcher to teaching candidates. Data will be collected using surveys and interviews between the researcher and teaching candidates as part of the case study.

The benefit of these case studies was the support for this work, investigating the hypothesis that teaching candidates math self-efficacy can improve by implementing high-leverage practices within a teacher preparation program and field experience setting. A limitation of the previous research is that several different factors can influence math self-efficacy. Ensuring that the results obtained can be attributed to the designed case study will be challenging.

Summary

The previous literature made it evident that many teaching candidates seeking elementary

or early childhood teaching degrees view their ability to be successful in mathematics as unattainable (Grossman 1990 and Loewenberg-Ball and Forzani 2009). This low mathematical self-efficacy view within teaching candidates stems from interaction with teachers from their formative PK-12 education. These candidates did not have the opportunity to have a mathematical learning experience that incorporated high-leverage practices. These teaching candidates will shape the minds and beliefs of the students they teach. Thinking through the math of this possibility, say a teaching candidate with low math self-efficacy begins their teaching career in 2025. They acquire their dream job of becoming a third-grade teacher. They had an average classroom size of twenty students for the next thirty years, meaning they had influenced over 600 students. If 1% (6 students) of those 600 students becomes a teacher and the same low mathematic self-efficacy still exists within three of these students and they also have an average teaching class size of 20 students for thirty years, this is an influence on 18,000 students. Thus, continuing the cycle of low mathematical self-efficacy from generation to generation. In order to understand if high-leverage practices influence teaching candidates' math self-efficacy, a qualitative case study in the form of surveys and interviews will be the best means to gather data and analyze the data. The next section discusses the qualitative methodological approach for this study, including the setting, participants, data collection, and data analysis method.

Chapter 3: Methodology

Introduction

The start of each school year should be one of excitement and joy for learning. However, year to year, there is one subject that elementary students and their teachers dread: math. This study will focus on collecting data from teaching candidates on their math self-efficacy beliefs and the perceived competence in their ability to implement three specific high-leverage practices

(HLPs) before and after their student teaching semester at a midwestern university. The data collected will track if teaching candidates' math self-efficacy views changed during the twelve weeks of student teaching. The three HLPs of focus in this study are leading a group discussion, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking.

Individual teachers' strengths, weaknesses, understanding of teaching and learning practices, and how practices are implemented influence the students they teach. According to Santoro (2011), “individual teachers and the qualities they bring to their classrooms affect their teaching and their students profoundly” (p.6). Kennedy (2010) stated that “the qualities teachers bring with them to their work are not enough to ensure better teaching practices. It is what teachers actually do that is most relevant to student learning” (p. 591).

As a former elementary math teacher and state math consultant/specialist, I have worked with many teachers who reluctantly teach mathematics to their elementary students. These teachers openly confess their anxiety when teaching math and prefer not to teach it. Currently, as an assistant professor at a midwestern university teaching elementary mathematical methods courses, most teaching candidates each semester believe that they, too, are unable to solve fundamental elementary mathematic problems and are reluctant to teach or even learn more about mathematics. Teaching candidates should embrace the importance of “promoting student interactions and discourse, with the goal of helping students make sense of mathematical concepts and procedures” (NCTM, 2014, p. 10). This study will explore if implementing high-leverage teaching practices can influence a teaching candidate's self-efficacy.

Purpose of the Study

This study aims to determine the association between teaching candidates' feelings and perceptions regarding mathematics teaching and learning and the candidates' implementation of high-leverage teaching practices within an elementary mathematical setting.

Within teacher preparation programs, teaching candidates must complete multiple hours of field experiences where they practice and learn how to teach using strategies that "must have a considerable impact on student learning" (Kearney, 2015, p. 101). Following the social constructs of self-efficacy, if current teaching candidates believe they are incapable of being productive mathematics teachers, the time spent teaching mathematics will probably be less productive than other core content within elementary classrooms. When the individual teaching mathematics has a low self-efficacy or holds deficit-minded beliefs about students learning, these beliefs may influence class/student decisions rather than relying on pedagogical knowledge or curriculum guidelines (Clark & Peterson, 1986). In a study of 691 elementary teachers from eight states, McAnallen (2010) reported that approximately 33% of elementary school teachers "had a mathematical anxiety and led to a decreased feeling of enjoyment about mathematics" (p. 1). This study explored ways to influence or increase future teachers' self-efficacy for teaching mathematics. Gibson and Dembo (1984) found that "high-efficacy teachers may achieve higher student engagement rates by utilizing whole class instruction and be better able than low-efficacy teachers to keep other students engaged while instructing small groups" (p. 578). This study aims to provide teaching candidates with tools to increase their mathematical self-efficacy, thus changing the cycle of fear of teaching mathematics in elementary and early childhood settings.

Research Question

This qualitative case study explores the experiences of teaching candidates enrolled in a university teacher preparation program. Within previous method courses, content focused on the planning, instruction, and assessment of high-leverage practices. The overarching question of this study is: How did the implementation of three specific HLPs during a twelve-week student teaching experience in an elementary classroom environment impact a teaching candidate's self-efficacy with mathematical content?

Research Design

The design of the qualitative case study closely follows that of Merriam's (1998) case study applications in education and Merriam and Tisdell's (2016) and Creswell and Poth's (2018) parallel designs for qualitative research. Creswell and Poth (2018) describe the nature of qualitative research:

> Qualitative research begins with assumptions and interpretive/theoretical frameworks that inform the study of research problems addressing the meaning individuals or groups ascribe to a social or human problem. To study this problem, qualitative researchers use an emerging qualitative approach to inquiry the collection of data in a natural setting sensitive to the people and the places under the study and the data analysis that is both inductive and deductive and establishes patterns and themes. (p. 8)

Case studies are heuristic in that they "illuminate the reader's understanding of the phenomenon under study. [Case studies] can bring out the discovery of new meaning, extend the reader's experience, or confirm what is known" (Merriam, 1998 p. 30). Creswell and Poth's (2018) case study research are a type of design in qualitative research that can be defined as an investigation into "real-life, contemporary bound system (a case) or multiple bounded systems

(cases) over time, through detailed, in-depth data collection involving multiple sources of information and reports a case description and case themes (p. 97).

Within this bounded system case study, data will be collected through interviews, a collection of teaching candidates' specific lesson plans, video discussions/reflections, and recorded teaching observations. Since case studies are heuristic, teaching candidates can use self-discovery that employs hands-on, real-life experiences that may not be prescribed or perfect, allowing the freedom to help the teaching candidates explore and understand the purpose and power of high-leverage practices.

Participant Selection

Within the one small public midwestern university, the primary participants of this case study will be early childhood, special education, and elementary education majors who will be student teaching during the fall 2023 semester. Participants will be asked to engage in the study shortly before the beginning of the fall school year. An email will be sent to all registered teaching candidates asking if they would consider being part of the semester-long study. Creswell and Poth (2018, pp. 159-160) suggested that 4-5 cases be included in a study. Ideally, for a researcher to understand the scope of the impact of high-leverage practices on the mathematical self-efficacy of teaching candidates, data would need to be collected through multiple cases. Similar research has collected data from multiple teaching candidates in many elementary math methods courses offered across the teacher preparation programs inside and outside the United States. However, because this study is bounded by time, only a sample of teaching candidates will be obtained.

The inclusion criterion for this study is that teaching candidates must have been enrolled in a specific course section of elementary math methods before the Fall 2023 school year at the

designated midwestern university. Candidates must be student teaching in the Fall of 2023 in an early childhood, elementary, or elementary special education classroom and be able to complete math lessons with elementary-age students. Elementary students are defined for this study as being in kindergarten through sixth grade. If the chosen student teaching candidate works in a special education or early special education setting, the elementary students with whom they work should be at a four-year-old cognitive level or higher. Candidates must agree to the study, complete all surveys and interviews, and provide the researcher with video or audio recordings and lesson plans for analyzing at least two math lessons. The exclusion criterion follows a similar pattern; if any piece of data cannot be collected, then all the candidate's data will be withdrawn from the study.

The sample size will allow for multiple variances of math self-efficacy to be reviewed and potentially observe if there is any relationship between candidate's math self-efficacy level and their implementation level of the high-leverage practices of explaining and modeling content, eliciting and interpreting student thinking and building collective student knowledge through group or class discussions. Duffin et al. (2012) stated that "the quality of teacher education programs, which provide instructional opportunities, experiential teaching activities, feedback, and the effective models for [teaching candidates], play an important role in the establishment and development of [teaching candidates] efficacy beliefs" (p. 829).

This case study aims to explore the association between teaching candidates' feelings and perceptions and implementing high-leverage teaching practices within an elementary mathematical setting. If teaching candidates' math self-efficacy beliefs are at a level where they cannot design, implement, and assess high-leverage practices, then teacher preparation programs should consider modifications to assist candidates in eliminating the cause of these low math

self-efficacy beliefs. Quality experiences allow "student teachers' learning opportunities that reflect the orientations and experiences of their instructors and cooperating teachers" (Ball et al., 2009, p. 459). Ball et al. (2009) stated, "Teacher preparation must help novices learn how to *do* instruction, not just hear and talk about it" (p. 459).

Procedures

Participant Selection

A case study focuses on one specific bounded system (Creswell & Poth, 2018; Merriam & Tisdell, 2016). For this case study, the bounded system will be one midwestern university and a specific instructor's elementary mathematics methods course. Convenience sampling will be selected based on the researcher's place of practice. After contacting the Dean of Students and University Provost to obtain permission to use the school as a research site, purposive sampling will be used to select participants. Once full Institutional Review Board (IRB) approval has been granted, teaching candidates falling within the parameters will be requested to participate in this case study research. This contact will be through the university email system prior to the Fall semester (e.g., August 1-21, 2023). Through a participation recruitment letter (Appendix A), participants were notified of the study and assured that participation would not affect their standing within their student teaching placement. Upon agreeing to participate in the study, participants signed and submitted an informed consent letter (Appendix B).

Protection of Participants

The informed consent letter was sent electronically to all participants. This document outlined the individual's rights to participate and withdraw freely, the fact that the interviews would be recorded, and the fact that the recording would be destroyed after the research was

complete. A pseudonym will also be used for each participant and the university. Participants will know that they can ask questions at any time.

Expert Review

The ten interview questions have been vetted by Dr. Kandy Noles Stevens, Dr. Debbie VanOverbeke, Dr. Heather Beasley, and Dr. Jason Brasel. Dr. Noles Stevens and Dr. VanOverbeke are current education professors at the Midwestern University, where this research will be conducted. Each has completed the certification program in Practice-Based Approaches to methods of instruction in teacher education through TeachingWorks. TeachingWorks is a piece of the University of Michigan Teacher Education Initiative. This certification program focuses on supporting teachers and teaching candidates to develop equitable teaching practices to create classroom environments where all children flourish. This year-long sequence of learning opportunities is designed to support and build competency with high-leverage practices. Dr. Noles Stevens and Dr. VanOverbeke implement multiple high-leverage practices within their teacher education preparation courses at the midwestern university where this case study will be conducted. Dr. Beasley and Dr. Brasel are facilitators for TeachingWorks and the University of Michigan and work directly with Dr. Deborah Loewenberg Ball and Dr. Francesca Forzani, the director and deputy director of TeachingWorks whose definitive work has been cited throughout this research.

Data Collection

This case study will incorporate a corroboration of evidence by triangulating multiple data sources. Creswell and Poth (2018) state that the use of triangulation assists in "corroborating evidence from different sources to shed light on a theme or perspective" (p. 260). Data for this study will be collected through interviews, lesson plans and field experience observation videos.

Table 1.1 shows each data piece and its purpose within this study. The lesson plan and observation data will be the first data collected using the recommended lesson plan template from the midwestern university.

Table 1 *Data Collection and Purpose*

Data Tool	Lesson Plans	Teaching Video	Interview
Specifics of tool	Collect at least 1 math lesson plan using TPP recommend template. Document if at least one high-leverage practice is listed within the lesson. HLP's choice will be TC's.	Collect at least 1 video documentation of the TC teaching a math lesson. Document if at least one high-leverage practice is listed within the lesson. HLP's choice will be TC's.	Interview conducted with TC following specific questions on HLP implementation.
When implemented	By week 9 of student teaching experience.	By week 9 of student teaching experience.	Between weeks 10-12 of student teaching experience.
Purpose	Document TC plans on how they will implement HLP in a math environment.	Document TC implementation of HLP in a math environment. Document TC perceived comfort with the implementation of HLP in a math environment.	Document any influences that may affect TC ability to implement HLP in the math environment. Document TC own words on their experiences implementing HLP in a math environment.

Next, individual interviews with each candidate will be conducted. These will last approximately one hour and will include open-ended questions relating to teaching candidates' experiences of formal and informal learning of high-leverage practices and their overall feelings toward teaching elementary mathematics. All interviews will be recorded. All data resulting from the interview will be anonymized, and teaching candidates' identities will be kept confidential. Demographic data such as age, gender, and educational credits held during the study will also be noted. Bloomberg and Volpe (2018) stated that,

> the purpose of the demographic data is to provide participant profile information which will describe who the participants are within the case study, where they come from, and some of the history and or background of their education and other personal information such as age, gender, and ethnicity. This relevant demographic information is needed to help explain what an underlying individual's perceptions may be and the similarities and differences in perceptions among participants. (p. 188)

In my experience working with student teachers, their confidence can increase or decrease depending on situations and opportunities to practice the teaching pedagogy and strategies within the classroom environment. For this reason, student teachers will not submit their lesson plans and observational videos until after week eight of their student teaching. During weeks eight to eleven, candidates will complete lesson plan requirements and video recordings of their teaching an elementary math lesson of their choice. After the completion of their student teaching experience, sometime after December 11, 2023, a final interview will be conducted via Zoom recording technology.

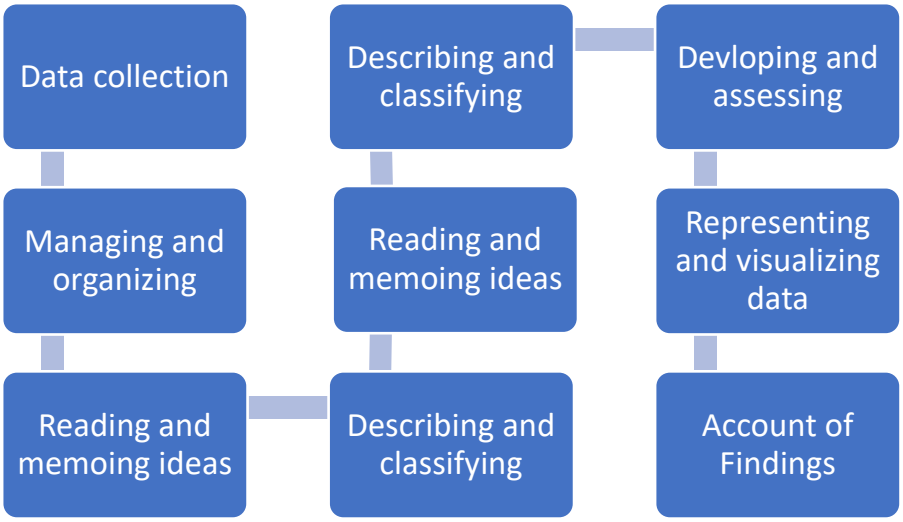
Merriam and Tisdell (2016) discuss the pros and cons of electronic communication, including lag or inadequate internet access for video conferencing and the inability to see facial expressions and body language in telephone interviews. As the participants in this study are all online learners, they are accustomed to using video technology to record or participate in discussions. The recordings and all documents collected during this case study will be stored on an external password-protected drive only accessible by the researcher.

