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The Impact Of Self-Efficacy And Mindset Of Elementary General Education Teachers Use Of Best Practices In Mathematics Instruction

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THE IMPACT OF SELF-EFFICACY AND MINDSET OF ELEMENTARY GENERAL EDUCATION TEACHERS' USE OF BEST PRACTICES IN MATHEMATICS INSTRUCTION

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ABSTRACT

The purpose of this quantitative study was to gather information from elementary teachers who use best practices to examine the impact of self-efficacy and mindset. Data was gathered from elementary teachers who use best practices in mathematics instruction. This research examined if location type (rural, suburban, urban), years of experience (less than 5 years, 6 – 15 years, more than 15 years) and differences in primary (grade levels K –2) and intermediate (grades levels 3 – 5) teachers exist regarding impact on teachers' mathematics self-efficacy and mindset. The research rationalized the mindset and efficacy trends of characteristics found in elementary teachers who use best practices in mathematics.

The study originated from the initial quest to discover the state of self-efficacy, mindset, and best practices of math instruction among Indiana elementary teachers in the mathematics classroom. From this inquiry, four additional questions were created and the null hypotheses were generated. Based on the findings of the inferential data in the study, there was a lack of statistical significance amongst best practice usage in mathematics, self-efficacy, and mindset based on location type, years of experience, and grade level. Using a six-point Likert agreement scale survey, the teachers responded to statements in three areas (best practices, mindset, self-efficacy) and demographic questions. The teachers indicated a similar level of agreement in the targeted areas. Therefore, I found statistical belief that the state of self-efficacy, mindset, and best practices of math instruction among Indiana general education elementary teachers was similar; therefore, the first three null hypotheses, which stated no significant difference existed were retained. However, the fourth null hypothesis was rejected due to the existence of a linear relationship between self-efficacy and mindset as predictors of best practice usage in mathematics instruction. Of the two predictors, mindset was the strongest.

This study can be used for hiring and retention, identification of targeted professional development needs, as well as to inform teacher preparation programs at the elementary level in the areas of mathematics. The identification of teachers who use best practices in mathematics can enhance and grow teacher capacity of self and peers while developing teacher leaders amongst schools and districts. Perhaps most beneficial to student growth and mathematics achievement is the calibration for growth of elementary teachers' mindset at the collegiate level.

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CHAPTER 1

INTRODUCTION

The nation is facing a continuously looming crisis as it relates to mathematics teaching, learning, and proficiency. The U.S. was ranked number 38 out of 71 countries on the most recent 2015 PISA exam results in mathematics (Herman, 2019). In 2015, America's National Assessment of Educational Progress (NAEP) scores yielded declining math scores for grades 4 and 8, nationwide for the first time since 1990 (Herman, 2019). The 2015 Trends in International Mathematics and Science Study (TIMSS) revealed the U.S. ranked number 10 out of 48 countries for 4th graders' average math scores, with the U.S. landing behind countries such as Japan, South Korea, Taiwan, China, and Russia. As the U.S.'s rivals produced better mathematicians, the U.S. found itself lagging further and further behind the competition. Current trends in mathematics proficiency point to the state of Indiana as mediocre, while the Northwest Indiana region seems to be missing the mark on mathematics growth and proficiency on state standardized exams.

Hattie and Zierer (2018) listed "collective teacher efficacy as having the greatest [impact] on student" learning (p. 26), and in the preface of the book, *10 Mindframes for Visible Learning*, the authors state "expertise requires both competence and an appropriate mindframe" (Hattie & Zierer, 2018, p. xxi). So how can we ensure the most capable and effective people are teaching? This research is being completed to assist higher education programs, teacher preparation programs, educational leadership programs, and K–12 educational institutions in identifying key characteristics that appear in effective elementary mathematics teachers. These teachers possess the self-efficacy that will inspire the desire to learn and engage with mathematics in students, use best practice to help students understand the content, communicate the *how to* of mathematics, and possess a growth mindset that allows them to develop a safe learning environment. This environment will promote risk-taking, where students can feel free to *fail forward* and learn (Reys & Fennell, 2003).

Jo Boaler (2016) boasted about how important it is for students to take more math courses. The study linking math courses taken and students' earnings by Rose and Betts in 2004 showed when high school students took more than the minimum required math courses, their potential to earn higher wages than their counterparts was higher. They also predicted that taking advanced math courses would result in a salary increase of up to 19.5%, lasting approximately a decade after high school. The longitudinal study examined the effects of high school courses on earnings almost ten years after graduation by linking transcript data to identify courses taken with job placement. The study included 30,000 students from the High School and Beyond (HSB) (United States Department of Education. National Center for Education Statistics, 1992) sophomore cohort followed from 1980 to 1992. The study also explored the income gap between the earnings of low-income and middle class families and the effect advanced courses had on that gap. Variables used in the study included: demographic information, math credits earned in six math categories (high school), parental information (income, education), school characteristics (student-teacher ratio, books per pupil, teacher level of education), and the highest degree obtained by the participant. The study revealed that math courses taken make a difference in the lives of students. Students' math classes have a strong correlation to earnings, even ten years after graduation (Rose & Betts, 2004).

Additionally, students who took advanced math classes learned ways of working together, critical thinking, reasoning and logical strategizing. These skills make them more productive in their jobs. Students who took advanced math learned strategies for approaching complex mathematical situations and skills that were directly related to specific occupations (Rose & Betts, 2014). These skills made them more employable and better candidates for promotion and leadership roles, giving them the advantage of acquiring higher paying positions over those who did not take the advanced math courses (Boaler, 2016).

Boaler (2016) also elaborated on how mindsets can change from fixed to growth, which promote more positive and successful learning approaches overall. Students with a growth mindset tend to have more positive brain activity, especially when they make mistakes, promoting opportunities to focus their attention on the correction of errors. There are deficiencies in the thought process that supports a specific developmental readiness for certain mathematic topics and thinking; however, educators with a growth mindset begin to view students as ready based on their experiences, and they understand that experiences combined with higher expectations help those students develop a growth mindset.

According to a study conducted by Swars (2005), teacher efficacy is aligned with classroom instructional strategies and teachers' willingness to try new strategies. The qualitative study used an interview protocol involving four elementary pre-service teachers. Results showed their willingness to use reform-based, innovative strategies is linked to past experiences with mathematics and their experience of teachers' perceptions of effectiveness. Teacher efficacy is defined as teachers' beliefs about how effective they are in classroom instruction (Thomson et al., 2019). Math teacher efficacy has a strong link to past mathematics experiences and performance (Swars, 2005; Thomson et al., 2019). Self-efficacy presents as a strong determining factor in successful outcomes. Effective math teaching has a positive effect on student learning. However, elementary teachers, as generalists, generally do not have the high self-efficacy needed for mathematics teaching and instruction (Thomson et al., 2019). Teachers' perception of their own self-efficacy is an important influence on teachers' and students' success in the classroom (Klassen et al., 2011).

In Klassen et al.'s (2011) review of literature of self- and collective teacher efficacy studies from 1998 to 2009, it was revealed that teachers with strong efficacy possess a skill set that promotes teaching and learning among students. The review included 218 studies that included quantitative, qualitative, mixed methods, survey, phased, experimental designs. The results of the study reflect the need for more research on self-efficacy and collective efficacy. The study reported that the researchers were unable to conclude a relationship exists between efficacy and other outcomes. Therefore, teacher efficacy also has strong influence on students' motivation, leading to higher student achievement. All of this has a positive effect on teachers' beliefs about their ability to teach effectively and the instructional practices they use.

Teacher resilience is also pertinent to teacher efficacy as those who are deemed resilient have higher confidence levels, think more deeply, and problem solve more routinely. They feel strongly about their ability to meet students' needs, which, in turn, brings increased self-efficacy, risk-taking, and perseverance (Fry, 2009). Fry (2009) conducted a qualitative inquiry where four novice teachers participated in interviews and observations to find that teacher education programs play a major role in teacher efficacy and resilience. The student teaching placement can reduce attrition and provide a mentoring partnership for support and efficacy promotion

In order to improve the mathematics achievement of students in the U.S., a longitudinal quantitative study, involving 13,393 participants (kindergarten and first grade children) revealed identifying effective, evidence-based and practice-based instructional practices in mathematics is vital (Morgan et al., 2015; Osburn et al., 2011). Those evidence-based practices (best practices) include student-centered practices, such as problem solving with multiple solutions, peer collaboration, and real-world mathematics (Morgan et al., 2015). In 1938, Dewey was a proponent of student interests driving teacher instruction. He wrote about traditional classrooms not being the best learning environment for young learners. For the quality of mathematics instruction to improve in elementary schools, it is important to point to teachers as the biggest influence on students' achievement (Dewey, 1938; Hattie & Zierer, 2018). Students' views on their own mathematics abilities are formed in elementary school, therefore foreshadowing their own thoughts on their future abilities (Reys & Fennell, 2003).