Data Analysis

The data analysis process will follow Merriam's (1998; Merriam & Tisdell, 2016) methodological model for case studies. First, the data must be managed and organized.

Interviews will be transcribed using a laptop. Each piece of data will be identified and stored according to each interviewee, and a spreadsheet will be created for the preliminary analysis process. Once video and audio data have been transcribed, they will be sent to each interviewee. Member checking will be used to ensure their comments are credible and interpreted correctly as intended. According to Creswell & Poth (2018), "transcripts or the raw data" of each individual will not be given to all participants but rather "preliminary analyses consisting of descriptions or themes" (p. 262). The interview data will be analyzed using the data analysis flow chart based on the spiral method (Creswell & Poth, 2018) see Figure 2.

Figure 2 *Data Analysis Flow Chart*



Note. According to Creswell & Poth (2018), "transcripts or the raw data" of each individual will not be given to all participants but rather "preliminary analyses consisting of descriptions or themes" (p. 262). The interview data will be analyzed using the data analysis spiral method (Creswell & Poth, 2018) see Figure 2.

Following this analysis method will allow for the organization of data, memoing emergent ideas, and classification by coding themes. Memoing is a process used in qualitative research where I, the researcher, will write down my thoughts, interpretations, and any insights

related to specific data. A second process to analyze the data will be to use open coding. Within this process, I, the researcher, will search for recurring themes or phrases within the interview data, then group these data sections together and create a common code to represent their collective theme. Open coding allows a researcher to consider a wide range of data and then discern what is relevant to the research question (Merriam & Tisdell, 2016). Each interview transcript, classroom video, and lesson plan data will undergo the same process of open coding and memoing of data analysis. Next, as the researcher, I will employ the process of axial coding to group the codes into similar categories (Merriam & Tisdell, 2016, p. 206). Merriam (1998) likens this process to the inductive constant comparative method in which one compares a piece of data with another to sort the data into categories.

Research studies are connected to inductive, deductive, or both types of reasoning. Inductive, which is found in most quantitative studies, begins with a researcher noticing or observing something that repeatedly happens in a particular situation. This might be a pattern of habits or situational rituals that occur in a specific situation each time. This would lead to a tentative hypothesis and research theory. Deductive reasoning, which is associated with qualitative studies, begins with a particular theory and then moves to the hypothesis, followed by the collection of observational data that is used to form a specific conclusion from a general premise. For example, Christine is in a class that only elementary education majors are allowed to take; thus, Christine is an elementary education major. A mixed methods study would use inductive and deductive reasoning to support quantitative and qualitative research.

This specific case study research will utilize deductive reasoning. I, the researcher, will focus on Bandura's (1977,1982,1993) work with self-efficacy beliefs. This study will explore the mathematical self-efficacy beliefs held by student teachers. Data will be collected by

interviewing and observing the implementation of three specific high-leverage practices in an elementary mathematics classroom. Seeking to answer the question of how student teaching candidates' mathematical beliefs change based on engaging in the implementation of high-leverage practices. The categories will eventually be separated into themes and given names that coincide with themes derived from the teaching candidates' interviews. A spreadsheet will be used for consistency to keep track of each category identified through the open coding and memoing processes. A diagram will be constructed to represent the multiple themes and link subcategories as they become present (Merriam, 1988).

Instruments

Role of the Researcher

Within qualitative research, the researcher is the primary instrument for data collection and analysis (Creswell & Poth, 2018; Merriam & Tisdell, 2016). Thus, the researcher must practice reflexivity or disclose biases to position oneself in the context of the research, disclose how the researcher's biases may influence the collection and interpretation of the findings, and describe what the researcher hopes to learn from the teaching candidates (Creswell & Poth, 2018; Merriam & Tisdell, 2016).

Previous Knowledge and Bias

As a former elementary classroom teacher, state math consultant, school district math specialist, and now current assistant education professor of elementary mathematics methods courses, I, the researcher, have a predisposition concerning how elementary mathematics should be taught. As the researcher, I fervently believe that math instruction in all classrooms, but especially elementary classrooms, should allow for a student-centered atmosphere and sound employ multiple high-leverage practices, which include leading a group discussion, explaining

and modeling content, practices, and strategies, and eliciting and interpreting student thinking which are foci of this case study.

Merriam and Tisdell (2016) point out that instead of eliminating biases, it is essential to recognize and monitor them, thus reducing their impact on the study. Within the previous course instruction, student teachers within this study would have received elementary math course content from the lead researcher. Within the elementary teacher preparation program at this midwestern university, it is the intent to provide purposeful and meaningful mathematical content where leading a group discussion, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking are seen as not biased but as research practices for which the results allow for student teachers math self-efficacy to change.

Several electronic devices will be used for the collection of data. First, paper and pencil will be used to take notes during video interviews. All notes will be kept in a locked file cabinet. All documents will be kept on a password-protected computer. A password-protected laptop computer will stream and record the meetings for web-based video conferencing.

Qualifications

As the researcher, my experience in conducting interviews consists of training within the Doctor of Education program at Minnesota State University, Moorhead. Within this doctoral program, interviews used for field research were supervised and guided by course requirements. Within the specific course of ED 705, Qualitative Methods in Educational Research, this researcher consulted the works of Briggs et al. (2012), Merriam and Tisdell (2016), and Creswell and Poth (2018). These authors provided examples of interview protocols, multiple levels of interviews (structured, semi-structured, or informal), and in which situation to use each.

Transcription methods and data analysis were also explored and experienced in the abovementioned course.

In addition to this formalized training, I, the researcher, received training as a state math and school improvement consultant. During my ten-year tenure, I attended coaching conferences led or sponsored by the state Department of Education, many of these focusing on mentoring and practical leadership-focused relationships. During this time, I also acquired my administration licensure, allowing me to practice providing feedback and obtaining direct data from classroom situations. As a math and school improvement consultant, I have worked with several school districts and administration teams in multiple midwestern states, helping them to analyze their own classroom, school, and district data as well as providing collaborative consulting and coaching for prekindergarten to high school students, teachers, administrators, and parents.

Ethical Considerations

I have utilized Creswell and Poth's (2018) framework in this case study for considering ethical considerations at each point in the research process from prior to conducting the study, beginning the study, collecting data, analyzing data, reporting data, and publishing the study. Before conducting the study, IRB approval was obtained from the Minnesota State University, Morehead, IRB board. Permission from the Dean and Provost of the midwestern university has also been obtained prior to beginning this case study.

While beginning to conduct this case study, an informed consent form was developed. It informed the participants of their freedom to participate or withdraw from the study at any time. This form also outlined the study's explicit purpose and each participant's role, detailed interview procedures, and disclosed no harm. The form also protected the research sites' and the

participants' identities by using pseudonyms as needed. Data will be stored in secure locations, and all data will be destroyed after this study.

I, the researcher, fully disclose that I was the elementary mathematics methods professor for all participants in this case study and may have been the university supervisor for some of the participants in this case study. During this study's data analysis, reporting, and publishing phase, I will adhere to ethical practices, including using clear and transparent language, reporting all findings, and maintaining the confidentiality of the participants.

Summary

This study aims to determine teaching candidates' feelings and perceptions associated with implementing high-leverage teaching practices within an elementary mathematical setting. Within teacher preparation programs, teaching candidates must complete multiple hours of field experiences where they practice and learn how to teach using strategies that "must have a considerable impact on student learning" (Kearney, 2015, p.101). Following the social constructs of self-efficacy, if current teaching candidates believe they are incapable of being productive mathematics teachers, the time spent teaching mathematics will probably be less productive than other core content within elementary classrooms. When the individual teaching mathematics has a low self-efficacy or deficit-minded beliefs about how to teach, how students learn, or the resources that should be used to promote learning, these beliefs may act as a filter through which they will make class and student decisions rather than relying on pedagogical knowledge or curriculum guidelines (Clark & Peterson, 1986).

Within this bounded system case study, data will be collected through interviews, a collection of student teachers' specific lesson plans, video discussions/reflections, and recorded teaching observations. Since case studies are heuristic, teaching candidates can use self-

discovery that employs hands-on, real-life experiences that may not be prescribed or perfect, allowing the freedom to help the student teachers explore and understand the purpose and power of high-leverage practices. Convenience sampling was used to select the school based on the location of this researcher's place of practice. Purposive sampling will be used to select participants. Teaching candidates registered for fall 2023, student teaching will be contacted to see if they are willing to participate in this case study research. Participants will be notified of the study and assured that participation will not affect their standing with the University or the College of Education through a participation recruitment letter.

The data analysis will follow a spiraling procedure in which the researcher will transcribe all data and undergo open and axial coding to form categories. The analysis process will be conducted simultaneously with the data collection to uncover themes and allow adjustments to be made to the final interview process. Memos will be categorized and organized using a number system. Member checking will also be implemented to provide participants with a way to offer feedback on the clarity and relevance of the analysis. Following ethical research practice standards, I, the researcher, will keep any biases in check by not asking any leading questions or corroborating with the participants and reassuring participants that their student teaching assessments will not be impacted by their participation in this study.

In Chapter 4, details regarding the actually obtained sample will be provided. As prescribed by Merriam (1998) and Merriam & Tisdell (2016), the research methodology will be explained as it will be applied to data. All data and results of the analysis will be presented.

Chapter 4: Findings

Introduction

Most teachers believe in their ability to teach specific subjects successfully. These self-efficacy beliefs can and often are transferred with or without intention to the students they teach (Santoro, 2011; Kennedy, 2010). This research followed five teaching candidates during their twelve weeks of student teaching experience. The research attempted to discover how implementing three specific high-leverage practices (group discussion, modeling, and eliciting student thinking) affected the student teacher's math self-efficacy. The interactions between the researcher and participants are explained, the data analysis method is described as the findings unfolded, and the research questions are answered in this chapter. In addition, this chapter will also include the researcher's role and motivation for this study, a description of the participants, how the data analysis method was executed, and the study's findings.

The data and results will be presented by analyzing each participant's responses to the overall research question and the two sub-questions. This study's data was verified through lesson plan coding, observation video annotation, and interviews with each participant.

Researcher's Role

My interest in teacher math self-efficacy stems from my experiences as an elementary math teacher, state math consultant, and elementary education assistant professor. With over thirty years in education, I have encountered many elementary teachers who preferred not to teach math. As someone who has always found mathematics to be intriguing and thought-provoking, I wanted to discern if an implementation of high-leverage practices could influence these candidates' math self-efficacy. The findings from this study will support my practice as an assistant professor of education and my colleagues' work within the elementary and early childhood teacher preparation programs.

As the researcher, my interview experience consists of training I received in the Doctor of Education program at Minnesota State University, Moorhead. In this doctoral program, interviews used for field research were a part of the course requirements. In ED 705, Qualitative Methods in Educational Research, the researcher consulted the works of Briggs et al. (2012), Merriam and Tisdell (2016), and Creswell and Poth (2018). These authors provided examples of interview protocols and different types of interview questions (structured, semi-structured, or informal). Transcription methods and data analysis were also explored and experienced in the abovementioned course.

In addition to this formalized training, I received training as a state math and school improvement consultant. During my ten-year term, I attended coaching conferences led or sponsored by the State Department of Education. Many of these conferences focused on mentoring and how to develop leadership-focused relationships. During this time, I also acquired my administrative license, which allowed me to practice providing feedback and obtaining direct data from classroom situations. As a math and school improvement consultant, I have worked with multiple school districts and administration teams in Iowa and Minnesota. Primarily, I assisted districts with analyzing their own classroom, school, and district data. I provided collaborative consulting and coaching for prekindergarten to high school students, teachers, administrators, and parents.

Understanding that my background experiences may interfere with my objectivity, I worked diligently to approach this research with an open mind. I relied on the participants to describe their experiences and attempted to construct a reality based on their accounts and the documentation they provided. Due to my experience, I am also predisposed to how elementary mathematics should be taught. I believe that math instruction should allow for a student-centered

atmosphere. In addition, math instruction should employ multiple high-leverage practices, which include leading a group discussion, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking. These three concepts are the foci of this case study.

Description of the Sample

Five student-teaching candidates participated in this study. The following section provides a brief overview of each participant. The actual names of the participants have been changed to maintain confidentiality. All participants were enrolled at the same Midwest university and completed their student teaching experiences during the fall of 2023. Table 2 provides the demographics of each participant. All five student teachers admitted that they had a love and desire to be elementary or early childhood teachers from a young age. While nervous about student teaching for twelve weeks, they were excited to teach most subjects. In 2023, many U.S. elementary classrooms spent most of their instructional time focused on literacy and math content. Each student teacher in this study understood that a career as an elementary or early childhood teacher requires teaching all subjects including mathematics. However, a statement shared by Emma resonated with all five student teachers at the beginning of their twelve-week experience. She stated, “I know I have to teach math, but I don’t like to because I’m not good at it.”

Michelle is an 18–24-year-old early childhood major. Michelle describes herself as someone who disliked and even “hated” math before attending this Midwest university teacher education program.

Emma is an 18–24-year-old elementary education major. Before attending this Midwest university teacher education program, Emma described herself as having "low confidence and didn't like taking math classes."

Julia is a 31–35-year-old elementary education major. Julia described herself as someone "who lacks confidence in mathematics."

Lindsey is an 18–24-year-old elementary education major. Lindsey describes herself as someone who "always felt defeated in math class."

Tanna is also an 18–24-year-old elementary education major. Tanna describes herself as always in the middle math group; however, due to struggling with reading, if there were story problems, she admits she may have struggled with those.

Table 2 *Demographics Characteristics of Participants*

Demographic Characteristics	Number
Gender	
Male	0
Female	5
Major	
Elementary Education	4
Early Childhood Education	1
Age at Time of Study	
18-24	4
25-30	0
31-35	1
Identified Race as	
White	4
African American	1

Research Methodology Applied to the Data Analysis

Purposive sampling was used to find contacts for this study. These individuals needed to meet three criteria before being contacted to participate. The first criterion was to be enrolled in the teacher education program at the selected Midwest university. Secondly, any possible participants needed to be pursuing an elementary or early childhood education degree. Finally,

each participant would need to complete their student teaching in an elementary classroom between the grades of kindergarten and sixth grade during the fall of the 2023-2024 school year. Fourteen participants met these qualifications and were contacted via email to determine if they would be interested in attending an informational meeting about the study. Five participants expressed an interest in knowing more information. Participants that did not reply or declined the request were noted. The informational meeting was conducted via a video streaming software called Zoom (zoom.us). The Zoom meeting was not recorded as it was an informational meeting to present potential participants with the study details.

Realizing that most student teachers may feel some stress during student teaching, the researcher let participants know that this study would not interfere with their student teaching or impact their completion of student teaching. During the informational meeting, the researcher shared that each participant must complete one math lesson plan following the template provided during their elementary math methods course. This same lesson would be digitally recorded and used to observe their teaching. The lesson plan and observation recording they would submit should be completed after week nine of their twelve-week student teaching placement. This was done for two reasons: first, their comfort level with the students, mentor teacher, and daily routines should be established due to being at the last third of their placement. Second, a major piece of their student teaching experience, their formal portfolio assessment, will be completed. The researcher felt that by waiting until after week nine, a stronger sampling of the quality of their teaching would be submitted for analysis. Finally, the researcher shared the timeline for the individual interviews. These interviews would take place after the participants' student teaching experience had ended. This was an additional precaution so as not to cause any undue stress within their student teaching experience. It was explained that the individual interviews would

also be conducted using Zoom technology, where the audio and video were recorded and used as additional data within the study. All five individuals who attended the informational meeting agreed to participate in the study.

Upon the completion of week nine of the student teaching experience, lesson plans and video recording data were collected. The final piece of data, individual interviews, was scheduled to occur just after the semester was completed, from December 18, 2023, to January 20, 2024. These interviews were conducted using Zoom technology as participants were located throughout the state. Also, by using Zoom, the video and audio could be recorded and then hand transcribed for authenticity.

After all three pieces of data were collected from each participant, the analysis started. The data was organized on a laptop computer and backed up using a private cloud storage service. The analysis followed Merriam's (1998; Merriam & Tisdell, 2016) methodological model for case studies, in congruence with Creswell and Poth's spiral process (2018).

These qualitative data analysis procedures occurred simultaneously with the data collection recommended by Merriam and Tisdell (2016) and Creswell and Poth (2018). A preliminary deductive analysis of the transcripts was first conducted using open coding. Any interesting or important information was highlighted during this process, and memos or notes were written in the margins. These highlighted words or phrases were labeled with preliminary codes. These codes became the working themes of the study and were noted in the same spreadsheet as all other data from this study.

As each participant's data was analyzed, pieces were compared with previously analyzed data, marking the preliminary stages of axial coding and the constant comparative method (Merriam, 1998). Timestamps were again noted for ease of accessibility within the research

process. All the data was reviewed multiple times to ensure all references to math self-efficacy were noted.

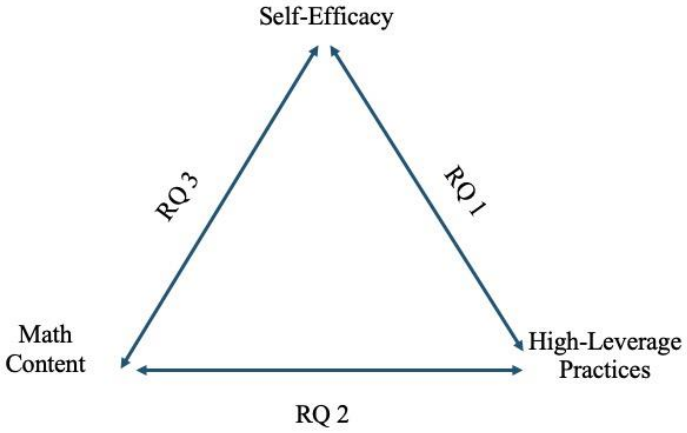
At the conclusion of the data analysis process, each participant was sent a transcript of their interview to complete the member-checking process. (Creswell & Poth, 2018). No revisions were recommended.

Presentation of Data and Results of the Analysis

This case study has three research questions. Each question connects two specific focus areas: self-efficacy, high-leverage practices, or math content (see Figure 3). The main research question was, “How did the logical and consistent implementation of three specific high-leverage practices (HLPs) during a twelve-week student teaching experience in an elementary classroom environment impact a teaching candidate's self-efficacy with mathematical content?” This question will be addressed by exploring the themes and how the themes serve as evidence to show changes in the student teacher’s self-efficacy.

Bandura (1977) defined self-efficacy as one’s personal conviction of a required behavior they believe they can successfully execute to produce an outcome. In this case study, high-leverage practices and teaching elementary math content are the behaviors applied to discover if a student teacher’s math self-efficacy is impacted. As the results are reviewed, all three research questions will be used to highlight the three major focus areas. The data was collected and analyzed simultaneously and will be woven within this chapter to provide a picture of the results.

Figure 3 Research Question Focus Areas



Emerging Themes

Four themes emerged from the data concerning these research questions. Participant quotes were used to connect the themes and provide data to answer each research question. Table 3 lists the initial codes that became the working themes. The labels for the themes “confidence” and “beliefs” came directly from the participants' language. The remaining themes of “attitude” and “action” were derived from the participants' descriptions.

Table 3 *Axial Coding: Themes derived from Open Codes*

Theme	*Open Code*
Confidence	• Trust • Comfort • Confident
Attitude	• Emotion • Positivity • Negativity
Actions	• Focus • Management • Movement • Routines
Belief	• Viewpoint • Assumptions • Effectiveness

Confidence. Student teachers described their confidence as related to teaching a math lesson, interacting with students, and collaborating with their mentor teacher. In relation to the teaching of math, comments were made on how trying different strategies helped build comfort with the math content and instill a feeling of trust in themselves. For example, Julia commented on her confidence growing when her mentor teacher recommended that she teach the lesson instead of a substitute when the mentor had to be gone for a day.

Attitude. Each student teacher's attitude toward mathematics was reflected through the observation of their teaching and during the interview session. During the interview session, student teachers recounted a number of mostly negative emotions related to their experiences with learning math as an elementary student. These highly charged emotions were assessed as attitudes. The analyzed observation data provided insight into student teachers' current attitudes toward teaching and learning mathematics, while the interview data provided past and current attitudes toward teaching and learning elementary math. For example, as previously stated, Emma began her student teaching with an apprehension or unease toward teaching math. "However, when I started to explain to the students what and how I was thinking through the problems, I noticed that I felt like I am better at math than I ever thought I would be."

Actions. When student teachers were asked if anything contributed to the increase in confidence and positive attitude toward teaching elementary math content, they described how certain routines, classroom management techniques including movement throughout the classroom aided in their feelings of successful teaching. Tanna shared, "I had to decide by what I saw and heard if students understood enough to go on or if I need to model more. I had to know what I was doing and keep the lesson going while managing everything."

Beliefs. All student teachers in this study shared that their beliefs toward elementary mathematics were not always positive. These beliefs often made them feel like they were ineffective at "doing" math, and thus, they believed teaching elementary math would be difficult. Their assumptions and viewpoints toward math began to unravel during the student teaching experience. Lindsey noted:

> I always felt very defeated as a young student; I knew what the students in my class felt. They needed to know I believed in them. The more I believed in them, the more they trusted and believed in me, and I noticed I began to believe I could be good at math, too.

These four themes are embedded in each of the three focus questions (see Figure 4) and work in conjunction to provide a continuous perspective on how the study impacts each student's math self-efficacy.

Figure 4 Themes and Focus

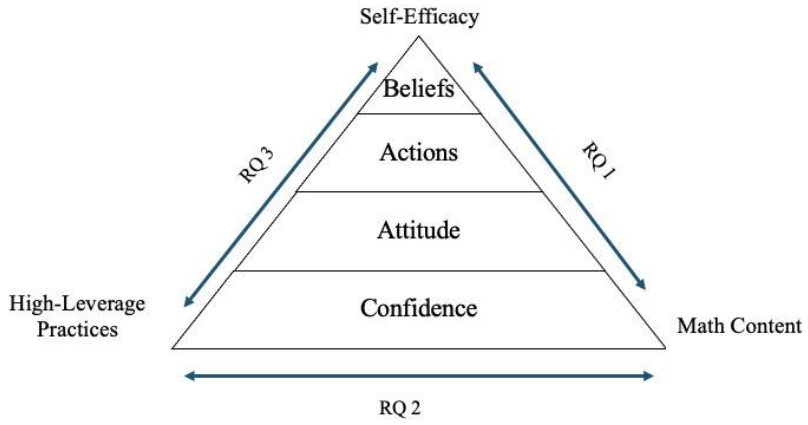


Figure 4 was constructed to incorporate the focus areas for each of the three research questions along with the four theme areas that were revealed through the analysis of the data.

Research Question

"How did the logical and consistent implementation of three specific high-leverage practices (HLPs) during a twelve-week student teaching experience in an elementary classroom

environment impact a teaching candidate's self-efficacy with mathematical content?" Research question one was the overarching research question in this study. To answer this question, an understanding of how high-leverage practices were implemented into the math content needed to be explored.

High-Leverage Practices

Before beginning their twelve-week experience, each student teacher had some knowledge of the three specific high-leverage teaching practices in this study. Lesson plans, observation videos, and interview data were examined for evidence of how student teachers perceived the relationship between high-leverage practices and math content.

The researcher reviewed each lesson plan and observation video for evidence of the three specific high-leverage practices. Table 4 shows the number of planned high-leverage practices, obtained through synthesizing the student teachers' lesson plans, and the enacted or performed high-leverage practice obtained by synthesizing the observation video.

Table 4 *Planned versus Enacted HLPs*

Student Teacher	Lesson Focus & Grade Level	HLP 1 Discussions		HLP 2 Modeling		HLP 3 Eliciting	
		Planned	*Enacted*	Planned	*Enacted*	Planned	*Enacted*
Emma	Multiplication 4th	3	*2*	5	*4*	5	*7*
Michelle	Addition 2nd	4	*3*	6	*8*	7	*9*
Lindsey	Multiplication 5th	2	*0*	6	*4*	6	*12*
Tanna	Data Analysis 4th & 5th	2	*5*	2	*2*	5	*13*
Julia	Multiplication 4th	4	*1*	2	*2*	2	*8*

HLP 1: Leading a Group Discussion. Within this study, the purpose of leading a group discussion was more than having elementary students be attentive and voice their opinions. When leading a high-leverage practice large group discussion, students and their teacher work together, using each other's ideas to build collective knowledge on a particular concept or idea.

Student teachers ask students to justify and defend their ideas or the ideas of others within the class. It is an opportunity for complex ideas to be discussed. For this to occur, an environment of trust and comfort between the student teacher and their students must be established. Student teachers elicit and probe students' thinking by asking open-ended questions to clarify ideas. In working toward establishing such an environment, Emma shared how she would plan out specific questions to assess students understanding throughout the lesson. "I actually wrote the prompt I wanted to ask on sticky notes and put them on the easel at the front of the room, this way I had access to it throughout the lesson. It really built my confidence." This small action became part of Emma's daily routine. She stated how she would use it as her informal daily assessment to note how well the students understood the lesson. Julia also shared how she led group discussions.

> I want to make sure I knew how students came up with the answer**.** I'd ask, how did you think about that? Can you talk us through it? Then, other students would raise their hands and either ask a connected question or add to the explanation. There was a lot of talking about how each of them solved it, how the method differed from what they did but we all got the same answer.

Julia's example again highlights how she managed the learning through active engagement in a class discussion to build math understanding. Michelle had a similar response,

> I just knew that by leading the conversation, we could work on the concept deeper. I needed to listen to how they would explain their solution versus me telling them how to solve it. This told me if I had to go back and reteach. I used this a lot as an informal assessment to check where my students were at.

Michelle's statement about using this informal assessment "a lot" shows her comfort with the high-leverage practice. When she states, "I just knew," this describes her positive attitude and beliefs in the effectiveness of implementing this high-leverage practice.

While the data from the student teachers' lesson plans indicated the intent to incorporate class discussions, the observation video revealed fewer discussions actually took place. What four out of five student teachers planned as discussions were actually a string of of low-level questions. The only student who carried out multiple classroom discussions with students was Tanna. In fact, she had increased the number of enacted versus planned class discussions. When presented with the data, Tanna responded,

> I feel comfortable leading large group discussions because I've had a lot of practice with these. Each day, we started with a discussion prompt for the first part of math class. Students are familiar with this routine and are open to sharing. These discussions allowed my students and I to connect multiple learning pieces with the lesson.

HLP 2: Explaining and Modeling Content, Practices and Strategies. Student teachers used various modeling content, practices, and strategies within their observation videos. Often, modeling math content is seen as using manipulatives or sketching a mathematical representation on the board for the class to see and use. However, as a high-leverage practice, it can also represent the breaking down of the thinking process. Sometimes referred to as "thinking aloud" or demonstrating the practice or strategy in real-time in front of students. Student teachers by nature are novice teachers thus "thinking aloud" in front of a class of students can sometimes be a tense or uncomfortable experience. Most of the HLP 2 evidence collected from the observation videos would be classified as think-aloud explaining and modeling. The demeanor observed in each student teacher's video evidence was regarded as calm. All depicted optimistic body

language as they demonstrated the math content and/or strategies to their students. Tanna's data analysis lesson was an excellent example of this, as she referred to several bar graphs on the board that her students were using to extrapolate data, she would rephrase student responses as a think-aloud, allowing the learning to be visible to all students within the class. Tanna could be heard joking and praising the students for taking risks as they explained how they solved the problem. She could be seen using hand gestures that implied "keep going" or as a "celebration cheer" to let students know they are on track. When asked about this, Tanna explained,

> In most of my lessons, modeling became part of the daily discussion with the class. I wanted to make sure all the students could access at least the basic skills of the content. I got really excited when I could see how close they were to figuring out the problem or method.

Tanna's example and response represent the themes of action, attitude, and confidence. Her ability to "see" the math content that students were processing in real-time and predict a reasonable outcome shows her confidence and positive attitude toward teaching mathematics.

When analyzing Lindsey's math lesson, the data showed that she had planned to model six specific math problems for the class. When cross-referencing the lesson plan data with the observational data, she modeled only four. When asked about her day-to-day routines and if her actual lesson ever varied from her plans, she stated,

> Everyone learns in different ways, and by walking around the room, I could see what and how each student was doing. I could quickly assess their comfort level with the material and ask them to share their strategy with the class. Often, I realized that we didn't need to solve all the problems I had planned, so I would adjust the lesson.