In classrooms where learning is the focus, both teachers and students are able to make learning a priority (Ritchhart, 2015). Meaningful, quality education means the students are "engaged and active thinkers, able to communicate, innovate, collaborate, and problem-solve" (Ritchhart, 2015, p. 19). These skills are regarded as best practices of the 21st century, which ultimately prepare students for the global society. Together, these skills also create a network of usable knowledge for students.

Statement of the Problem

Schools have the responsibility of finding elementary teachers who can inspire young students to learn, deliver effective instruction (i.e., effectively scaffold and break-down content for mastery), and create a safe, trusting academic environment. Often, this type of teacher has become a rarity, and increasingly more difficult to identify and develop. Mathematics is a challenging subject area in which students are asked to problem solve, demonstrate understanding, apply, analyze, and synthesize knowledge. And yet, K–12 students are expected to learn mathematics from teachers who are challenged with their own understanding of mathematics (Boaler, 2016). In 2000, the Principles and Standards for School Mathematics (2000) stated, “Effective teaching requires knowing and understanding mathematics, students as learners, and pedagogical strategies” (p. 17).

Elementary teachers are asked to get excited about, teach, and translate a language they often do not understand. Most elementary teachers are not licensed as mathematics content specialists. Instead, they are challenged with becoming masters of many subjects while developing a conceptual understanding of each content area. It is important that elementary teachers understand the nature and extent of the vital role they play in teaching mathematics to their students. It is also vital that school districts are able to ensure students are exposed to teachers with a conceptual understanding of mathematics content, as well as best practices for students to master mathematics (Reys & Fennell, 2003). Effective instruction typically comes from understanding; therefore, the lack of attention to conceptual understanding of mathematics in teacher preparation and pre-service programs, and the vague preparation for rigorous mathematics provides a very small opportunity to change teachers’ beliefs about mathematics. Consequently, this situation does not inspire teachers to teach differently from the manner in which they were taught. And, the expectation that elementary teachers would be math specialists with specific mathematics (and other subjects) knowledge is not reasonable. Therefore, it is vital that educators promote and target the use of best practices in mathematics in students’ foundational years, which will provide for stronger mastery in later years (Youmans et al., 2018).

The use of a narrow mathematics curriculum with elementary students can have lasting negative effects. When students' experiences in mathematics only include rules, facts, and procedural memorization and regurgitation, these students are less likely to understand the power of mathematics or to carry an interest in math into secondary education (Reys & Fennell, 2003). Students' proficiency in mathematics decreased dramatically in the state of Indiana as the state strengthened the Indiana Academic Standards with the addition of the new Indiana Mathematics Process Standards, based largely on the nation's Common Core standards (Elliott, 2013). Data Center and Reports (2021) identified the most current Indiana Learning Evaluation Assessment Readiness Network (ILEARN) scores as:

- 58.7% of Indiana's 3rd grade students were proficient in mathematics
- 54% of 4th grade students were proficient
- 47.8% of 5th grade students, and 46.4% of 6th grade students were proficient
- The scores declining even more in 7th and 8th grades (42% and 38% respectively)

According to Elliott (2013), "Indiana policy recommendations emphasized a shift in rigorous expectations to reflect meaningful data and the identification of support for future student success" (para. 5). In addition, assessment and adaptability features allow ILEARN to better measure each student's College and Career Ready (CCR) level of mastery, while identifying where additional instruction might be necessary. "ILEARN achievement levels [included]: Below Proficiency, Approaching Proficiency, At Proficiency, and Above Proficiency" (Indiana Department of Education, n.d., para 5).

> The Indiana Academic Standards for Mathematics are the result of a process designed to identify, evaluate, synthesize, and create the highest quality, rigorous standards for Indiana students. The standards are designed to ensure that all Indiana students, upon

graduation, are prepared for both college and career opportunities. In alignment with Indiana's Every Student Succeeds Act (ESSA) plan, the academic standards reflect the core belief that all students can achieve at a high level (Indiana Department of Education, n.d., para. 1).

The standards promote a constructivist learning perspective which encourages new and innovative ways of teaching and learning. These new ways for students also require new ways of teaching and learning for teachers (Lowery, 2002). In a qualitative case study conducted by Lowery, 31 respondents revealed data that suggest university methods courses are unable to provide the necessary authentic, hands-on training needed by teachers to be successful Bandura maintained efficacy expectations determine how much effort people will put toward achieving a task and how long they will persist in the face of obstacles and challenges (Bandura, 1977). Largely, self-efficacy determines grit, the intersection of passion and perseverance (Duckworth, 2019). Bandura also stated, "The stronger the perceived self-efficacy, the more active the efforts." (Bandura, 1977, p. 194). Since the use of effective instructional practices in mathematics by teachers and teacher self-efficacy are factors in student achievement, it is imperative to examine them closer (Swars, 2005).

Purpose of the Study

The purpose of this quantitative study is to gather information from elementary teachers who use best practice to examine the impact of self-efficacy and mindset. This research examines the impact self-efficacy and mindset have on the use of best practices in mathematics instruction. The study addresses whether location type, years of experience, and differences in primary and intermediate teachers exist, regarding impact on teachers' mathematics self-efficacy and mindset. The research rationalizes the mindset and efficacy trends of characteristics found in elementary teachers who use best practices in mathematics. The research gives insight into what teachers who use best practice do to get students engaged in learning mathematics. This study will also inform hiring practices and recruitment of effective elementary teachers, as well as identify characteristics of educational leaders who use best practice in mathematics. The research proposes that those teachers who use best practices in mathematics possess a conceptual knowledge of mathematics and are able to effectively communicate and explain content to students, believe in their own mathematics teaching ability, and have a growth mindset that promotes a safe, trusting learning environment for students to learn. Teachers who inspire the desire to learn mathematics in students make content meaningful, important, and engaging. Teachers who effectively communicate and explain the mathematics are those who understand the content and possess the critical thinking skills necessary to solve complex content. Teachers with positive mathematical mindsets create safe learning environments and foster classrooms where growth is promoted and facilitated.

Significance of Study

The intent of this study is to examine elementary mathematics instruction to identify teacher qualities that will lead to increased mathematics achievement for students in the state of Indiana. The information from this study will be used to inform pre-service teacher programs and school districts looking to hire elementary teachers who possess strong self-efficacy and a mathematical mindset for growth as key indicators of effective mathematics instruction. The information from this study can be used to develop and implement robust professional development focused on elementary mathematics, inform hiring practices, and identify teachers who use best practices in elementary mathematics. The study could also assist principals and district leaders in identification of leaders in mathematics education. This study is intended to support raising mathematics achievement in K–12 classrooms and the U.S.

Research Questions

In an effort to predict the impact of self-efficacy and mindset on best practices in mathematics instruction, this study will address the following questions:

1. What is the state of self-efficacy, mindset, and best practices of math instruction among Indiana general education elementary teachers?
2. Is there a statistically significant difference based on location type on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana general education elementary teachers?
3. Is there a statistically significant difference based on years of experience on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana general education elementary teachers?
4. Is there a statistically significant difference based on grade level area on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana general education elementary teachers?
5. Does the self-efficacy and mindset composite scores explain a statistically significant amount of variance within the best practices of math instruction composite scores for Indiana general education elementary teachers?

Definition of Terms

Best practices in mathematics refers to "evidence-based with evidence-based practice" (Osburn et al., 2011, p. 18) as what can be documented and "meaningful, quality education that shows the students as engaged and active thinkers, able to communicate, innovate, collaborate, and problem-solve" (Ritchhart, 2015, p. 19). *Best Practices in mathematics* also describes explicit evidence-based mathematics instruction (Greene, 2021).

Co*nceptual understanding* is in regard to a network where relationships and discrete (separated or detached) information connect (Österman & Bråting, 2019). Conceptual understanding takes place as a result of a combination of fluency and skills. Problem solving and basic skills are both necessary for conceptual understanding to exist (Wu, 1999).

Growth mindset is considered:

> The belief that your basic qualities are things you can cultivate through your efforts, your strategies, and help from others. Although people may differ in every which way—in their initial talents and aptitudes, interests, or temperaments—everyone can change and grow through application and experience. People with a growth mindset feel their skills and intelligence can be improved with effort and persistence (Boaler, 2016, p. 7)

Mathematical Mindset is when people:

> Approach math knowing that math is a subject of growth and the user's role is to learn and think about new ideas. Successful math users have an approach to math as well as mathematical understanding that sets them apart from less successful users. They approach math with the desire to understand it and to think about it, and with the confidence that they can make sense of it. Successful "math users" search for patterns and relationships and think about connections. (Boaler, 2016, p. 8)

Past math experiences refer to a person's previous encounters with mathematics.