When any teacher, no matter the experience level, can informally assess students' understanding wan then adjust the lesson based on those results, this teacher has a strong understanding of the content they are teaching. This understanding supports the connection between high-leverage practice and math content. In this quote from Lindsey, the themes of attitude and belief could be inferred as she was making in-the-moment decisions that impacted students' learning. Thus, her math self-efficacy would be positive.

HLP 3: Eliciting and Interpreting Student Thinking. Some examples of how student teachers posed questions to help facilitate discussions or explain content were already discussed in this chapter. However, it should be noted that there is more to this high-leverage practice. This particular practice works to establish self-confidence in each and every student. Teachers must believe that all students are capable of learning any content. This is at the heart of self-efficacy. When teachers understand how their students are thinking through the material, they are better equipped to facilitate an atmosphere where all students feel as if they are capable of learning. In this case study, the number of enacted eliciting versus planned examples was increased by each student teacher. In two of the five cases, the numbers doubled, and in one case, it quadrupled, going from two planned questions to eight enacted questions, see Table 4. When asked in the individual interviews about the incorporation of this specific high-leverage practices into their instruction, Michelle responded,

> I used a lot of questions to dig deeper into how my second graders were applying the different strategies of addition. I needed to know the reasoning behind the specific strategy they were using. Otherwise, they just might be guessing. I wanted to know why they used that addition strategy. Could they explain to the class how they got their answer? This strategy, by itself, has changed how I feel about teaching math.

Emma had a similar experience as she implemented this high-leverage practice,

> I caught myself using eliciting questions more than I expected. When we were learning about this high-leverage practice, I didn't understand how it worked in a math classroom setting. Now, I use it every day. I connect it with our discussions and when I model different problems. I'd be lost without it.

Julia noted that she often combined the high-leverage practice of eliciting with the other high-leverage practice of explaining and modeling. Her teaching style lent itself to this combination, especially if a student was struggling with the math problems.

I would walk around the room and check in with students as they worked. I'd ask them how they got their answers. If they couldn't tell me, I would say let's talk it out; how did you start? Sometimes, if I saw a student was stuck, I would say let's draw it out or can you go get the math tools so we can think it through together.

High-Leverage Practice Summary.

The data from student teachers' implementation of the three specific high-leverage practices: leading a group discussion, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking, show that these strategies did impact their math teaching. While all three strategies were implemented with varying success, none of the student teachers in this study were discouraged. In fact, through the verification of the four themes, this data and subsequent data will show how the high-leverage practices led student teachers to higher math self-efficacy.

Math Content

The second research question is: "What are teaching candidates' understanding and perceptions of high-leverage practices related to math content?" Data was gathered from the

interview questions (Appendix C) and the observation video to answer this question. While all four themes were considered when answering this question, the theme that played an intricate role was confidence.

Math Self-Efficacy

The interview data was used primarily to answer this research question. The interview took place after the student teaching experience was completed. Table 5 presents data from each student's teaching in relation to confidence. As stated earlier in this chapter, Table 3, the theme of confidence was comprised of trust, comfort, and confidence. Also included in the data presented in Table 5 are connections to high-leverage practices if they could be made. Including the high-leverage practices highlights again how intertwined math self-efficacy is within teaching and learning.

Table 5 *Student Teacher's Responses Related to Theme of Confidence with Math Content*

Student Teachers	Response	HLP connections
Emma	• Being able to explain what I'm doing and why I'm doing that definitely made me feel more confident (Think-alouds)	Modeling
	• I know I need to act confident or at least think confidently about what I'm doing.	Modeling
	• When I was comfortable with the math, I felt a lot better about being able to teach it	Modeling
	• I know the day was successful when my students are engaged in the lesson	Eliciting
Michelle	• I am trying new strategies that I've seen other teachers do.	Modeling
	• I realize I can pick and choose how many problems we do. I didn't realize till math methods and then student teaching that we are in control of how and what we teach. I need to pay attention to what my students are telling me and use it to structure the lesson.	Eliciting
	• Math has become my most confident subject I teach, I actually enjoy teaching it.	

Tanna	• I had the situation where I taught each lesson twice, so I was able to learn from the first class of students and then adjust before the next class came in. That was great.	Modeling & Eliciting
	• I found myself thinking about changes I needed to make as I was teaching. I'd think I'm going to need to model this because of what they just said to show others that students thinking.	Modeling
	• I feel comfortable teaching math now at the end of student teaching, more than I was at the beginning.	
Lindsey	• I definitely found teaching strategies that work best for me and my classroom. This helped me not be as anxious about teaching math.	Modeling
	• The support of the team helped me feel at ease	
	• I asked lots of questions of my mentor teacher to help find my teaching style, I realized I could do it differently, I didn't have to stand in the front of the room. I could move about and check in with students.	Modeling
	• Once I found, my style, I found I was calling on the same students and needed to change it up. This made the lessons more engaging for all and I felt like students trusted me.	Eliciting
	• The math lessons I was able to teach taught me that I am capable of teaching math and that the students I had were learning from me. This was a huge confidence builder. I never thought I was good at math, now I know the more I teach it the stronger I'm becoming.	
Julia	• I referenced past college class material to help me manage the classroom and feel more comfortable teaching.	Modeling
	• I was comfortable teaching math because of the support I had from the grade level team of teachers. They let me try my own strategies and style that worked for me. I needed to move about the room and not just stay in one place. When I did this, I learned more about the students, and I felt like I could teach them better.	Modeling

When summarizing the comments made by student teachers in their interviews related to their overall confidence in teaching mathematics, the data shows it to be positive. All five student teachers' comments exhibit confidence. In some cases such as Michelle's, the data represents a 180-degree turn around in her outlook toward teaching and learning math. Michelle openly stated that she "hated" math for most of her upper elementary and beyond years. However, at the end of study interview she states that "Math has become my most confident subject I teach, I actually enjoy teaching it." Following up on what she believed influenced this change in her outlook

toward math, she credited it to her math methods teacher introducing her to number talks and how using this strategy led to her diving into and using questions to elicit students' thinking. "I didn't know math could be taught like this. When all you know about math is worksheets and time tests, who would like it? I've learned math can be much more hands-on and deeply conversational."

As teachers develop a strong understanding of content, they begin to focus on the "how" of teaching. Information such as what specific facilitation moves, conversations, and strategies to embed work for each situation becomes a key piece of lesson planning. Teachers move away from an assessment of learning to more of an assessment for learning or assessment as learning, where the students they teach are assessing their own learning.

Table 6 represents a wide variety of resources (Chappuis et al., 2012; Fenwick & Parsons, 2009; McNamee & Chen, 2005; Schraw, 2001; Sparks, 1999) showing how teachers can create and manage situations to assess students that arise within their classrooms. Student teachers alluded to this when they described the different routines and the need to be fully prepared to understand the math content of each lesson.

Influenced how teaching candidates prepared lessons.

As teachers, much of our understanding of content grows when we realize we don't know as much as we thought—the research behind metacognitive thinking, assessment as learning. Many novice and seasoned teachers will, sometime in their career, realize, "I didn't know what I didn't know," becoming aware of one's own learning or thinking process. Emma had noted, "If I'm being completely honest, I never thought I'd use these high-leverage practices as much as I did in math."

Table 6 Assessment OF/FOR/AS Learning

Assessment	Of Learning	For Learning	As Learning
Type	Summative	Formative	Formative
What	Teachers determine the progress or application of knowledge or skills against a standard.	Teachers and peers check progress and learning to help learners to determine how to improve.	The learner takes responsibility for their own learning and asks questions about their learning and the learning process, and explores how to improve.
Who	Teacher	Teacher & Peers	Learner & Peers
How	Formal assessments use to collect evidence of student progress and may be used for achievement grading on grades.	Involves formal and informal assessment activities as part of the learning and to inform the planning of future learning.	Learners use formal and informal feedback and self-assessment to help understand the next steps in learning.
When	Periodic report	Ongoing feedback	Continual reflection
Why	Ranking and reporting	Improve learning	Deeper learning and learning how to learn
Emphasis	Scoring, grades, and competition	Feedback, support, and collaboration	Collaboration, reflection, and self-evaluation

Asking more higher order thinking questions.

Three of the five participants shared in their interviews that implementing high-leverage practices influenced their preparation for teaching. Julia, Tanna, and Emma shared how they focused and planned more deliberate questions to ask within the learning segments.

Julia commented, “One thing I'm realizing I need to do better with is asking higher-order questions to see what they're thinking or, once they share, asking them another question, asking the right question.”

Tanna noted how being fully prepared in a lesson is important as we want students to be able to justify solutions and approaches/strategies used when solving math tasks. “Preparing areas in the lesson where the students can question or debate the concept. I think it has strengthened my math a little bit.” Later on in the interview, Tanna discussed how, at times, she needed to make in-the-moment decisions on where to take the lesson. “I’d think, okay, do I need to model this yes or no, given how the student responded to my question.”

Emma noted how she changed her delivery method to ensure she had possible questions available when needed.

> I actually wrote [my questions] on a sticky note and stuck it to the easel. I then had them on the corner so I could ask them. I used that as my informal assessment if they could answer them. I would say oh, can you repeat what they said that showed me that, okay, they're good, we can move on or no, maybe we should work on this a little bit more. Then, I used it to guide where I went next.

Being fully prepared.

Lindsey and Emma noted how being fully prepared helped them facilitate the lesson better. Emma noted,

> You need to be prepared. Know what you will teach and how you will teach it. When I first started teaching math, I'm like, oh no, of course I made a mistake. One of the first days, I didn't know how to solve the word problem. And I'm like, well, Emma, you should have looked at that beforehand. After that, I was nervous to teach math again, but once we started, I slowly began to feel comfortable.

Lindsey commented:

> If my students were struggling, I would try to catch it right away or make notes that I needed to go over and re-explain or go back to it as a whole class the next day. Especially when I first started, I was like, well, I don't know if I should draw this out or what I should do, but I became better each day. And I think doing that gave all the kids confidence.

Predominant Findings

A synthesis of these themes and the findings revealed how student teachers' attentiveness to how their students were learning mathematics and how implementing math discussion, modeling, and asking purposeful high-level questions helped strengthen their students' understanding and math pedagogy. The participants were making instructional decisions that benefited all students within the learning environment. No students were singled out for not "knowing" the concepts or if they struggled to understand the concept. The beliefs and attitudes that the student teachers expressed at the beginning of this study were being broken down and not passed on to the students they were teaching.

Self-Efficacy

The final research question is, "How do teaching candidates describe their self-efficacy beliefs related to their own mathematical content ability?" Again, interview data was used to answer this question. Table 7 presents this data. The theme of belief, as extracted earlier in this research, is defined as the student teachers' viewpoints and assumptions about their skills and effectiveness when teaching math.

Table 7 *Student Teacher's Responses Related to Theme of Belief in Math Content*

Student Teachers	Response
Emma	• I'm better at math than I thought I was • I'm better at math altogether • Even with some challenging student behaviors on a daily basis, I found myself very motivated to go in and teach.
Michelle	• When I realized I was getting through to them and they were learning. That was really cool, how I met their needs and helped them learn. • When I was young and up until a year ago during math methods course, I hated math. I had never seen math taught the way it was in that class. Asking questions instead of telling students what to do. • I'm eager to learn more math strategies to help the students I will teach in the future. Previously I looked at math as a set of steps that you told students to follow. Now I understand there is more to math than this.
Tanna	• I was worried I would be in a math classroom all day • It isn't my favorite subject, but I don't dread it anymore. • There were times I was nervous about the content so I would re-teach myself to prepare for the next day. My mentor teacher told me that is normal, we can't remember everything year to year. That helped me a lot.
Lindsey	• I struggled in math since the third grade. I have always felt as if I didn't get it. I'm terrible at math and it sucked the confidence right out of me. • I had the best experience. Everyone helped me grow and I was part of the team. • The longer I was with this class the more at ease I became. • When I was confident my students picked up on it and they seemed to reflect it in their attitude towards math.
Julia	• I loved being about to use different engagement strategies to teach. This is not the way I was taught math. I feel like this opened up a whole new way of teaching for me. • After this student teaching experience, I am much surer of myself when teaching math. When I was young, I didn't get math right away or as fast as everyone else. I think this convinced me that I wasn't good at math, but I am and I know that now.

Tanna's beliefs about her math ability changed from the beginning. She stated, "I feel more comfortable teaching math at the end of student teaching than I did at the beginning." When exploring why that may be, Tanna stated that she believed much of it was because she got to teach math multiple times a day and adjust the lessons to help students deepen their understanding.

When asked to reflect on what stood out about the math lesson she submitted as part of this study Lindsey stated:

> Many of the math lessons I taught during my twelve weeks proved to me that I am very capable of teaching math and that the students I had were learning from me. This was a huge confidence builder. I never thought I was good at math, but now I know the more I teach it, the stronger I'm becoming.

As a final question in the interview, Lindsey was asked how she knew if her day of teaching math had been successful. She responded:

> I could see that I was successful by the work and learning my students were doing each day. When that "light bulb" moment that veteran teachers talk about happens to you for the first time it is life changing.

Predominate Findings

All five participants agreed that mathematics was a subject they believed they were weak in at the beginning of this case study. Tanna, Julia, and Lindsey all remarked that now, as they begin their teaching career, they do not want any child to feel the way they felt in math class.

Tanna said she would cry each night at home because she felt she was not good enough. There were times in elementary school, she remembers, "I was pulled out into the hall for extra help. I could understand the math if someone showed me how to do it, but I couldn't always do it on my own."

Julia noted, "When I was young, I thought I wasn't good at math. Because I just that learned differently than everybody else."

Lindsey remembers being in the third grade when her low confidence in her math ability began.

I always did fine with math until, in third grade, we started subtracting three-digit by three-digit numbers. And I did not get it from then on. Math was just a struggle for me. It took all of my confidence away. I was like, gosh, I'm terrible at math. I remember working with the teacher's aide; a couple of us kids who were struggling got pulled out of the room so she could help us. And I was like, this means I'm just terrible at math, and that just sucked all the confidence out of me.

The predominant finding is that all five student teachers have an increase in their math self-efficacy. Emma shared:

I am better at math than I ever thought I would be. Now, I can confidently explain what I am doing and why I am doing it. This experience has helped me become more confident and better at math overall.

Julia realizes, "Now, as an adult, I've learned it's not that I wasn't good at math. It's just I didn't see math the way everyone else did. I didn't have the support to build my confidence as I do now." She went on to add:

I am more confident in teaching math, period! Even just talking about math wasn't something I ever felt comfortable doing. Overall, I'm still learning all the strategies I never learned, and I'm okay with actually learning them and seeing the benefit of why we need to teach them. Overall, I'm much more comfortable.

Synthesis

Teaching elementary mathematics can be a frightening experience if you feel inadequate or ill-prepared. All the participants in this study admit they felt inadequate in their mathematical understanding and ability before their math methods course. Through their university professors'

guidance and hands-on experience, they learned the mathematical material to prepare them for their twelve-week student teaching experience. However, an apprehension still existed.

This case study research explored three research questions, all seeking to understand if incorporating specific strategies could impact an individual's math self-efficacy. The hope of the research was that it would positively impact individuals' math self-efficacy. Student teachers were asked to plan, teach, and record a math lesson later in their student teaching experience. The intent was that by week nine of their twelve-week experience, these individuals would be comfortable with the students and the content, and their best work would be captured. While there is no evidence that this is not their best lesson, that information is unknown. Each individual had the freedom to submit any math lesson they chose. Their submissions of materials were analyzed and associated with the three specific high-leverage practices: leading a group discussion, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking.

Research Questions

With the design of the research questions for this case study, one must understand how each of the three research focus areas (see Figure 3) validates the themes of this study. Research questions two and three of this case study were composed in order to provide the data to explore research question one: “How did the logical and consistent implementation of three specific high-leverage practices during a twelve-week student teaching experience in an elementary classroom environment impact a teaching candidate’s self-efficacy with mathematical content?” (see Figure 4) Consequently, research question one will be discussed after research questions two and three have been examined.

Research Question Two

Research question two identified teaching candidates' understandings and perceptions of high-leverage practices related to math content. In other words, did student teachers find high-leverage practices beneficial to teaching and learning mathematics? The responses from student teachers would show they did find two of the three high-leverage practices valuable: explaining and modeling content, practices, and strategies and eliciting and interpreting student thinking. Through the exploration of the observation video data, there was not enough evidence to show that leading a group discussion was fully carried out in all five of the candidate's environments on the day of their recorded lesson. However, all student teachers felt that the high-leverage practices provided them with valuable information about how their students were learning and thus made them more confident in their facilitation of the learning.

Research Question Three

Research question three focused on understanding the student teachers' self-efficacy beliefs related to their math content ability after teaching for twelve weeks. The data for this question was obtained through the observation video and the interview conducted at the end of their student teaching experience. Themes were generated and analyzed from these data. There were several quotes highlighting how each student teacher's own views of their math beliefs had changed for the better. All five student teachers stated they had a greater likeness for teaching mathematics. While for some, it will never be their favorite subject to teach, they no longer dread it.

Research Question One

Research question one is the heart of this study. "How did the logical and consistent implementation of three specific high-leverage practices during a twelve-week student teaching

experience in an elementary classroom environment impact a teaching candidate's self-efficacy with mathematical content?" The findings of research questions two and three reveal that high-leverage practices can impact a teaching candidate's (student teacher) self-efficacy, and the results were positive. All of the student teachers shared positive views on math self-efficacy post-student teaching. Lindsey noted how she felt she is "capable of teaching math" now. Michelle's viewpoint changed to the point where she wanted to learn more, "I'm eager to learn more math strategies." Julia shared how she feels "like this opened up a whole new way of teaching for me." Tanna expressed how her comfort level with teaching math had also increased, and finally, Emma noted how "I'm better at math than I thought I was."

Summary

This chapter reports the findings of this research study, in which five participants in their last semester of an elementary or early childhood education teacher preparation program implemented three specific high-leverage practices in an elementary math classroom to study if this would affect their mathematical self-efficacy. The findings suggest the participant's math self-efficacy was positively impacted, increasing overall math confidence and mathematical self-worth.

In Chapter 5, the researcher will present a personal analysis of the study's findings in relation to prior research on math self-efficacy, specifically when connected to the implementation of high-leverage practices. The findings from this study have many implications and practical suggestions that can be drawn for implementation in future studies. The researcher will self-critique the overall study, discuss the limitations, and make suggestions to continue this study and/or similar studies in the future.

Chapter 5: Discussion, Implications, and Conclusions

Introduction

This study explored how five student teachers' math self-efficacy was impacted by implementing three high-leverage practices: leading group discussions, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking during their twelve-week student teaching experience. The focus of this chapter is a discussion of the compiled results of how mathematical content knowledge and specific high-leverage practices impacted five-student teachers' math self-efficacy. Chapter 5 will accomplish the following: evaluate the results of the study, determine if the study answered the research question, measure if the need of the study was met, compare the results of this study to previous research, suggest applicable implications for use in teacher preparation programs, provide the researcher's self-evaluation of the study in its entirety and finally make recommendations for future research.

Chapter 5 begins with a summary of the study, including the need and the significance of the study. A brief review of the literature is presented, the methodology discussed, and a synopsis of the study's findings is presented. Following the summary, the results of the study will be discussed in connection to the research questions. The next section, the conclusion based on the results, will compare the findings with the theoretical framework and previous literature and interpret the study's findings. The researcher will discuss the limitations, delimitations, and implications of the study as it pertains to influencing the design of teacher preparation programs. Finally, a recommendation concerning any future research on this study will be noted, personal growth from this endeavor discussed, and concluding thoughts presented.

Summary of Results

This study was necessary to discover how the logical and consistent implementation of high-leverage practices may impact student teachers' math self-efficacy. With the ongoing teacher shortage, it is monumental that future teachers feel they are capable of successfully teaching elementary mathematics. Teaching candidates who have an aversion to teaching mathematics may, in turn, pass that aversion, intended or not, on to the students they teach (Santoro 2011). This aversion, in turn, creates a cycle of individuals who feel they are unable to be successful in math.

This study was designed to explore if teaching candidates' specific implementation of three high-leverage practices with success could influence their own math self-efficacy. This, in turn, would provide an opportunity to influence the students they teach and possibly raise those students' own self-efficacy, again providing the student teacher with evidence of their own ability to teach elementary mathematics successfully. The significance of these overall results supports the implementation of high-leverage practices within teacher preparation programs. Teacher preparation programs are intended to provide teaching candidates with the most effective teaching and learning strategies based on up-to-date research.

This study supports the need for teacher preparation programs that embed the learning of high-leverage practices within them. By designing a program that allows teaching candidates to experience firsthand how to teach while still learning the art of teaching, individuals can have the latitude to make mistakes without being judged and criticized, thus not destroying their math self-efficacy or their K-12 students. Too often, teaching candidates attend lectures about how to teach math using out-of-date practices and have minimal lab hours. Instead, candidates could be learning and using the facilitation of large group math discussions where their students feel

comfortable discussing strategies in order to learn and understand mathematics. Teaching candidates would model and explain strategies, having students use an abundance of manipulatives where they could strategically build understanding versus just memorizing a procedure. In these teacher preparation programs; teaching candidates constantly elicit and interpret student thinking in order to facilitate a learning environment where students feel valued. "Patterns of bias related to race, gender, and other social identities, as well as stereotypes about subject matter competence" (TeachingWorks, 2019), no longer negatively influence teacher's beliefs in themselves or the capability of their students.

Literature Review

The literature reviewed to support this study was focused on two specific themes: self-efficacy and high-leverage practices through the content lens of elementary mathematics. This qualitative research is grounded in the work of Bandura (1991;1993) and Ball (2009) to provide a framework and overview theory to assist with data analysis. Bandura's (1993) research found that people's beliefs about their capabilities influence the results they achieve in their own lives. Specifically, related to this study, can the implementation of specific high-leverage practices influence an individual's math self-efficacy? Gibson and Dembo (1984) "found that teachers who have a high sense of instructional efficacy devote more classroom time to academic learning" (p. 140). A more recent study to support this (Shaughnessy et al., 2020) found that using high-leverage practices can assist teaching candidates in providing equitable instruction and identifying common patterns of student thinking. This reinforces the premise of this study, which is if teaching candidates implement high-leverage practices, is there an increase in their own willingness to teach or be engaged with the math content, thus building their understanding and math self-efficacy?

Campbell and Yeo (2023) conducted a similar qualitative self-efficacy study involving 25 preservice K-12 teachers enrolled in a mathematics education course from the University of Eastern Canada. Their study found that pre-service teachers seemed to attend to negative aspects of their mathematical collaboration rather than the positive aspects. By focusing on the negative aspects of collaboration, the pre-service teachers were able to think about how they might improve in the future. However, the research also presented how it may be beneficial for these individuals to consider both the negative and positive aspects of their collaboration while noticing their own K-12 students' work. These results also showed that if pre-service teachers continually focus on negative aspects of their collaboration, it may negatively influence their math identity. Thus, there is a need within teacher preparation programs to help future teachers overcome or lessen their apprehension of mathematics and the hypothesis behind the need for this current research study.

This study used the case study methodology to explore the association between teaching candidates' feelings and perceptions and implementing high-leverage teaching practices within an elementary math setting. Participants submitted their best examples of mathematical planning and teaching to be analyzed and then participated in individual interviews with the researcher. Purposive sampling was used to find the five individuals for this study. All were enrolled in a teacher preparation program at a Midwest University as either early childhood or elementary education majors.

Data analysis followed Merriam and Tisdell's (2016) and Creswell and Poth's (2018) methodology for case studies. The researcher transcribed the interviews and analyzed them using a system of open and axial coding, producing four specific themes that were coordinated with the study's three research questions (see Figure 4). The findings suggest the participant's math self-

efficacy was positively impacted, increasing overall math confidence and mathematical self-worth.

Discussion of the Results

This study is centered on the main research question: how did the logical and consistent implementation of three specific high-leverage practices during a twelve-week student teaching experience in an elementary classroom environment impact a teaching candidate's self-efficacy with mathematical content? Early in the research process, the researcher validated that all teaching candidates had a low belief in their own math self-efficacy. By the end of the study, all five teaching candidates acknowledged that their math self-efficacy had improved. The results confirmed that if given the opportunity to teach any content lesson, these individuals are now less likely to avoid teaching math. This study's findings support the assumption that if teaching candidates have the opportunity to implement high-leverage practices within field placements on multiple occasions, their understanding of how to teach math concepts purposefully and meaningfully will overall increase their own beliefs in their ability to "do" mathematics. This supports the research that teaching candidates must have multiple opportunities to be in the classroom practicing strategies that have a considerable impact on student learning (Kearney, 2015). Two additional questions were developed to answer the main research question. First, what are teaching candidates' understandings and perceptions of high-leverage practices related to math content? Second, how do teaching candidates describe their self-efficacy beliefs related to their own mathematical content ability?

Using these two questions, the researcher uncovered four associated themes (see Figure 4). The relationship between each research question and one or two themes became apparent as the predominant link to beginning to understand how to increase teaching candidates' math self-

efficacy. This supports the work by Gibson and Dembo (1984), who found that "high-efficacy teachers may achieve higher student engagement rates by utilizing whole class instruction and be better able than low-efficacy teachers to keep other students engaged while instructing small groups" (p. 578).

Conclusion Based on the Results

Upon analyzing the results, the focus of this case study fits into the wider field of math self-efficacy. Several conclusions can be drawn from this study regarding how specific strategies for teaching math content within teacher preparation programs assist in increasing math self-efficacy. First, the findings will be compared to the theoretical framework and previous literature. Then, the findings will be interpreted, and the researcher will provide reasonable explanations for why the study yielded these findings.

Comparisons of the Findings with the Theoretical Framework and Previous Literature

Self-Efficacy

Bandura (1993) defined self-efficacy as beliefs that individuals hold that influence how they feel, think, motivate themselves, and behave. An individual's self-efficacy can be filtered through four processes, as discussed in Chapter 2 (pp. 16 & 17). Three of the four processes are relevant to this study: cognitive, motivational, and selection see Table 8.

Table 8 Bandura's Self-Efficacy Processes (1993)

Process	Definition
*Cognitive	One's self-appraisal of their own capabilities.
*Motivational	One's belief if they are capable of attempting a task and setting goals to accomplish the task.
Affective	One's view of the environment as having an effect on their capabilities
*Selection	Due to an individual's belief in one's own capabilities they will proceed with a task or avoid the task.

These three self-efficacy processes relate to the four themes that emerged from the data of this study: confidence, attitude, actions, and beliefs. See Chapter 4 (pp. 9-11).

Confidence. The student teachers in this study shared how their confidence had increased by the end of their twelve-week experience. Phrases such as "I'm better at math than I thought I was" or "the stronger my confidence, the more it seemed to transfer to my students." These findings align with the self-efficacy process of cognition. The theme of confidence incorporated trust in oneself and ability and each person's comfort with math content. Participants shared how they didn't have to ask their mentor teacher or others for assistance as much as they had in the past. Their feelings of "being capable" or "being able to" teach and understand elementary mathematics increased. Crosswell and Beutel (2017) noted that an individual's capacity for resilience relies not only on their previous experience but also on additional factors such as confidence. Tschannen-Moran and Hoy (2001) also stated how efficacy beliefs influence teachers' persistence when things do not go smoothly and their resilience in the face of setbacks. In the informational meeting held before the onset of this case study, individuals shared how they had concerns about how well they would teach math as they didn't even like to discuss it with adults. By the end of their student teaching experience, phrases such as "I really like math" and "I want to learn more math" were shared by participants, showing an increase in overall confidence related to teaching elementary math.

Attitude and Beliefs. A teacher's attitude and belief, whether intentional or not, can transfer to students. Kagan (1992) suggested that novice teachers are not able to focus on the needs of their students until their own beliefs of self as a teacher are understood. As this study progressed, evidence was collected to show that student teachers were changing their assumptions of their own capabilities of teaching math. They began to view math from a positive

perspective. Phrases like “I didn’t know math could be taught like this” or “The students I’m teaching are learning the math.” The student teachers saw their own perceived effectiveness change within the twelve-week experience. This is similar to other studies, such as Oppermann and Lazarides’ (2021), whose findings stated, “that teachers provide higher levels of support, as perceived by the students if they feel more confident in their own ability to support their students’ learning” (p. 9).

Actions. The routines or actions implemented each day in classrooms coincide with a teacher’s beliefs, attitudes, and confidence. The strategies implemented relate directly to one’s self-efficacy. Tschannen-Moran and Hoy (2017) concluded that low self-efficacy affects teachers' efforts to prepare lesson plans and set student outcomes toward specific disciplines. In short, if teachers do not believe they can understand a specific concept, they will likely spend less time teaching it to their students.

The student teachers in this study noted that “how” they planned for lessons changed over the twelve weeks. They spent more time preparing lessons. They designed more hands-on, active learning, which allowed them to incorporate opportunities to assess what and how their students were building mathematical understanding. Student teachers were building their own understanding of the power of utilizing multiple high-leverage practices in daily lessons to facilitate math lessons. These student teachers were beginning to see assessment as formative instead of summative. They were incorporating assessments *for* learning instead *of* learning. See Table 6.