Teachers who use best practices are teachers who use effective, "evidence-based or practice-based" (Osburn et al., 2011, p. 18) instructional strategies and [have a] "willingness to embrace innovations" (Swars, 2005, p. 139).

Self-efficacy "is a personal belief in one's capability to organize and execute courses of action required to attain designated types of performances" (Artino, 2012, p. 76).

Years of experience references the number of years a teacher has worked in the K-12 education setting. These years are recorded and recognized by the IDOE.

Summary and Organization of the Study

This quantitative study is divided into five chapters. Chapter 1 includes the statement of the problem, purpose of the study, research questions, null hypotheses, definition of terms, and significance of the study. Chapter 2 reviews the literature related to the history of mathematics education, mathematics reform efforts and politics, instruction, best practices in mathematics instruction, self-efficacy, and mindset. In Chapter 3, I describe and outline the data collection procedures and analysis. In Chapter 4, I introduce the quantitative analysis of the null hypotheses. Chapter 5 concludes the study with a summary of findings, conclusions, implications, and recommendations.

CHAPTER 2

LITERATURE REVIEW

Teachers' use of best practices in mathematics instruction and efficacy, along with mindset, have an impact on student achievement. I investigated research that relates to best practices in mathematics instruction, teacher self-efficacy, and mindset in mathematics. First, I included the history of elementary mathematics education. I then explored information regarding mathematics education reform efforts. Also, I addressed the political influences impacting reform in mathematics education. Next, I examined the evolution and factors leading to the development of the Indiana Academic Standards. I further reviewed the research on effective mathematics instruction. The remaining elements of the literature review defined and reviewed operational skills, the relationship between procedural and conceptual knowledge, and explored the impact of teacher efficacy on learning (for students and teachers). I also investigated teacher efficacy and mindset in mathematics, reviewed select challenges for teachers in delivering effective mathematics instruction today, and concluded with a summary of elementary mathematics education as it compares now to the past.

History of Mathematics Education

Mathematics education has been an ongoing, high stakes war for at least the past century. Throughout the last century, common themes in education have cycled as *the answer* to mathematics' education. There has been a continuous battle between those who support constructivism, those who support progressivism, and curriculumists (also known as parents who opposed the NCTM Standards). Curriculumists were parents who had strong feelings about how mathematics should be taught in schools (Barnhill, 2011). They preferred an organized, logical, curriculum that could be taught to all students (Klein, 2001). The term constructivism was coined as focusing on active learning and participation in the creation of content knowledge, using problem-solving and reasoning, and higher order thinking skills (Herrera & Owens, 2001; Klein 2001). Progressivism, fathered by John Dewey, is centered in pedagogy that focuses on the needs and experiences of students, and takes on a discovery approach for students and embodies the belief that teachers are facilitators of learning (Österman & Bråting, 2019).

In the U.S.'s quest to lead the world in mathematics and reading there have been many emerging trends in mathematics' best practice. Beginning in the 1960s and 1970s and lasting, throughout the 1990s, a movement, entitled the *Math Wars,* brought about continuous controversy regarding the delivery of mathematics content to students (Wu, 1999). The disagreement existed between those who wanted students to learn basic skills and those who wanted students to have a conceptual understanding of mathematics (Klein, 2001). This war came on the heels of the introduction of *New Math* and standards-based reform (Herrera & Owens, 2001). These wars were representative of the ongoing debates regarding mathematics instruction that occurred regularly throughout the 20th century. The wars were symbols of a disconnect that existed between content and pedagogy (Klein, 2001).

Progressivism dominated the first half of the 20th century, leading to what was known as the *death of arithmetic* (Klein, 2001). Controversy arose in 1920 from the Reorganization of Science in Secondary Schools report supported by the National Education Association, as it highlighted the issues regarding teaching mathematics in high schools (Commission on the

Reorganization of Secondary Education, 1920). This report followed the notion the only mathematics that should be taught is the math that will be useful and practical for daily living (Barnhill, 2011; Klein, 2001). This followed a recommendation that the traditional high school mathematics curriculum should only be taught to a select few. Seen by mathematicians as an attack on mathematics, this argument was opposed heavily (Barnhill, 2011). This report prompted an urgency for vocational education by the business community along with the formation of the National Council of Teachers of Mathematics (NCTM; Barnhill, 2011). The NCTM advocated for changes in curriculum to be headed by teachers versus educators who want to reform education (Barnhill, 2011).

Butler (1951) rewrote a call for mathematics reform from an earlier generation entitled *The Reorganization of Mathematics in Secondary Education*. It was designed to provide a thorough look at secondary mathematics. The previous generation saw the major themes of progressivism supported (Klein, 2001). Progressivism supported curriculum based on student needs and the integration of subjects in elementary schools, focusing on the whole child rather than subject matter. Elementary schools began to introduce arithmetic in bases beyond ten, algebraic properties and theory (Herrera & Owens, 2001). There was a consensus that school curriculum should be determined by the needs and interests of children, and facilitated by educators (Dewey, 2008; Klein, 2001). This determination brought on the Activity Movement, which promoted the integration of subjects in elementary schools, instead of encouraging separate subject area instruction. The Activity Movement did not acknowledge reading and learning multiplication tables as appropriate skills for elementary students, representing a major movement in the elementary schools throughout the country (Klein, 2001).

The 1940s were filled with complaints of mathematical deficiencies and lack of mastery of basic skills in mathematics (Klein, 2001). Specifically, military personnel complained and mocked public schools for basic skills that were missing from incoming recruits and officers (Barnhill, 2011). As a result, a new school program, called *The Life Adjustment Movement,* was created to prepare students for everyday living. The program grew in the 1940s, focusing on real world, practical, everyday life problems (i.e., insurance, taxation, home buying) with education leaders concluding that more than 60% of students in public schools (Klein, 2001) appeared to be deficient in skills necessary for college or skilled work (Kliebard, 2002). This decade brought about heavy criticism for public schools, and the program dwindled by 1949, after steps were taken to include all students in the program, even if they were able to take on more advanced mathematics (Barnhill, 2011).

Mathematics Reform Begins

In the 1950s, progressive education was forced out, due to lack of attention to basic skills (Barnhill, 2011; Klein, 2001). Progressive education was credited with the decrease in the numbers of students enrolled in advanced high school mathematics courses (Barnhill, 2011). The New Math Period came about in the 1950s and lasted through the 1960s (and into the 1970s) (Kilpatrick, 2012). New Math was considered a “pedagogical failure” (Herrera & Owens, 2001, p. 84). This period was marked with several disagreements between mathematicians and psychologists. The New Math curriculum placed emphasis on focusing on rigor, deductive reasoning, and abstract learning (Herrera & Owens, 2001). This movement represented a move away from progressivism, opening doors for mathematicians to contribute to the K–12 curriculum (Klein, 2001).

In 1951, the Committee on School Mathematics, headed by Max Beberman at the University of Illinois, produced the first major curricular project of the New Math era (Klein, 2001). Beberman maintained that improvement of mathematics curriculum would take place through classroom instructional resources (Herrera & Owens, 2001). Beberman and his group received financial support from the Carnegie Corporation and the U.S. Office of Education to publish a series of math textbooks. The materials emphasized instruction based on discovery learning (Herrera & Owens, 2001). In 1955, the College Entrance Examination Board established a committee (Commission on Mathematics) to reflect on the examination's link to changes in mathematics education (Herrera & Owens, 2001). The report was aimed at college preparation for high school students (Herrera & Owens, 2001; Klein, 2001).

The American competition with Russia (formerly the USSR) regarding the space program, was a catalyst for change in the U.S. When the USSR launched Sputnik in the fall of 1957, the U.S. saw this as a major embarrassment of the math and science instruction in America's public schools (Furr, 1996; Herrera & Owens, 2001; Kilpatrick, 2012; Klein, 2001; (Stanic & Kilpatrick, 2003) and an issue of national security (Furr [Waggener], 1996). Therefore, Congress passed the 1958 National Defense Education Act, geared at "increasing the number of science, math, foreign language majors, and school construction programs" (Klein, 2001, p. 193) and to develop more scientists and mathematicians by improving instructional practices in these areas (Stanic & Kilpatrick, 2003). At the same time, the American Mathematical Society at Yale, headed by Edward Begle, was tasked with leading a study group to develop a new curriculum for high schools. This group became the most influential group of the New Math period. The group began developing curriculum for 11th and 12th grade high school programs, and eventually developed an elementary curriculum as well (Klein, 2001). The curriculum revealed elementary students and their teachers were struggling. Elementary teachers, for the most part, were not content specialists and had been exposed to very little professional development on the new curriculum. Teacher surveys showed emphasis in the classroom was given to geometry and other subjects (e.g., statistics, graphs, probability) were ignored (Herrera & Owens, 2001). Beberman warned that changes in elementary curriculum should be made slowly in an effort to retain teachers. He figured massive changes would scare them because they lacked the skills of content specialists and were required to teach several subjects (Kilpatrick, 2012).