High-Leverage Practices

High-leverage practices are core tasks or strategies that teachers must execute to help students learn. Ball and Forzni (2009) stated, “Skillful teaching requires appropriately using and

integrating specific moves and activities in particular cases and contexts, based on knowledge and understanding of one's pupils and the application of professional judgment." Not only are these practices critical to helping students understand content, but they are also central to supporting equity in classrooms. High-leverage practices require teachers to facilitate opportunities for all students to share, justify, and defend ideas. This case study focused on three specific high-leverage practices: leading a group discussion, explaining and modeling content, and eliciting and interpreting individual students' thinking. Each was explored through the lens of elementary mathematics content.

The student teachers in this study repeatedly mentioned how implementing these three specific high-leverage practices increased their math self-efficacy. Each candidate shared specific quotes on how they felt their mathematical ability and their ability to teach elementary math increased (See Table 7). These results align with the research by Hackett and Betz (1989),

> Mathematics self-efficacy can be distinguished from other measures of attitudes toward mathematics in that mathematics self-efficacy is a situational or problem-specific assessment of an individual's confidence in her or his ability to perform or accomplish a particular task or problem successfully. (p. 262)

Also, research by DeMink-Carthew et al. (2017) found that when implementing high-leverage practices within classrooms, candidates in teacher preparation programs "gained a deeper understanding of how any given practice may be enacted depending on the underlying values brought to this practice by teachers" (p. 99). Wheatley's (2002) research reported how teachers with positive self-efficacy believe they can influence student outcomes. In this case study, comments by student teachers reflected similar results. "I knew what the students in my class

felt... I could see that I was successful by the work and learning my students were doing each day."

Summary of Conclusions

Overall, when this case study data was compared to the theoretical frameworks of Bandura's self-efficacy research and Ball's high-leverage practice work, there was a consistent parallelism of results. Teaching candidates, in this case, student teachers with low math self-efficacy described how their beliefs, confidence, and self-worth increased by repeatedly implementing high-leverage practices in their teaching of elementary math content. In the next section, the findings will be interpreted, and plausible explanations for how and why the study yielded these findings will be presented.

Interpretation of the Findings

The predominant finding is that all five student teachers have an increase in their math self-efficacy. To answer the larger question of what might account for these outcomes, it should be noted that all five student teachers had the opportunity to become familiar with high-leverage practices before their twelve-week student teaching placement. As part of the instructional curriculum in their teacher preparation courses at the Midwest University, where this study took place, the professors have begun implementing different high-leverage practices into their methods courses each semester. As teaching candidates, these five individuals were able to have first-hand experience within their methods classes in how to implement a large group discussion successfully and elicit and interpret student thinking. The high-leverage practices of explaining and modeling content practices and strategies was addressed, but it was not as detailed as the other two practices in methods courses. Thus, when their twelve-week student teaching placement began, they were able to focus on the teaching and learning of mathematics. It should

be noted that despite the previous practice in methods courses where learning of the three high-leverage practices began, there was room for improvement with each candidate, and all five candidates still began their student teaching experiences with low math self-efficacy and a strong belief that they would not be good math teachers. Kennedy (2010) stated that "the qualities teachers bring with them to their work are not enough to ensure better teaching practices. It is what teachers actually do that is most relevant to student learning" (p. 591).

The five student teachers in this case study were asked to teach math multiple days and weeks before submitting their "best" work for analysis. This case study was purposefully set up to be carried out toward the end of the twelve weeks, specifically after week eight. This researcher believes this did play a role in these five student teachers expressing more positive math self-efficacy due to the opportunity to "teach" more math. As they taught more math, they could get to know their students and identify their strengths and weaknesses. As stated by one student teacher, "When that light bulb moment that veteran teachers talk about happens for the first time, it is life-changing…I want more of those moments, and they only happen if I can understand what my students are thinking." When the student teachers have the opportunity for extended hands-on math experiences versus just role-playing or watching classroom videos of how another teacher interacts with students, their math self-efficacy increases.

Also, unbeknownst at the onset of this case study, four of the five student teachers had mentor teachers who supported their use of the high-leverage practices even if it was not a common routine within their building or district. This undoubtedly had an influence on the student teacher's math self-efficacy. They were in daily situations where someone supported their learning and development of pedagogy of practices. It was also noted that four of five student teachers expressed how they were welcomed as part of the school and grade-level teams.

Julia noted how she felt like a true team member whose opinion about teaching and learning mattered. When student teachers have someone who can support and guide them as they are still learning and practicing these high-leverage practices daily, it reinforces Bandura's (1993) research on how people's beliefs about their capabilities influence the results they would achieve in their own lives. It is this researcher's opinion that when the student teachers experienced success in teaching math during weeks one through eight, this strengthened their self-efficacy and was exhibited in their lessons, observation video, and interview data from weeks nine to twelve.

Finally, as these five student teachers implemented these high-leverage math practices, their depth of mathematical understanding also grew. Two of the student teachers specifically acknowledged that there were a few situations in which the math concepts that they were responsible for teaching caused them to have to review what and how to teach them. However, since they had already established a connection with their mentor teacher, if the situation arose, they felt comfortable asking for support. Student teachers noted that if they asked for support, they would then use their own experience to create a "think-a-loud" situation where they could model and explain the strategy to the students. This provides additional evidence of how high-leverage practices assisted these individuals in approaching the mathematics of the problem. This supports the research by Kahle (2008) that demonstrated that when teachers teach math topics, their confidence influences how they go about building an understanding of that topic and use a more hands-on, constructivist approach to teaching. These student teachers' comfort level with high-leverage practices by week nine correlated with their increased math self-efficacy when teaching mathematics.

Limitations

The concept for this case study developed out of the need to understand if an individual's math self-efficacy, which in most cases had been established and nurtured by others with similar beliefs over time, can be positively influenced or even changed. While the results have been reviewed, there is an area in which this study could be enhanced to allow for greater analysis. Multiple lesson plans and observation videos could be collected over time during the entire student teacher's twelve-week placement instead of just one submission. For example, perhaps three lessons could be collected: one during week two, one between weeks six and seven, and one between weeks eleven and twelve. This would allow the researcher to collect additional data revealing additional influences on how high-leverage practices meaningfully impacted student teachers' math self-efficacy.

A second limitation of this case study is while participation was voluntary, there were no male subjects in this study. Opening up and actively recruiting male and female participants could provide a wider scope for the data analysis. While there is an undisputed underrepresentation of females in Science, Technology, Engineering, and Mathematics (STEM) fields, does this equate to males having a higher math self-efficacy, or was the lack of male participants due to their being a traditionally low number of male early childhood and elementary majors as compared to females? Danan and Ashkenazi's (2022) research explores the relationship between a person's gender and spatial ability, math anxiety, and math performance. While their study was a larger quantitative study in which eighty-nine Israeli undergraduate students participated, the results concerning math self-efficacy showed females had a greater sense of low math self-efficacy and, thus, possibly a reason why there were fewer males participating in this case study.

A final limitation of this study was its focus on only three high-leverage practices and only in an elementary math classroom. Could the implementation of additional practices also affect other elementary content areas, such as science and literacy? How might a person's science or literacy self-efficacy be affected if specific high-leverage practices were applied to their elementary learning environment?

Delimitations

This study included a particular population of participants, elementary and early childhood majors. However, this study could be opened up to include additional education majors such as special education and those returning to acquire a master's in teaching degree who have a previously obtained, non-educational degree. At this particular Midwest University, undergrad special education majors are required to take the same math methods course as their peers seeking elementary and early childhood degrees. Also, looking at the perspective that individuals who are returning to college seeking an education degree as part of a master's program could deepen the data and provide additional viewpoints from those who essentially have already been in the workforce and are choosing to leave their current profession to become teachers. Prompting the question, did their math self-efficacy beliefs influence their first career choice?

Implications of the Study

This case study is a qualitative research endeavor to explore the math self-efficacy of future elementary and early childhood teachers and how teacher preparation programs can use this information to support future teachers. First, the implications of this theory will be discussed, followed by an analysis of the implications for teacher preparation programs. Finally, the practical implications for math education as a whole will be reviewed.

Theory

The purpose of this study was not to formulate new theories or disprove a theory but rather to add to the literature on math self-efficacy by providing an understanding that a person's math self-efficacy can be influenced and changed when provided with the proper support and strategies. Bandura's cognitive, social learning theory suggests that an individual's motivation is affected by outcome expectations, as well as the individual's own beliefs on how well they will or will not be able to obtain a goal, known as efficacy expectations (Bandura 1977, 1982). Bandura (1993) explains how our perceived self-efficacy affects the goals we set for ourselves: "Personal accomplishments require not only skills but self-beliefs of efficacy to use them well." (p. 119). Many individuals, young and old, believe that they are "not good at math" or that they can never be successful at computational math problems. In the United States, radio, television, and movies depict individuals who are "good at math" as having a higher intelligence than others and must have been given a specific DNA gene in order to be able to perform successful math computations mentally. This study provided evidence to support Bandura's theory that when the student teachers routinely implemented high-leverage practices over the span of their twelve-week student teaching experience in an elementary math environment, their math self-efficacy improved.

The second major framework theory cited within this study was that of Ball (1990), which stated that many teaching candidates' own "pre-college mathematics classes are unlikely to be adequate for teaching mathematical concepts and procedures meaningfully" (p. 463). This adds to the low math self-efficacy belief held by student teachers within this study. Student teachers documented through planning and observational evidence their ability to facilitate math discussions, explain and model specific content, practices, and strategies, and elicit and interpret

students thinking, all within the context of elementary mathematics confidently and correctly. Both Bandura's and Ball's theories support the idea that student teachers' low math self-efficacy can be influenced by incorporating specific high-leverage practices.

Teacher Preparation Programs

Teacher preparation programs provide teaching candidates with instruction in the art of teaching. By incorporating high-leverage practices within these undergraduate programs, colleges and universities are preparing more confident elementary teachers. According to Forzani (2014), traditional programs attempt to focus novices' learning on "academic or theoretical topics that may have only marginal relevance to the realities of the classroom." On the other hand, "practice-based" programs focus directly on the work of teaching. Infusing high-leverage practices into these practice-based programs will create additional opportunities for teaching candidates to experience a successful, effective model learning environment where they can practice the art of teaching and learning from their teaching, thus strengthening their overall math self-efficacy. The individual design of these experiences will be dependent on each state's educational licensing requirements; however, by providing teaching candidates with additional field placement experiences where they have a safe environment to practice and cultivate their strategies and content understanding, colleges and universities will be able to provide school districts with highly qualified teachers in elementary mathematics.

Practical Implications

This research may benefit or be used in many ways by professionals in the educational field, including those in elementary education and those who support advancements in education. At the elementary education level, it is essential that those teaching elementary school children understand how to teach math using high-leverage practices to deepen their and their students'

math content knowledge. Teachers need to continue to listen and facilitate mathematical situations where each student is seen as able to add value to the learning experience. These students are comfortable participating with their peers to explore solutions to problems. Having these types of open discussions allows the student to justify their thinking, strategies, and the processes used for solving the math problems. Likewise, when students are able to identify or reveal math misconceptions through class discussions, they are able to support their peers. Thus, an environment where all students feel valued has been created, positively impacting students' math self-efficacy. These classrooms are identifying, addressing, and applying math situations in real time versus continuing with the antiquated worksheet and computer rote skill processing programs, which seem to be in countless classrooms where teachers with low math self-efficacy are educating our leaders of tomorrow.

In relation to those who support advancement in teacher preparation educational programs, this study provides a pivot point for colleges and universities to incorporate lab classrooms as part of their overall learning experiences. University lab classrooms are in practice in some teacher preparation programs already across the United States. However, an additional benefit of implementing these lab or field placement classrooms would be increased teacher candidates' self-efficacy, which could then be explored if it also increases the elementary students who participate in math self-efficacy. Starting to break the ongoing belief that some people are unable to "do" math well.

These classrooms are a partnership with community schools where K-12 students and teachers could spend the day within specialty-designed university classrooms or within their own classrooms where multiple teaching candidates and professors are present and actively teaching and learning. According to Darling-Hammond (2006), educational experiences within

classrooms should be “extensive and intensely supervised clinical work tightly integrated with course work that allows candidates to learn from expert practice in schools that serve diverse students” (p.307). In support of changing how teacher preparation programs are designed, Boyd et al. (2008) stated:

> Field-based experiences for teacher candidates can better ensure teaching candidates have pre-service experiences that make them profession-ready from the start of their teaching careers and, equally important, these models have been found to be more effective in increasing student outcomes.

Finally, in this researcher’s opinion, the most significant implication for the educational field is that this study’s results support ways to end the aversion to teaching mathematics in early childhood and elementary classrooms. The math self-efficacy of five individuals math self-efficacy improved within this study. If we can imagine that these five teachers begin their careers in the fall of 2024 and teach for the next thirty years with an average class size of twenty students, they will have the potential to positively influence over 3000 students' math self-efficacy.

Recommendations for Future Research

The remainder of Chapter Five will discuss recommendations for future research. These are based on the data and methodological approach in relation to the research question: How does the logical and consistent implementation of three specific high-leverage practices during a twelve-week student teaching experience in an elementary classroom environment impact a teaching candidate's math self-efficacy?

Recommendations from the Data

Based on the study's data, future research is recommended in the areas of literacy and science methods related to implementing the same three high-leverage practices of leading a group discussion, explaining and modeling content, practices, and strategies, and eliciting and interpreting student thinking. As within any high-achieving K-12 school district, successful teams of educators work together for the betterment of their students. Teacher preparation programs are no different. When professors who educate the same teaching candidates can work together and simultaneously promote effective cross-curricular high-leverage practices, it stands to reason that the teaching candidate's overall teaching self-efficacy would improve. These candidates would be better prepared for their first year of teaching.

Recommendations from the Design

A second possible study would be based on the methodological design of the study. Changing to a mixed-methods study would allow additional data on beginning math self-efficacy to be recorded and compared to ending math self-efficacy. This study could incorporate *The Teachers' Sense of Efficacy Scale* developed at Ohio State University by Anita Woolfolk Hoy. Again, this particular study could also include the content areas of science and literacy.

Recommendations from the Data and Design

A final recommendation for future studies would be to conduct a longitudinal three-part study over several semesters. This study would begin in math methods classes, where teaching candidates will be introduced to high-leverage practices. Then, within part two, teaching candidates would deepen their understanding of a specific practice within an action research course. As part of the semester final project, data would be collected on specific high-leverage practices over a five-consecutive-day field placement. Finally, as the culminating piece of the

study, student teachers would again provide lesson plans, observation videos, and perhaps, depending on the study, quantitative, qualitative, or mixed methods, a survey on math self-efficacy could be included.

Conclusion

This conclusion will begin with a summary of the study, followed by the researcher's reflection and concluding thoughts.