In 1959, the National Council of Teachers of Mathematics (NCTM) implemented the Secondary School Curriculum Committee, which launched a recommendation for standards-based curriculum (Klein, 2001). This group, along with several other groups of college and high school teachers, wrote and created curriculum for K-12 schools. The New Math era was also credited with introducing calculus courses at the high school level.

The New Math era created confusion and alienation with parents of students who experienced the curriculum. Parents did not understand the mathematics and therefore, became frustrated as they were unable to assist their children at home (Herrera & Owens, 2001). Many teachers were ill-prepared to interact with the demanding curriculum (Klein, 2001) but still attended various summer institutes for professional development with the new programs (Herrera & Owens, 2001). This backlash created a storm of public criticism. In 1962, the Mathematical Association of America published a letter entitled, *On the Mathematics Curriculum of the High School* (Klein, 2001). The letter criticized New Math and provided what the committee deemed as more suitable guidelines for ensuing high school mathematics (Barnhill, 2011; Klein, 2001).

By the time the 1970s rolled around, the New Math era was evaporating, and the country was being urged “to go back to basics” (Klein, 2001, p. 194), which ushered in the Open Education Movement. This movement returned the country to the progressivist programs of the 1920s. This meant once again children would be able to decide what they would learn, involving “activity tables, play corners, and reading centers” (Klein, 2001, p. 194). Schools patterned themselves after the aggressively progressive, Summerhill School in England (Barnhill, 2011). This movement highlighted the lack of access to resources among disadvantaged and minority students and schools. The Open Education Movement proved to be destructive to students from lower socio-economic backgrounds with limited resources because their parents were unable to supplement their education at home like many of their white counterparts. This period brought attention to the lack of access to supplemental instruction for students from home and outside of school. It also showed the wide “disparity between African-American and White students” (Klein, 2001, p. 194).

The impact of the movement was highlighted when Nancy Ichinga, a prominent Inglewood, California principal (of Bennett-Kew School), noticed the devastating effects on the test scores of her poor and minority children, and therefore reformed the math and reading curriculum offered in her school with an emphasis on basic skills (Barnhill, 2011; Klein, 2001). This sudden change catapulted the students’ test scores from the “third percentile in the state to above the fiftieth percentile, earning the school national recognition and serving as a model” (Klein, 2001, p. 195) for other schools with similar demographics (Klein, 2001).

As a result of the country reverting to progressivism, most states created minimum competency tests, focused on basic skills, requiring students to pass in order to graduate (Barnhill, 2011). In the 1970s, standardized test scores steadily decreased in the U.S. and had reached their lowest point yet in the 1980s, leaving the U.S. to recognize the deterioration of math and science education (Klein, 2001). The country called for national investigations of the decline in mathematics education. The investigations rendered the beginning of an era known as the Math Wars (Barnhill, 2011). An *Agenda for Action* and *A Nation at Risk* represented two different points of view on mathematics education and required change in mathematics curricula in the 1980s (Barnhill, 2011; Swarner, 1998). Released in 1980 by the NCTM, *An Agenda for Action,* recommended problem solving (and new ways of teaching) as the focus of mathematics in schools (Klein, 2001). The report did not recommend the complete mastery of basic skills before participating in challenging problems; however, the report did clarify that paper and pencil challenges should not be the barrier for problem solving. The report favored the use of technology, requesting that all students have access to calculators and computers and specified the use of calculators in both elementary and secondary classrooms. It also pointed to regular usage of strategies involving collaboration and teamwork when problem solving in elementary classrooms. The report also encouraged the use of manipulatives in elementary classes and documented a request for assessment methods beyond traditional testing.

The new recommendations led to heated debate in the Math Wars of the 1990s. *An Agenda for Action* proposed less emphasis be placed on the role of calculus in differentiated math programs (Klein, 2001). Although *An Agenda for Action* focused on a new direction in mathematics, it did not receive much national attention. However, *A Nation at Risk*, published shortly after, created an uproar in the country as it highlighted the shocking, current state of mathematics education (Barnhill, 2011). This report, written by the National Commission on Excellence in Education (1983) under the U.S. Secretary of Education Terrell Bell, received a great deal of attention. It warned "the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation and as a people" (Klein, 2001, p. 197). This report referenced mediocrity in the current educational system as an act of war (Barnhill, 2011; Herrera & Owens, 2001; Klein, 2001).

A Nation at Risk called out the lack of focus on basic skills in elementary schools and blamed earlier movements for the need for remedial courses in high school and college in the 1980s (Barnhill, 2011; Klein, 2001). This report marked a firm move toward standardized testing and accountability in the late 1990s, examining teacher quality and teacher preparation programs and calling for textbooks to be upgraded with more stringent mathematics. The report also prompted several states to create task forces to investigate their own programs against the report. In 1998, California's policies regarding mathematics became a front runner in the obstacles to the progressivist reign in mathematics (Klein, 2001).

In 1989, the country experienced the clear agenda of the NCTM, with the publishing of the NCTM standards (Herrera & Owens, 2001). The committee who created the standards was made up of 24 members, consisting of a variety of professionals, ranging from primarily teacher education professors and university instructors to technology specialists. The standards grade bands included K–4, 5–8, 9–12 (Klein, 2001), and brought about an acceptable consensus in mathematics across all grades (Herrera & Owens, 2001). The standards included lists of items, specifying content with more or less emphasis (Klein, 2001). The NCTM standards supported the themes of progressive education, circling back to the 1920s. The standards called for "student-centered, discovery learning" (Klein, 2001, p. 201) and ultimately emphasized the use of calculators for all students.

At the K8 level, the standards were viewed as embodying more reform, removing the teacher control, decreasing teacher-centered activities, such as "answer giving," and limiting the usage of rote memory activities, paper and pencil tasks (such as long division, fraction computations), and the exactness of the textbook answer keys (Klein, 2001). These activities were replaced with a focus on number sense, mental math, more calculator usage for difficult calculations, patterns and data collection, use of manipulatives, and more collaborative group-work.

And while the standards promoted the use of calculators on a wide scale, they also acknowledged the need for appropriate usage of paper and pencil, algorithmic-based computation (Klein, 2001). They called for almost everything to be learned and explored through real world problems. The emerging theme under which the standards were promoted was constructivism. This heading covered self-paced learning and discovery learning, implying that only constructed knowledge, knowledge found out for oneself, would be integrated and understood by students. According to Harold Stevenson, a University of Michigan psychologist, the published standards did not give actual guidance to the content that needed to be taught, and they were not helpful in creating and planning lessons (Klein, 2001). Stephenson also contended that the standards did not address general attitudes and mathematical skills of students (Klein, 2001, p. 191).

The NCTM standards left a profound impact on the state of K–12 mathematics education. The constructivism approach was supported by “Piaget’s ideas on developmental learning and Vygotsky’s zone of proximal development, [because they aligned with] child-centered, cooperative learning” (Klein, 2001, p. 202). The timing for the standards coincided well with the political pressures brought about by employers’ costs of teaching entry level workers the basic skills needed and the low standing of U.S. students, compared to foreign students, in the race for an economic competitive edge. The country was looking for massive improvement in education;

therefore, the NCTM standards became the new national model for education (Barnhill, 2011), leaving them overwhelmingly endorsed by a lengthy list of distinguished organizations. The NCTM also produced additional documents that were focused on pedagogy in 1991, testing/assessment in 1995 (Herrera & Owens, 2001), and by 1997, most state and local governments had adopted standards in mathematics that were largely based on the guidance of the NCTM standards (Kilpatrick, 2012). The NCTM enlisted the assistance of the National Science Foundation (NSF) to implement the standards. The support of the NSF had a major effect on the use of the NCTM standards throughout the country (Klein, 2001).

President Bush's Education Summit in 1989, attended by all of the nation's governors, was the bipartisan call for a change in the way math and science were taught in American schools. The NCTM standards were adopted as the blueprint for change. Grants were awarded nation-wide to encourage states' education agencies to align their mathematics to the NCTM standards (Kilpatrick, 2012). By 1996, the NSF clarified its thoughts on what defined "effective, standards-based education" and showed its clear support of the NCTM standards and progressive education (Klein, 2001, p. 203). Since the NSF agreed with children learning through group-based discovery, utilization of manipulatives, and the operation of calculators to assist with computation; the NSF created a standards-aligned curriculum to sell and distribute to schools for profit. Although very specific in their support of constructive pedagogy, the NCTM standards were vague in the description of what should be taught at each grade level in mathematics (Herrera & Owens, 2001). The NSF went to great lengths to promote the NCTM standards. In addition to funding the curriculum, the NSF financially supported the distribution centers that produced the curriculum resources (Klein, 2001). The NSF operated under the guise of providing support to school districts in order to support students with an effective mathematics curriculum program, aligned to the NCTM's curriculum. Therefore, the NSF received contributions from private foundations for implementation of the standards. The NSF awarded grants through "systemic initiative programs" (Klein, 2001, p. 204) to improve teachers' knowledge and skills and implement the curriculum (Stanic & Kilpatrick, 2003). The programs were successful in promoting the NSF's math curriculum, aligned directly to the NCTM standards.

However, parents had difficulty helping their children, and students struggled with the rigor of the new standards. Therefore, parents opposed the NCTM standards, citing multiple drawbacks and flaws (Klein, 2001). They argued the standards failed to develop computational skills and analytical skills. They called for mathematics to return to placing emphasis on basic skills (Stanic & Kilpatrick, 2003). They categorized elementary programs as encouraging students to create their own computational algorithms and discouraging the use of the more thorough traditional algorithms for addition, subtraction, multiplication, and division. They claimed calculators were overused, even in kindergarten classrooms, and argued that student discovery group work was the learning mode of choice with meaningless guidelines. They complained that topics in statistics and data analysis were repeated among grade levels and had shifted the focus. Those who opposed the standards were disappointed in the lack of emphasis on computation and algebra. Some of the elementary programs did not offer books to students in an effort to avoid complications with student discovery. This led to rigorous questioning of algorithms and a hypothesis by some that algorithms can have harmful effects on children, especially when the results include rote memory and static memorization (Klein, 2001; Wu, 1999).

This basis of the Math Wars represented dissent between basic skills computation and conceptual understanding of mathematics (Klein, 2001; Wu, 1999). In his 1999 report, Hung Wu argued understanding mathematics required skills and fluency and that both conceptual understanding and basic skills go hand in hand. Parents across the nation were outraged and alarmed about the mathematics education students were receiving in the nation's schools (Klein, 2001). "This introduced the parent organization, entitled 'the Curriculumists, [who] favored an organized, coherent curriculum" (Klein, 2001, p. 212). This group created one of the first charter schools for grades K–8. They are responsible for the Princeton Charter School, one of the first charter schools to exist, which focused on essential academic areas, and provided an alternative to the philosophy of mathematics taught in the school district.

The NCTM standards were blamed for dramatic decreases in performance on standardized tests in mathematics. From 1992 to 1994, America's data revealed the students' scores for 8th grade math showed a decrease from "the 91st percentile rank to the 81st percentile in overall national rank" (Klein, 2001, p. 213). A considerable nationwide weakness was discovered in computation. A decrease also showed in the Stanford Achievement Test (SAT-10), which was used to measure the academic proficiency of elementary and secondary students (Klein, 2001).

In the late 1990s the NCTM standards were challenged by *Mathematically Correct*, a program geared to prepare students for college preparatory mathematics, or CPM (Klein, 2001). The founders of *Mathematically Correct* were credentialed in math and science, making their opposition difficult to dismiss, and the organization's purpose was to support parents who were unhappy with the new, confusing math. This sparked the development of several parent organizations who opposed the NCTM standards, with the internet becoming a major tool for organization.

Nationally, the Third International Mathematics and Science Study (TIMSS) data was quite revealing when released in comparison to participating countries. In 1996, U.S. eighth graders scored lower than the international average in mathematics (Klein, 2001, p. 218). In 1997, U.S. fourth graders scored slightly higher than the international average. In 1998, data showed U.S. twelfth graders scored amongst the lowest, internationally. However, although the data was important, it still did not influence politics (Klein, 2001), and TIMSS supporters continued to support the NCTM standards, failing to ever attribute the standards to the poor performance of the nation's students.

This prompted the basis for the "Clinton education agenda" in the form of *Goals 2000: Educate America Act* which focused on readiness of students for school, graduation rates and completion, creating responsible citizens and increasing challenging courses, a focus on math and science, literacy in adults, life-long learning, safe and orderly environments, teacher development and training, and increased parental involvement (Stanic & Kilpatrick, 2003).

In 1999, Liping Ma released the book, *Knowing and Teaching Elementary Mathematics*. This was a comparison of 23 U.S. and 72 Chinese teachers' knowledge of mathematics. The Chinese teachers had little formal education, while American teachers all had post-secondary experience. The study revealed the Chinese outperformed the Americans in their understanding of fundamental mathematics (Ma, 1999). The book drew conclusions regarding the relationship between pedagogy and content, particularly at the elementary school level; this indicated while the Americans seemed to be more algorithmic in nature, the Chinese had a better grasp on the understanding of mathematical content.

In addition, in 1999, the U.S. Department of Education (USDOE) released a list of 10 recommended/preferred math programs, which endorsed the work of an expert panel (Stanic &

Kilpatrick, 2003). This endorsement came as a response to Richard Riley's (Secretary of Education) statement to America of a need to improve teacher quality in order to improve education and the workforce (Riley, 1998). The programs were categorized as exemplary or promising. The NCTM endorsed the *exemplary* and *promising* programs in its *Open Letter to the United States Secretary of Education* with the drawbacks of the program publicized in the American School Board Journal (Klein et al., 1999).

The 20th century ended with the release of the Principles and Standards for School Mathematics (2000), which was a revision of the Curriculum and Evaluation Standards (1989). The intent of the original framework was to upgrade the standards for mathematics, guide reform at the state and district level and facilitate the goals for development of curriculum for local usage (Stanic & Kilpatrick, 2003). The intent of the revised document was to remedy the criticisms of the former document (Klein, 2001). In this new document, the NCTM stressed the importance of "arithmetic algorithms and computational fluency" (Klein, 2001, p. 226). The grade spans in the new document included PreK–2, 3–5, 6–8, and 9–12. The new document was not necessarily supported by critics because it was perceived that the new message mirrored the old, failing to state exactly what a student should learn throughout 13 years of school. The end of the 20th century was marked with continued discord over the K–12 mathematics curriculum. Without strong foundations in arithmetic and concepts from elementary school, entering middle school students will not be able to explore algebra. This will ultimately close the door to meaningful mathematical development, leaving a grave impact on the country's college and university students.

Since 1985, Congress has given the USDOE millions to improve access to quality math and science instructors at the kindergarten through twelfth grade levels (Stedman, 1989). The funding was issued in response to a concern that the skills of students in America's schools did not meet the rigor of the workplace nor would their skills afford them the opportunities to compete globally. In 1988, Congress authorized the Dwight D. Eisenhower Mathematics and Science Education Act: An Analysis of Recent Legislative Action and Program Evaluations. International comparisons from different countries showed America's students as being outperformed almost regularly, but of most importance and concern was the availability of qualified math and science teachers for elementary and secondary education. Also of serious concern was the fact that not all high school students had access to a full set of science and mathematics courses, and nearly one-third of the nation's high school students who were enrolled in the courses were being taught by unqualified teachers. The Eisenhower program was aimed at:

- Providing training for pre-service teachers
- Recruitment and retaining minorities
- Training in the use of technology within math and science
- Integrating higher order thinking skills in math and science curriculum
- Projects created by individual teachers to improve their own math and science instruction or instructional materials (Stedman, 1989, p. 8).

No Child Left Behind Act of 2001 (NCLB) was reauthorized as Every Student Succeeds Act (ESSA) and signed into law in 2015. The state ESSA plan was required to include challenging state academic standards, academic assessments, a statewide accountability system and school support and improvement activities. As a result, Indiana developed and integrated the process standards to strengthen the current academic standards.

Indiana finalized its school accountability rating system in 2001, in response to the General Assembly's passing of Public Law 221 in 1999. This was a performance-based accountability system in which schools were labeled and placed in categories: academic probation, academic watch, academic progress, commendable progress, exemplary progress. In 2011, the State Board made changes to the accountability system introducing the Adequate Yearly Progress (AYP) determination.

This system prevailed until 2014–15 when the A–F model of grading changed to accommodate growth. The new system stepped away from comparing students to peers and instead focused on individual student performance, proficiency, and growth. In this system, grades were determined for elementary and middle school by establishing preliminary scores for ELA and math based on proficiency. That score was then either decreased or increased based on growth and participation rate targets. High school grades came from scores in ELA and math growth and participation (60%), college and career readiness (CCR; 10%) and graduation rate (30%), with these weights changing each year to increase CCR and decrease ELA and math. In each of the above-mentioned systems, the Indiana schools were rated based on students' proficiency on the state's standardized assessment (ISTEP), administered once a year. The A–F grading systems essentially measured growth and proficiency based on an annual standardized assessment.