Summary

This qualitative case study explored how implementing specific high-leverage strategies could impact the teaching of elementary mathematics and, in turn, affect a person's math self-efficacy. This study defines math self-efficacy as a person's beliefs about their ability to perform mathematical tasks related to understanding. This definition is based on Bandura's (1993) theory of self-efficacy, which states that:

> perceived efficacy in exercising control over stressors plays a central role in anxiety arousal. People who believe they can exercise control over threats do not conjure up disturbing thought patterns, but those who believe they cannot manage threats experience high anxiety arousal (p. 132).

This case study focused on early childhood and elementary student teachers and whether their math self-efficacy beliefs could change over a twelve-week period. Early childhood and elementary teachers are among some of the first influencers in young people's lives, and as such, they have the ability to pass on their own math self-efficacy beliefs to their students. Santoro (2011) stated that those who have an aversion to teaching mathematics may, in turn, pass that aversion, intended or not, on to the students they teach. If an aversion can be passed along to students, why not pass along an appreciation instead? Thus, the formulation of the research

questions.

There were three research questions associated with this study: First, how did the logical and consistent implementation of three specific high-leverage practices during a twelve-week student teaching experience in an elementary classroom environment impact a teaching candidate's self-efficacy with mathematical content? The second and third questions were constructed to answer the first question. These two questions were: what are teaching candidates' understanding and perceptions of high-leverage practices related to math content, and how do teaching candidates describe their self-efficacy beliefs related to their own math content ability? Student teachers were asked to submit a lesson plan and an observation video and then participate in an interview to answer these research questions. These data pieces were analyzed to determine themes associated with implementing high-leverage practices and understanding math content. After the results were analyzed, it was confirmed that all five participants' math self-efficacy was positively impacted, and their math confidence, belief in their own math content knowledge, and overall mathematical self-worth increased.

Researcher's Reflection

Upon reflection on this dissertation, the researcher has come to appreciate the importance of fully disclosing biases, professional skills, and assumptions, as well as any conflicts of interest that may influence the execution, analysis, or interpretation of the results. As a scholar-researcher and an individual with a strong passion for how mathematics should be taught in elementary classrooms, it was critical that these beliefs not become embedded and influence the participants within this study.

The literature review justified the development of this study and supported the researcher's personal beliefs that the research questions constructed were valuable and worth

pursuing. Possibly one of the more important pieces of this study was the construction of Figure 4 (see Chapter 4), showing how the themes and research questions supported each other. This piece helped to tell the story of five student teachers' math self-efficacy journey and supports the continued teaching of high-leverage practices within teacher preparation programs. Additional studies such as this must continue in order to enhance the misconception that many individuals hold in relation to their ability to be successful at mathematics. It is not just changing a person's math self-efficacy but instilling in individuals the strategies and skills to make math accessible for all learners, young and old.

References

Advancing Justice. (2020). TeachingWorks. https://library.teachingworks.org/our-perspective/on-justice/

Allinder, R. M. (1994). The relationship between efficacy and the instructional practices of special education teachers and consultants. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, *17*(2), 86–95. https://doi.org/10.1177/088840649401700203

Ball, D. (1990a,). Prospective elementary and secondary teachers' understanding of division. *Journal for Research in Mathematics Education*, *21*(2), 132–144. https://doi.org/10.5951/jresematheduc.21.2.0132

Ball, D. (1990b,). The mathematical understandings that prospective teachers bring to teacher education. *The Elementary School Journal*, *90*(4), 449–466. https://doi.org/10.1086/461626

Ball, D., Sleep, L., Boerst, T., & Bass, H. (2009). Combining the development of practice and the practice of development in teacher education. *The Elementary School Journal*, *109*(5), 458–474. https://doi.org/10.1086/596996

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191–215. https://doi.org/10.1037/0033-295x.84.2.191

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*(2), 122–147. https://doi.org/10.1037/0003-066x.37.2.122

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, *28*(2), 117–148. https://doi.org/10.1207/s15326985ep2802_3

Bandura, A., & Jourden, F. J. (1991). Self-regulatory mechanisms governing the impact of social comparison on complex decision making. *Journal of Personality and Social Psychology, 60*(6), 941–951. https://doi.org/10.1037/0022-3514.60.6.941

Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences, 107*(5), 1860–1863. https://doi.org/10.1073/pnas.0910967107

Bekdemir, M. (2010). The pre-service teachers' mathematics anxiety related to depth of negative experiences in mathematics classroom while they were students. *Educational Studies in Mathematics, 75*(3), 311–328. https://doi.org/10.1007/s10649-010-9260-7

Bloomberg, L. D., & Volpe, M. F. (2018). *Completing your qualitative dissertation: A road map from beginning to end* (Fourth ed.). SAGE Publications, Inc.

Boaler, J. (2015). *Mathematical mindsets*. John Wiley & Sons.

Briggs, A., Coleman, M., & Morrison, M. (2012). *Research methods in educational leadership & management*. SAGE Publications Ltd. https://doi.org/10.4135/9781473957695

Bursal, M., & Paznokas, L. (2006). Mathematics anxiety and preservice elementary teachers' confidence to teach mathematics and science. *School Science and Mathematics, 106*(4), 173–180. https://doi.org/10.1111/j.1949-8594.2006.tb18073.x

Buxton, L. (1981). *Do you panic about maths? coping with maths anxiety (mathematics)*. Heinemann Educational Books Ltd.

Campbell, T. G., & Yeo, S. (2023). Student noticing of collaborative practices: Exploring how college students notice during small group interactions in math. *Educational Studies in Mathematics, 113*(3), 405–423. https://doi.org/10.1007/s10649-023-10206-3

Chappuis, J., Stiggins, R. J., Chappuis, S., & Arter, J. A. (2012). *Classroom assessment for student learning: Doing it right - using it well (2nd edition) (assessment training institute, inc.)* (2nd ed.). Pearson.

Clark, C. M., & Peterson, P. L. (1986). *Handbook of research on teaching* (3rd ed.). Macmillan;.

Clark-Meeks, L. F., Quisenberry, N. L., & Mouw, J. T. (1982). A look at the mathematics attitudes of prospective teachers in four concentration areas. *School Science and Mathematics*, *82*(4), 317–320. https://doi.org/10.1111/j.1949-8594.1982.tb17201.x

Cohen, J. (2015). Challenges in identifying high-leverage practices. *Teachers College Record: The Voice of Scholarship in Education*, *117*(7), 1–41. https://doi.org/10.1177/016146811511700702

Collins, A., Brown, J., & Newman, S. E. (2019). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In *Knowing, learning, and instruction* (pp. 453–494). Routledge. https://doi.org/10.4324/9781315044408-14

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications, Inc.

Crosswell, L., & Beutel, D. (2017). 21st century teachers: How non-traditional pre-service teachers navigate their initial experiences of contemporary classrooms. *Asia-Pacific Journal of Teacher Education*, *45*(4), 416–431. https://doi.org/10.1080/1359866x.2017.1312281

Danan, Y., & Ashkenazi, S. (2022). The influence of sex on the relations among spatial ability, math anxiety and math performance. *Trends in Neuroscience and Education*, *29*, 100196. https://doi.org/10.1016/j.tine.2022.100196

Darling-Hammond, L. (1999). *Teaching as the learning profession: Handbook of policy and practice* (1st ed.). Jossey-bass.

Darling-Hammond, L. (2006). Constructing 21st-century teacher education. *Journal of Teacher Education*, *57*(3), 300–314. https://doi.org/10.1177/0022487105285962

Darling-Hammond, L. (2009). Teacher education and the american future. *Journal of Teacher Education*, *61*(1-2), 35–47. https://doi.org/10.1177/0022487109348024

DeMink-Carthew, J., Grove, R., & Peterson, M. (2017). The influence of the core practices movement on the teaching and perspectives of novice teacher educators. *Studying Teacher Education*, *13*(1), 87–104. https://doi.org/10.1080/17425964.2017.1289083

Duffin, L. C., French, B. F., & Patrick, H. (2012). The teachers' sense of efficacy scale: Confirming the factor structure with beginning pre-service teachers. *Teaching and Teacher Education*, *28*(6), 827–834. https://doi.org/10.1016/j.tate.2012.03.004

Fenwick, T., B.c., U. O., Parsons, J., & Alberta, U. O. (2009). *Art of evaluation, 2nd edition: A resource for educators and trainers* (2nd ed.). Thompson Educational Publishig.

Fink, A. G. (2013). *How to conduct surveys: A step-by-step guide* (Fifth ed.). SAGE Publications, Inc.

Forzani, F. M. (2014). Understanding “core practices” and “practice-based” teacher education. *Journal of Teacher Education*, *65*(4), 357–368. https://doi.org/10.1177/0022487114533800

Gibson, S., & Dembo, M. H. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology*, *76*(4), 569–582. https://doi.org/10.1037/0022-0663.76.4.569

Green, E. (2014). *Building a better teacher: How teaching works (and how to teach it to everyone)* (Illustrated ed.). W. W. Norton & Company.

Grier, J. M., & Johnston, C. C. (2009). An inquiry into the development of teacher identities in stem career changers. *Journal of Science Teacher Education*, *20*(1), 57–75. https://doi.org/10.1007/s10972-008-9119-2

Grootenboer, P., & Jorgensen (Zevenbergen), R. (2009). Towards a theory of identity and agency in coming to learn mathematics. *EURASIA Journal of Mathematics, Science and Technology Education*, *5*(3). https://doi.org/10.12973/ejmste/75277

Grosser-Clarkson, D., & Neel, M. A. (2019). Contrast, commonality, and a call for clarity: A review of the use of core practices in teacher education. *Journal of Teacher Education*, *71*(4), 464–476. https://doi.org/10.1177/0022487119880162

Grossman, P. (Ed.). (2021). *Teaching core practices in teacher education* (8th ed.). Harvard Education Press.

Grossman, P., Compton, C., Igra, D., Ronfeldt, M., Shahan, E., & Williamson, P. W. (2009). Teaching practice: A cross-professional perspective. *Teachers College Record: The Voice of Scholarship in Education*, *111*(9), 2055–2100. https://doi.org/10.1177/016146810911100905

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching*, *15*(2), 273–289. https://doi.org/10.1080/13540600902875340

Grossman, P. L., Smagorinsky, P., & Valencia, S. (1999). Appropriating tools for teaching english: A theoretical framework for research on learning to teach. *American Journal of Education*, *108*(1), 1–29. https://doi.org/10.1086/444230

Hackett, G., & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. *Journal for Research in Mathematics Education*, *20*(3), 261. https://doi.org/10.2307/749515

Herbel-Eisenmann, B. A., & Breyfogle, M. (2005). Questioning our patterns of questioning. *Mathematics Teaching in the Middle School*, *10*(9), 484–489. https://doi.org/10.5951/mtms.10.9.0484

Hiebert, J., & Morris, A. K. (2012). Teaching, rather than teachers, as a path toward improving classroom instruction. *Journal of Teacher Education*, *63*(2), 92–102. https://doi.org/10.1177/0022487111428328

Hong, J., Day, C., & Greene, B. (2017). The construction of early career teachers' identities: Coping or managing? *Teacher Development*, *22*(2), 249–266. https://doi.org/10.1080/13664530.2017.1403367

Hughes, G., Carney, M. B., Champion, J., & Yundt, L. (2023). Building mathematics professional development with an explicit attention to concepts and student opportunities to struggle framework. *Mathematics Teacher Educator*, *11*(2), 93–116. https://doi.org/10.5951/MTE.2021.0030

Hurlbut, A., & Krutka, D. (2020). Where do we start?: initiating a practice-based teacher educaiton program around high-leverage practices. *Journal of Teacher Education and Educators*, *9*(2), 169–199.

Jackson, C. D., & Leffingwell, R. (1999). The role of instructors in creating math anxiety in students from kindergarten through college. *The Mathematics Teacher*, *92*(7), 583–586. https://doi.org/10.5951/mt.92.7.0583

Jenset, I. (2018). Researching practice-based teacher education: Trends, challenges and recommendations for future research. *Acta Didactica Norge*, *12*(3), 3. https://doi.org/10.5617/adno.5933

John, P. D. (2002). The teacher educator's experience: Case studies of practical professional knowledge. *Teaching and Teacher Education*, *18*(3), 323–341. https://doi.org/10.1016/s0742-051x(01)00072-5

Kagan, D. M. (1992). Implication of research on teacher belief. *Educational Psychologist*, *27*(1), 65–90. https://doi.org/10.1207/s15326985ep2701_6

Kahle, D. (2008). *How elementary school teachers' mathematical self-efficacy and mathematics teaching self-efficacy relate to conceptually and procedurally oriented teaching practices* [Doctoral dissertation, The Ohio State University].

Kearney, E. (2015). A high-leverage language teaching practice: Leading an open-ended group discussion. https://doi.org/10.1111/flan.12128

Kebab, L., Bush, S. B., & Jackson, C. (2021). Leveraging student identities to develop pedagogical fluency. *Mathematics Teacher Learning and Teaching PK-12*, *114*(12), 948–955. https://doi.org/10.5951/MTLT.2020.0355

Kennedy, M. (1999). *Teaching as the learning profession: Handbook of policy and practice* (1st ed.). Jossey-Bass.

Kennedy, M. M. (2010). Attribution error and the quest for teacher quality. *Educational Researcher*, *39*(8), 591–598. https://doi.org/10.3102/0013189x10390804

Klassen, R. M., & Tze, V. M. (2014). Teachers' self-efficacy, personality, and teaching effectiveness: A meta-analysis. *Educational Research Review*, *12*, 59–76. https://doi.org/10.1016/j.edurev.2014.06.001

Knowing, learning, and instruction: Essays in honor of robert glaser (psychology of education and instruction series) (1st ed.). (1989). Routledge.

Korthagen, F., Loughran, J., & Russell, T. (2006). Developing fundamental principles for teacher education programs and practices. *Teaching and Teacher Education*, *22*(8), 1020–1041. https://doi.org/10.1016/j.tate.2006.04.022

Lau, W. F. (2021). Predicting pre-service mathematics teachers' teaching and learning conceptions: The role of mathematical beliefs, mathematics self-efficacy, and mathematics teaching efficacy. *International Journal of Science and Mathematics Education*, *20*(6), 1141–1160. https://doi.org/10.1007/s10763-021-10204-y

Loewenberg Ball, D., & Forzani, F. M. (2009). The work of teaching and the challenge for teacher education. *Journal of Teacher Education*, *60*(5), 497–511. https://doi.org/10.1177/0022487109348479

Loughran, J. (2008). *Handbook of research on teacher education: Enduring questions in changing contexts* (M. Cochran-Smith, S. Feiman-Nemser, D. J. McIntyre, & K. E. Demers, Eds.; 3rd ed.). Routledge.