History of Reform

There were three significant reform movements that took place during the 20th century. All three movements were aimed at changing how mathematics were taught. One of the first reform efforts was known as the Chicago Movement and it took place in the earliest part of the 20th century (Barnhill, 2011; Swarner, 1998). Professors started this movement in order to combine algebra, geometry, and physics into one four-year course (Swarner, 1998). The second reform movement of the 1950s, still referred to today, was the New Math movement. Professors, specifically of pure mathematics, at the university level joined with secondary teachers to make changes to the curriculum. This movement focused on content and did not influence pedagogy. The goal of this movement was to prepare students to become mathematicians at the college/university level. New Math did not promote real life applications. It was filled with formal proofs and abstract mathematics. The third reform movement was brought about in the latter part of the century by the NCTM. NCTM's standards recommended K–12 mathematics place emphasis on problem solving and applications, re-examine basic skills, integrate use of calculators, computers, and technology into the curriculum, along with a conceptual understanding of mathematics. This last reform movement essentially changed the way math was taught.

The NCTM Standards were considered vague and general. Not many people initially opposed the standards and in fact, most people agreed with the general concepts (Swarner, 1998). However, the controversy arose about how mathematics should be taught. Experts debated on real world application versus algorithmic mathematics. The reform called for a useful approach to mathematics while teaching students math they could understand. One goal was to make math more relevant to students, especially those who were already turned off to mathematics. This was problematic for university professors, because they wanted elementary and secondary students to be exposed to only formal algorithms (Swarner, 1998). These professors ignored the fact that only one percent of all college calculus students actually became mathematicians at the time. This meant the professors wanted a K–12 mathematics education system that ignored the needs of 99% of their students. The reality became clear, the focus needed to shift to accommodate the majority of students, while continuing to provide preparation for rigorous math. Technology was advancing, and shining a light on the need for all students to have a general understanding of math in order to succeed. There needed to be a balanced package: The average math student needed to see how math related to his or her life while the student in pursuit of mathematician status needed the skills to be prepared for success also.

Politics Led to Educational Reform

Looking at the role politics played in education over the past two decades highlights the rationales behind educational reform efforts. In 1991, *The Professional Standards* were released. These standards detailed specific requirements and qualifications for teachers of mathematics. The *Professional Standards* infused collegiate level courses into math teachers' careers, suggesting K-4 teachers take nine semester hours of math content courses, middle school teachers take 15 hours, and high school teachers acquire enough courses equal to a mathematics major (Stanic & Kilpatrick, 2003). Between 1993 and 1994, there was an increase in federal authority over educational policy (Rhodes, 2014). The new reforms allowed the federal government to mandate that states legislated standards-based education reforms for all students and all schools.

Business entrepreneurs, who contributed to the Clinton administration's politics, expressed unrest with the state of school improvements at the state and local levels. They felt as if the concerns of economic development were not being met by the current reform efforts. Therefore, a business roundtable was formed. Business roundtable leaders from each of the states promoted accountability for assessments and standards-based curriculum since the late 1980s (Rhodes, 2014). This was a push for revolutionary change. However, fearing little progress, leaders continued public proposals to expose the desperate and desolate status of education in the

U.S. Civil rights entrepreneurs also expressed dismay with the lack of reform-based education for poor and minority children. Goals 2000 and the Improving America's Schools Act fundamentally shifted the role the government played in education, shining the new focus on compensatory education and reform that was state-concentrated and standards-based (Stanic & Kilpatrick, 2003).

According to scholar Jesse Rhodes (2014), the Clinton administration marked the first comprehensive reform of national educational policy in the country's history. The platform focused on accountability, reforms based on states' accountability factors, and high standards for all students. Since *The Goals 2000: Educate America Act* (1994) provided a process for creating national standards along with grants to states to adopt their own systems of aligned standards, tests, and school report cards, the Improving America's Schools Act (IASA) of 1994 seemed even more fierce. This act was a reconfiguration of the *Elementary and Secondary Education Act* (ESEA, 1965). IASA mandated states adopt education standards in math and reading, implement tests aligned to the standards, develop required district and school report cards, and ensure that all students made progress toward the same high standards (Rhodes, 2014). Under the IASA, the states bore responsibility of assessment data collection and reporting and devising criteria to hold schools accountable for making progress. However, many states struggled with the accountability factors due to unbalanced data collection and reporting along with conflicting use of exemptions. This skewed the accountability data of disadvantaged and poor students.

According to Rhodes (2014), *The Goals 2000* proposal operated as a newly established grant given to states, but the IASA initiative persisted through the grant structure of the *Elementary and Secondary Education Act of 1965*. Even though the federal government set the agenda for standards, tests, and accountability, states and local agencies continued to be responsible for the planning and implementation of details, including standards, content, and assessments. The federal government also held very little oversight in holding states and local government accountable for the federal goals and guidance. However, according to NCTM (Stanic & Kilpatrick, 2003), the IASA was an instance of state-level reform initiating federal change.

Both acts developed a common understanding of educational equity, especially in terms of disadvantaged students (Rhodes, 2014), where equity addressed “equitable access to high standards and rigorous curricula, rather than merely more-equitable access to school resources” (Rhodes, 2014, p. 97). While the two laws extended federal responsibility, they also continued with the traditional method of federal intervention in schools, which included awarding conventional grants to the states and local entities. The two acts were presumably intended to work together to pressure states to adopt synchronized systems of standards, tests, and accountability to hold all children to the same high standards. At that time, U.S. Secretary Richard Riley proclaimed *The Goals 2000: Educate America Act* (1994) as another way to improve education. This Act was about forging a better future for the youth of American in a manner that embodied the education of the entire child and the whole school. It drew controversy in Congress but was hailed as a compromise between Democrats and Republicans and a win for the Clinton administration (Goals 2000).

The Department of Education explained that the framework, based on standards, was reflected in both ESEA and Goals 2000. It maintained the state’s responsibilities and local control of education by supporting states as each established its own standards outcomes for students. It also acknowledged and recognized states and localities as the primary carrier of responsibility for elementary and secondary education in the U.S. (Rhodes, 2014). Further, it designated them as the main accountability piece for educating students. Rhodes's (2014) book went on to explain that since states and local entities were given the primary responsibility to implement reforms and their resources, and capacities to implement were so vastly different, the two acts became a source of separation among business and civil rights leaders' expectations and what the states could deliver.

In 2002, the *No Child Left Behind Act of 2001* evolved. NCLB picked up where the IASA initiative left off, but with significant sanctions instituted. NCLB put very detailed demands on states and local governments in exchange for opportunities for federal education funding (Rhodes, 2014). NCLB also furthered the quest for educational equity by requiring states to adopt the same standards and assessments for all students, insisting on "equality of academic outcomes" (Rhodes, 2014, p. 127). NCLB called for more rigorous enforcement of the standards forcing schools to be accountable for: "subgroups" of students, and the "average" students (Rhodes, 2014, p. 127). Schools could also be sanctioned if just one subgroup did not make adequate academic progress toward the goals. NCLB also severely sanctioned schools that failed to improve the performance of disadvantaged students. The sanctions included: "restructuring to state takeover, or forced closure" (Rhodes, 2014, p. 127). Continuing ESEA's system of categorical grants, NCLB delegated a significant amount of authority to states and localities. NCLB dictated the federal government to have more increased control in setting the agenda for development of standards, testing, and accountability reform, but states and localities still had the primary responsibility for how to implement reforms.

NCLB was designed to widen the standards-based reform movement, delivering it to each state in the nation and following the practices of Texas, North Carolina, and Massachusetts, because these states experienced increases in students' achievement after creating and implementing comprehensive systems of standards, assessments, and accountability (Rhodes, 2014). The NCLB blueprint in 2001 made ESEA funding conditional based on states' adoption of the preferred set of standards, testing, and accountability reforms. Civil rights entrepreneurs became known as the *intellectual fathers* of NCLB due to their advocacy of policy provisions, focusing their crusade on the education and achievement of disadvantaged students, and further requiring states to report the assessment scores of subgroups of students, while holding schools accountable for subgroup performance. NCLB confirmed for many that "the standards-based reforms that were adopted by Congress in 1994 . . . can be made to work" (Rhodes, 2014, p. 145).

Ultimately, NCLB required states to take soaring steps against schools that failed to make annual progress toward meeting state-developed academic standards (Rhodes, 2014). If schools did not make adequate progress for two consecutive years, the state was required to provide technical assistance to the school and the school's students were allowed to transfer to other public schools within the same district, with the district required to cover all costs, including transportation. If a school did not improve in three consecutive years, students were allowed to designate their portion of ESEA Title I funding to fund services that were supplemental to the services received during the regular school day from public or private sources. Schools who did not improve in four consecutive years, were required to experience changes in curriculum, staffing, and governance. The state implemented corrective actions at year four, and at year five, schools could be subject to reconstitution, which meant possibly reopening as a charter school, or undergoing state takeover. NCLB highlighted teacher quality in detail and required schools to employ "highly qualified teachers (teachers with full certification or licensure, a college degree, and demonstrated competence in subject matter and pedagogy by the 2005-2006 school year)"

(Rhodes, 2014, p. 155). NCLB's federal regulations also brought in an influx of federal aid for education. States still maintained control of designing their own standards, assessments, and teacher-quality provisions because the law explicitly stated "nothing could be construed to authorize any federal official or agency to mandate, direct or control a State's local educational agency's (LEA) instructional content, academic achievement standards and assessments, curriculum or program of instruction" (Rhodes, 2014, p. 156).

In 2008, when former President Obama was elected, he campaigned on fixing the shortcomings of NCLB. The Race to the Top Competition was a federal grant initiative pushed by the Obama administration to increase accountability while supporting the principles of NCLB. The administration persuaded many lawmakers to accept the Obama/Arne Duncan standards, testing, and accountability agenda (Rhodes, 2014,). By August of 2010, more than 31 states accepted the challenge, as they altered laws or policies to increase their likelihood of acquiring the funds. Business and civil rights leaders praised this plan because of the strong emphasis on standards, testing, and accountability reforms. President Obama's plan was an approach to reauthorize and reenact the ESEA. However, due to anguish of the midterm election outcomes and the Republican Party pressure, Obama's administration announced waivers from NCLB. In 2011, the revised waiver plan allowed states to apply for relief from some NCLB requirements as long as they agreed to adopt other education reforms including: upgrading standards, improving teacher and administrator quality, and providing interventions for the least performing schools.

The Indiana Academic Standards

The Indiana Academic Standards were defined by the Indiana Department of Education as being "designed to help educators, parents, students, and community members understand what students need to know and be able to do at each grade level" (What Are the Indiana Academic Standards, 2021). The standards are meant to give guidance and form the basis for strong Tier 1 instruction. Tier 1 instruction is the core instruction in the classroom that all students receive. It is comprised of evidence-based programs and practices and aligned to the state-standards. The State Board of Education adopted standards recommended by Indiana's Education Roundtable in September of 2000. For mathematics, the standards included grades K–8, algebra, geometry, algebra II, integrated math I, II, III, pre-calculus, probability, and statistics and calculus. Mathematical reasoning was implicit and/or explicitly required in the content standards.

The 2000 Indiana standards were based on the NCTM standards' conceptual understanding of mathematics. The intent was for the Indiana academic standards to be used as a guide to set clear expectations for students, while using the NCTM standards "as a guide for teachers to develop students' conceptual understanding" (Indiana Academic Standards, 2000, p. iii). However, in 2010, Indiana was a front-runner in the country-wide move to take on the Common Cores standards (Elliott, 2013). The Common Core standards were strongly supported and urged by former Governor Mitch Daniels, former state Superintendent Tony Bennett, and all 11 members of the state board. Therefore, the Indiana State Board of Education adopted the standards with a phase in plan. As a result of the decision to adopt the Common Core, Indiana lawmakers and educators were recipients of strong backlash, which eventually led them to backtrack and reconsider the adoption. And by 2012, a considerable amount of opposition to the Common Core existed in Indiana, leaving both new Governor Mike Pence and State Superintendent Glenda Ritz unsure of the Common Core standards. They favored re-evaluation of the standards, which prompted lawmakers to pass a bill that paused the implementation of the

Common Core. The bill also required the State Board of Education to study the standards and suggest whether or not to continue with the adoption. In 2011, Indiana committed to adopting CCR standards as a part of the agreement with the USDOE under President Obama. This agreement released the state from the NCLB mandates (Elliott, 2013). In 2014, Senator Scott Schneider, proposed a bill to void the 2010 adoption of Common Core and the development of new standards by July. Republican leaders backed the bill, fearing a loss of state control over standards and the Common Core's connection to federal priorities (Elliott, 2013).

The initial plan called for new Common Core linked tests in 2014–2015. Indiana was a part of the Partnership for the Assessment of Readiness for College and Career (PARCC) and had planned to adopt the PARCC test in place of the state ISTEP exam in 2014–2015 (Elliott, 2013). However, in 2013, Pence withdrew Indiana from the agreement with PARCC. The state of Indiana created standards aligned to the requirements of the Federal Government in 2014 and updated those standards again in 2020. Those standards were known as Indiana's new College-and-Career Ready (CCR) 2014 Indiana Academic Standards (Elliott, 2013). The standards closely resembled the Common Core Standards (Elliott, 2014). According to the Indiana Department of Education's website, the standards accounted for vertical alignment across grades and courses in mathematics (K–8), in-depth teaching, and integration of process standards. The state also had an agreement, with the USDOE, to put standards and new tests in place by 2015 (Elliott, 2013). The test was a "transitional test" intended to align to the new 2014 standards, measure CCR, and include technology-enhanced items (Elliott, 2014, p. 6).

The new state test would not be ready until 2016 and the old ISTEP did not measure CCR. The changes still called for a connection between the new standards and the state's test; therefore, Indiana was tasked with preparing schools and students to pass the tests. For the school year 2014–2015, the state was forced to give ISTEP with new adapted questions for CCR (Elliott, 2013). According to the IDOE, Indiana's newest assessment was mandated during the 2017 legislative session. The state opted to replace ISTEP+ with ILEARN, as its new assessment. The purpose of ILEARN was to assess "CCR content standards in English/language arts and mathematics in grades 3-8, science in grades 4 and 6, high school biology, social studies in grade 5, and U. S. government in high school" (Indiana Department of Education, n.d., para. 4). The new assessment highlighted the development of content priorities, included computer-adaptive functionality, integrated new accessibility features, including a Spanish translation option, and assessed CCR standards.

Mathematics Instruction

Good mathematics teaching is often ill-defined and subject to interpretation. There are various accounts from notable scholars whose definitions give meaning to good mathematics teaching. Dewey defined teaching as developing students' ability to think and stated that skill apart from thinking is purposeless (Dewey, 1916). According to Dewey, mathematics is abstract; therefore, it is important to help students develop strategies for reasoning and educators should keep the larger vision in mind. Polya (1965) defined mathematics teaching as an art in which thinking must be developed and students should be actively involved. He suggested further that elementary mathematics in schools should have a targeted, clear focus of teaching arithmetic-related basic skills while preparing students for the most important task of thinking. He stated that students should actively think and problem-solve in mathematics, as early as elementary school. Elementary schools' primary purpose is to develop problem-solving skills in students. He also went on to state that the instruction of the future will be student-centered, especially in elementary school. Students should be able to act on the ideas they develop, discuss those ideas, and direct the flow of the teacher's instruction. The Curriculum and Evaluation Standards (1989) defined good teaching as seeing "teachers encouraging students, probing for ideas, and carefully judging the maturity of a student's thoughts and expressions". This notion emphasizes teacher mindset and classroom culture.

Wilson and Goldenberg (1998) conducted a framework detailing the struggles of a veteran middle school teacher through observations and interviews of the teacher over a two-year period. From the investigation, the pair provided assumptions that good teaching involves a student-centered instructional style in which mathematics is treated conceptually, from an experimentalist view. They also concluded that good teaching occurred when teachers reflected on their own and their students' understanding of the mathematics. According to Wilson et al. (2005), successful instruction is "student-centered and process-oriented" (p. 88).

Since the mathematical base of many teachers is algorithmic only, they lack understanding and meaning to give the appropriate and adequate explanation to their students. Results of a quantitative study by Quinn (1997) reveal teachers with low mathematics competency and poor attitudes toward math pass those deficiencies on to their students through instruction. The research involved 47 pre-service elementary and secondary teachers. The results revealed successful mathematics teachers should have ample content knowledge and a positive attitude toward mathematics, which points to the limits and shortcomings in the mathematics content knowledge of elementary teachers having a negative effect on students (Quinn, 1997). When the teacher lacks a conceptual understanding of the foundational mathematics needed to explain the content, the challenges of teaching and understanding is often passed on to the students (Wu, 1999). The NCTM recommendation included embracing the importance of teachers emphasizing the processes of doing mathematics while connecting with students' understanding of mathematics (Wilson et al., 2005). Teachers must also know and understand the mathematics they are teaching and be able to draw on that knowledge, adapting to their teaching tasks; therefore, mathematics teachers need to have a conceptual understanding of their students and the mathematics they intend to teach in order to be successful.