Luciano Beltramo, J. (2017). Developing adaptive teaching practices through participation in cogenerative dialogues. *Teaching and Teacher Education, 63*, 326–337. https://doi.org/10.1016/j.tate.2017.01.007

Martino, A. M., & Maher, C. A. (1999). Teacher questioning to promote justification and generalization in mathematics: What research practice has taught us. *The Journal of Mathematical Behavior*, *18*(1), 53–78. https://doi.org/10.1016/s0732-3123(99)00017-6

Matsumoto-Royo, K., & Ramírez-Montoya, M. (2021). Core practices in practice-based teacher education: A systematic literature review of its teaching and assessment process. *Studies in Educational Evaluation*, *70*, 101047. https://doi.org/10.1016/j.stueduc.2021.101047

McAllen, R. R. (2010). Examining mathematics anxiety in elementary classroom teachers (Publication No. 3464333) [Doctoral dissertation, Unviersity of Connecticut]. *ProQuest LLC*.

McDonald, M., Kazemi, E., Kelley-Petersen, M., Mikolasy, K., Thompson, J., Valencia, S. W., & Windschitl, M. (2014). Practice makes practice: Learning to teach in teacher education. *Peabody Journal of Education*, *89*(4), 500–515. https://doi.org/10.1080/0161956x.2014.938997

McNamee, G., & Chen, J.-Q. (2005). Dissolving the line between assessment and teaching. *Educational Leadership*, *63*(3), 72–76.

Merriam, S. B. (1998). *Qualitative research and case study applications in education: Revised and expanded from case study research in education* (2nd Revised & Expanded ed.). Jossey-Bass.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.

Merriam webster dictionary (Revised ed.). (2004). Gardners Books.

Minnesota Professional Educator Licensing and Standards Board. (n.d.). *Office of Revisor of Statutes, 2018*.

Mizala, A., Martínez, F., & Martínez, S. (2015). Pre-service elementary school teachers' expectations about student performance: How their beliefs are affected by their

mathematics anxiety and student's gender. *Teaching and Teacher Education*, *50*, 70–78. https://doi.org/10.1016/j.tate.2015.04.006

National Council of Teachers of Mathematics. (2012). *Closing the opportunity gap in mathematics education* [Position Statement].

National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*. National Council of Teachers of Mathematics.

National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*.

National Council of Teachers of Mathematics. (2016). *High expectations in mathematics education* [Position Statement].

Newmann, F. M., Marks, H. M., & Gamoran, A. (1996). Authentic pedagogy and student performance. *American Journal of Education*, *104*(4), 280–312. https://doi.org/10.1086/444136

Pajares, F., & Miller, M. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. *Journal of Educational Psychology*, *86*(2), 193–203. https://doi.org/10.1037/0022-0663.86.2.193

Pajares, M. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, *62*(3), 307–332. https://doi.org/10.3102/00346543062003307

Patkin, D., & Greenstein, Y. (2020). Mathematics anxiety and mathematics teaching anxiety of in-service and pre-service primary school teachers. *Teacher Development*, *24*(4), 502–519. https://doi.org/10.1080/13664530.2020.1785541

Piaget, J. (1952). *The origins of intelligence in children*. W W Norton & Co. https://doi.org/10.1037/11494-000

Resnick, L. (1988). Treating mathematics as an ill-structured discipline. In R. Charles & E. Silver (Eds.). *The teaching and assessing of mathematical problem solving*, (pp.32–60). Reston, VA: National Council of Teachers of Mathematics.

Rist, R. (2000). Her classic reprint - student social class and teacher expectations: The self-fulfilling prophecy in ghetto education. *Harvard Educational Review*, *70*(3), 257–302. https://doi.org/10.17763/haer.70.3.1k0624l6102u2725

Ross, J. A., Bradley Cousins, J., & Gadalla, T. (1996). Within-teacher predictors of teacher efficacy. *Teaching and Teacher Education*, *12*(4), 385–400. https://doi.org/10.1016/0742-051x(95)00046-m

Rubie-Davies, C. M., Flint, A., & McDonald, L. G. (2011). Teacher beliefs, teacher characteristics, and school contextual factors: What are the relationships? *British Journal of Educational Psychology*, *82*(2), 270–288. https://doi.org/10.1111/j.2044-8279.2011.02025.x

Rule, A. C., & Harrell, M. H. (2006). Symbolic drawings reveal changes in preservice teacher mathematics attitudes after a mathematics methods course. *School Science and Mathematics*, *106*(6), 241–258. https://doi.org/10.1111/j.1949-8594.2006.tb17913.x

Saclarides, E., & Lubienski, S. (2021). Teachers' mathematics learning opportunities during one-on-one coaching conversations. *Journal for Research in Mathematics Education*, *52*(3), 257–300. https://doi.org/10.5951/jresematheduc-2020-0092

Sam, L., & Ernest, P. (2000). A survey of public images of mathematics. *Research in Mathematics Education*, *2*(1), 193–206. https://doi.org/10.1080/14794800008520076

Santoro, D. (2011). Good teaching in difficult times: demoralization in the pursuit of good work. *American Journal of Education*, *118*(1), 1–23. https://doi.org/10.1086/662010

Schaeffer, M. W., Rozek, C. S., Maloney, E. A., Berkowitz, T., Levine, S. C., & Beilock, S. L. (2021). Elementary school teachers' math anxiety and students' math learning: A large-scale replication. *Developmental Science*, *24*(4). https://doi.org/10.1111/desc.13080

Schifter, D., & Fosnot, C. T. (1993). *Reconstructing mathematics education: Stories of teachers meeting the challenge of reform* (1st ed.). Teachers College Pr.

Schraw, G. (2001). Promoting general metacognitive awareness. In *Metacognition in learning and instruction* (pp. 3–16). Springer Netherlands. https://doi.org/10.1007/978-94-017-2243-8_1

Sharan B. Merriam, Elizabeth J. Tisdell. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Wiley Professional Development (P&T).

Shaughnessy, M., & Boerst, T. A. (2018). Uncovering the skills that preservice teachers bring to teacher education: The practice of eliciting a student's thinking. *Journal of Teacher Education*, *69*(1), 40–55. https://doi.org/10.1177/0022487117702574

Singh, D. K. (2017). Role of clinical practice in teacher preparation perceptions of elementary teacher candidates. *Education*, *138*(2), 179–189.

Smolleck, L., Zembal-Saul, C., & Yoder, E. P. (2006). The development and validation of an instrument to measure preservice teachers' self-efficacy in regard to the teaching of science as inquiry. *Journal of Science Teacher Education*, *17*(2), 137–163. https://doi.org/10.1007/s10972-006-9015-6

Sparks, D. (1999). Assessment without victims: an interview with Rick Stiggins. *Journal of Staff Development*, *20*, 54–56.

Speybroeck, S., Kuppens, S., Van Damme, J., Van Petegem, P., Lamote, C., Boonen, T., & de Bilde, J. (2012). The role of teachers' expectations in the association between children's ses and performance in kindergarten: A moderated mediation analysis. *PLoS ONE*, *7*(4), e34502. https://doi.org/10.1371/journal.pone.0034502

Sykes, G., Bird, T., & Kennedy, M. (2010a). Teacher education: Its problems and some prospects. *Journal of Teacher Education*, *61*(5), 464–476. https://doi.org/10.1177/0022487110375804

Sykes, G., Bird, T., & Kennedy, M. (2010b). Teacher education: Its problems and some prospects. *Journal of Teacher Education*, *61*(5), 464–476. https://doi.org/10.1177/0022487110375804

Teaching core practices in teacher education (core practices in education series). (2018). Harvard Education Press.

Teaching core practices in teacher education (core practices in education series). (2018). Harvard Education Press.

TeachingWorks (2020). Eliciting and interpreting – teachingworks resource library. (n.d.). https://library.teachingworks.org/curriculum-resources/teaching-practices/eliciting-and-interpreting/

Tripathi, P. N. (2008). Developing mathematical understanding through multiple representations. *Mathematics Teaching in the Middle School*, *13*(8), 438–445. https://doi.org/10.5951/mtms.13.8.0438

Tschannen-Moran, M., & Hoy, A. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education*, *17*(7), 783–805. https://doi.org/10.1016/s0742-051x(01)00036-1

Valli, L., Croninger, R. G., & Buese, D. (2012). Studying high-quality teaching in a highly charged policy environment. *Teachers College Record: The Voice of Scholarship in Education*, *114*(4), 1–33. https://doi.org/10.1177/016146811211400405

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

Webel, C., & Yeo, S. (2021). Developing skills for exploring children's thinking from extensive one-on-one work with students. *Mathematics Teacher Educator*, *10*(1), 84–102. https://doi.org/10.5951/mte.2020-0003

Weiland, I. S., Hudson, R. A., & Amador, J. M. (2013). Preservice formative assessment interviews: The development of competent questioning. *International Journal of Science and Mathematics Education*, *12*(2), 329–352. https://doi.org/10.1007/s10763-013-9402-3

Wheatley, K. F. (2002). The potential benefits of teacher efficacy doubts for educational reform. *Teaching and Teacher Education*, *18*(1), 5–22. https://doi.org/10.1016/s0742-051x(01)00047-6

Wood, R., & Bandura, A. (1989). Impact of conceptions of ability on self-regulatory mechanisms and complex decision making. *Journal of Personality and Social Psychology*, *56*(3), 407–415. https://doi.org/10.1037/0022-3514.56.3.407

Woolfolk, A. E., & Hoy, W. K. (1990). Prospective teachers' sense of efficacy and beliefs about control. *Journal of Educational Psychology*, *82*(1), 81–91. https://doi.org/10.1037/0022-0663.82.1.81

Zeichner, K. (2012). The turn once again toward practice-based teacher education. *Journal of Teacher Education*, *63*(5), 376–382. https://doi.org/10.1177/0022487112445789

Appendix A

Participation Recruitment Letter

MINNESOTA STATE UNIVERSITY MOORHEAD

Educational Leadership Doctoral Program

christine.quisley@smsu.edu

Delivered Electronically to: Participants Email
Dear Participant Name,

You are invited to participate in a study of higher education institutional education. I want to learn more about how teaching candidates' feelings and perceptions are associated with implementing three specific high-leverage teaching practices within an elementary mathematical setting. The three high-leverage practices focused on with this study are; leading a large group discussion, modeling and explaining content, practices and strategies, and eliciting and interpreting student thinking. You were selected as a possible participant in this study because you are a student teacher in elementary education or early childhood education during the fall 2023 school year.

Your participation in this study involves completing the SMSU lesson plan template for 1-2 elementary math lessons and providing video recordings of you teaching these lessons to a classroom of students. After the lesson plans and videos have been submitted, an interview with me will last approximately one hour.

If you are willing to participate in this study, a consent form outlining the details and investigator details will be sent to you for a signature. Choosing to participate or not participate will in no way affect your future relationship with the education department at SMSU or the completion of your student teaching. You are free to withdraw from this study at any time, and withdrawal will not affect your student teaching semester outcome.

Please feel free to contact me if you have questions regarding this study. Christine Quisley, Educational Leadership Doctoral Student, christine.quisley@smsu.edu

Thank you for your time and consideration.

Christine Quisley

Christine Quisley
MSU Moorhead Educational Leadership Doctoral Student

Appendix B

Informed Consent Letter

Institutional Review Board

Please read this consent agreement carefully before agreeing to participate in this study.

Title of Study: The Effects of High-Leverage Practices on Teaching Candidates Math Self-Efficacy

Purpose of the study: The purpose of this study is to determine teaching candidates' feelings and perceptions associated with the implementation of high-leverage teaching practices within an elementary mathematical setting.

What you will do in this study: This study will collect evidence in the form of lesson plans and video teaching observations and conduct an interview with each participant. This data will then be analyzed and evaluated to see if the implementation of three specific high-leverage practices affects teaching candidates' math self-efficacy.

Time required: This study will take place during the fall 2023 university semester, which is approximately sixteen weeks.

Risks: There are no known risks to any teaching candidate.

Benefits: The results of this study will benefit teacher preparation programs as well a benefit current teachers to strengthen their own math self-efficacy.

Confidentiality: All interview questions, answers, lesson plans, and video lesson recordings will be kept on a password-protected computer and destroyed one year after the study has been completed.

Participation and withdrawal: Participants can withdraw from this study at any time without repercussions to their student teaching placement or grade.

Contact:

Christine Quisley
Co-Investigator
641-390-0865
Email: Christine.Quisley@smsu.edu

Dr. Michael Coquyt
Principal Investigator
Professor of Leadership and Learning
Lommen 216C
School of Teaching and Learning
College of Education and Human Services
Minnesota State University Moorhead
Email: Michael.coquyt@mnstate.edu

Whom to contact about your rights in this experiment:

Any questions about your rights may be directed to Robert Nava Chair of MSUM Institutional Research Board, at irb@mnstate.edu or 218-477-4308.

Agreement:

The purpose and nature of this research have been sufficiently explained, and I agree to participate in this study. I understand that I am free to withdraw at any time, and my withdrawal will not affect any future relationship with the educational department at SMSU.

In signing this agreement, I also affirm that I am at least 18 years of age or older.

Signature: _____ Date: _____

Name (print): _____

Appendix C

Interview Questions

1. Tell me about your student teaching experience. What did you enjoy? What content areas are you anxious about with potentially starting in your own classroom soon?
2. What strategies and or practices within your methods classes do you feel helped you be more comfortable with your student teaching experience?
3. While at [University Name omitted], you learned about and experienced specific high-leverage practices, such as leading a large group discussion, eliciting and interpreting students' thinking, and explaining and modeling content, practices, and strategies. How did you incorporate these into the day-to-day experiences of student teaching?
4. As you reflect on the math lessons you have been able to teach, what stands out to you about the experience?
5. Do you feel you were able to incorporate any of these high-leverage practices, such as leading a large group discussion, eliciting and interpreting students' thinking, and explaining and modeling content, practices, and strategies, into your mathematical instruction?
    a. Potential follow-up question—Can you tell me more about _____ and how you feel this particular practice influenced your teaching?
6. What are some ways you have seen your teaching be affected by using high-leverage practices of large group discussion, eliciting and interpreting students' thinking, and explaining and modeling content, practices, and strategies to teach students?
    a. Potential follow-up question—Can you tell me more about how you feel this particular practice influenced your teaching in mathematics?

7. Do you feel that any of these high-leverage practices, such as leading a large group discussion, eliciting and interpreting students' thinking, and explaining and modeling content, practices, and strategies, have changed the way you prepare for teaching content area content?
    a. Potential follow-up question—Can you tell me more about how you feel this particular practice influenced your teaching in mathematics?
8. Do you feel your feelings about teaching math are the same as before student teaching?