Good teaching occurs when teaching is clear and flexible, allowing for improved students' learning (Wilson et al., 2005). Teaching for understanding involves students being able to actively practice mathematics outside of the classroom and apply it to other mathematics. Making connections and the use of visual representations intensifies students' understanding. Good teaching requires useful ways of helping students visualize mathematics and promotes quick assessment to inform instruction. Good teaching has moved away from the teacher giving information that the students are required to memorize or regurgitate. Preparation for solving real world problems or applying mathematics comes through discovery, being actively engaged, incorporating technology, and designing meaningful lessons (Wilson et al., 2005). Students who understand mathematics engage in several different approaches.

Developing good instruction and the use of best practices at a level of teaching excellence comes from:

- Experience - Teachers with several years of experience have interacted with content and pedagogy over time, participating in meaningful professional development (Wilson et al., 2005)
- Education - experiences in college helped develop good teachers
- Reflection - thinking about teaching practices

- Interaction with Colleagues - good teaching could be learned by discussing teaching with colleagues, observing other teachers, collaborating, and listening to the wisdom of experienced teachers (Wilson et al., 2005)

In Liping Ma's (1999) book, *Knowing and Teaching Elementary Mathematics*, Ma concluded that even though U.S. elementary teachers received more training than Chinese teachers, U.S. teachers did not have an adequate understanding of the mathematics they taught. Ma also reported the teachers in the U.S. did not know how to use common algorithms for the mathematics they were required to teach (e.g., division of fractions), and they did not have a deep understanding of the content, thus, leaving teacher educators to conclude that American teachers needed a conceptual understanding of mathematics. The Chinese teachers were more consumed with the why of the algorithms. "It is important to have a deep understanding of the math and to know the meaning underlying the computations performed" (Soto-Johnson et al., 2007, p. 495).

Conceptual and Procedural Knowledge

Students' interests should be used to guide instruction (Österman & Bråting, 2019). Students should also be active participants in their own learning, which shifts the teaching practice (Kilpatrick, 2012). Education occurs as students' experiences shift to exploration of abstract subject matter. Theory and mathematics research drive the practical application of mathematics in schools; therefore, the two aspects of theory and practice were inseparable. For students to develop mathematically, they have to see mathematics as meaningful with a connection to the real world (Kilpatrick, 2012). Mathematics concepts needed to show connections with students' experiences in other areas to provoke practical, hands-on, and real-world connections. According to Dewey, students are asked to develop duality in education; they learn a lot of fragmented rote memory, unconnected facts and then are asked to create general relationships. This implies two totally different worlds which is the opposite of learning. He stresses learning involves connectedness (Dewey, 2008).

Hiebert and Lefevre (1986) stressed both conceptual knowledge and procedural knowledge as being vital to understanding mathematics.

> Conceptual knowledge is described as knowledge rich in relationships that can be thought of as a connected web of knowledge, or a network in which the linking relationships are as prominent as the discrete pieces of information. All pieces of information were linked to some network. (Österman & Bråting, 2019, p. 461)

Procedural knowledge is "described as consisting of procedures used for solving mathematical problems, where procedures are chains of prescriptions for manipulating symbols" (Hiebert & Lefevre, 1986, p. 7-8). Lithner conducted a research framework for creative and imitative reasoning. The study addressed rote learning through imitative reasoning as compared to creative reasoning. "The use-inspired basic research" study observed reasoning types through the examination of thinking processes on calculus problems of 46 university mathematics students (Lithner, 2008, p. 273). The study found that although students may get very far in rote memory type activities in a textbook, they still suffer a significant amount of learning loss due to reliance on algorithms rather than using algorithms as a part of a larger thinking process. Lithner's studies suggested that rote learning, a process of learning something through repeated memorization, was a main factor in the development of learning and achievement difficulties. He also distinguished between two types of mathematical reasoning as imitative reasoning and creative reasoning. Imitative reasoning was connected to rote learning. Lithner referred to imitative reasoning as recalling and using a memorized algorithm to complete a specific task.

> Creative reasoning took place when a student created a reasoning sequence novel to him or her (or recreates a forgotten one), where there are arguments supporting the strategy choice, arguments that are anchored in intrinsic mathematical properties of the components involved. Creative reasoning and its importance is emphasized as critically important by Lithner. In creative reasoning the solution was created. (Österman & Bråting, 2019, p. 462)

Conceptual knowledge is the basis for teachers who used best practices in mathematics instruction (Österman & Bråting, 2019). Mathematical scholars Lithner, Skemp, Hiebert, and Lefevre had a common goal: To account for the difference in merely learning algorithms by heart without any real understanding and without knowing how to apply what one has learned, with actual understanding of a mathematical operation. They also placed emphasis on the ability to apply that knowledge in other situations and understand the connections between different concepts involved. This goal was focused on improving students' conceptual knowledge and minimizing procedural knowledge.

Jeannotte and Kieran (2017), in their research review of maintaining conceptual understanding and procedural skills found they cannot be seen as separate entities, since in reality both contribute to mathematical reasoning and understanding of mathematics in schools. Today's educational theorists, Boaler, Devlin, Darling-Hammond, Kieran agree with John Dewey that students should not learn a separate classroom mathematics that they would only use in school, criticizing school mathematics as boring and focused on algorithmic, rote memorization leading to only an acquisition of surface knowledge (Boaler, 2016; Darling-Hammond, 2005; Dewey, 2008; Jeannotte & Kieran, 2017). Dewey also theorized not every student should become a professional mathematician, but it is important to set the goals high (in every subject) so the students are pushed to more difficult tasks, develop their thinking, and reach further than expected. Educators should place emphasis on "psychologizing" the subject, making it interesting to students, relating it to everyday life outside the classroom, and then gradually moving to a more abstract direction (Österman & Bråting, 2019, p. 463).

The ability to use an algorithm was not an indicator of conceptual understanding. A team of researchers, including Brousseau and his wife in 2009, conducted an experiment to create a theory entitled nonradical constructivism (Brousseau et al., 2009). Given that they theorized that children could build their own mathematical knowledge, they also concluded algorithms are good for completing and applying a formula to a task, but not for understanding the mathematics required to complete the task (Brousseau, 2014). Algorithmic application was considered mechanical, with sometimes only carelessness in procedures leading to a mistake. True understanding was meant to be a mental process that led to the calculation as the end result. The result is viewed as a product of understanding. Dewey (2008) suggested that intellectual adjustments must occur to solve mathematical problems successfully, and it is imperative that students have an understanding of the situation and the context of the information, as well as the ability to perform needed computations and calculations both in and out of school.

Operational skills come from the combination of procedural and conceptual skills and involves students' learning through engagement with mathematics. This comes as a part of a practice that mathematicians were required to master to develop their mathematical intuition and make relevant connections properly, not just complete procedures. Mathematics is not something "we learn and then do, rather it is something we learn by doing" (Österman & Bråting, 2019, p. 466). Since operational skills highlight "the actual doing of mathematics procedures are conceptual in nature" (Österman & Bråting, 2019, p. 465). Therefore, operational skills are important because they reinforce the importance of computational skills for mathematical content knowledge but use and apply the necessary understanding of the mathematical solution.

Teacher Development - Increasing the Quality of Mathematics Education in the Nation

Teaching is the art of getting the students to learn the subject matter. Doing this successfully requires excellent understanding of both an understanding of mathematics and how to communicate the mathematics to students (Howe, 2000). Ensuring a quality education in mathematics for students involves teachers receiving better, earlier training and strong subject matter knowledge, because good training produces good teachers (Howe, 2000; Ma, 1999). When elementary teachers become specialists, they are able to experience an increase in mathematical aptitude and the most highly qualified teachers become recipients of the mathematics investment. This incentivizes “mathematically inclined people to become math teachers” and creates groups of colleagues who could work together to strengthen the teacher culture of mathematics (Howe, 2000, p. 885).

It is vital for educational institutions and employers to create working conditions that favor development and understanding for teachers by building time into the school day for teachers to study their teaching resources, work with teachers in need of special attention, and interact with colleagues (Darling-Hammond, 2005; Howe, 2000; Ma, 1999). This system resembles the college concept and brings newer and older teachers together to collaborate and study important information in an organized, consistent manner. They are also able to renew and update their skills through discussion of mathematical problems and topics, which allows them to develop both self and others (Howe, 2000). This notion reinforces the suggestion that teachers should acutely focus on fostering a conceptual understanding of elementary mathematics in students. Educational agencies need to work with university mathematics departments in order to place emphasis on pedagogy and subject matter.

Teachers need to learn and teach for understanding in mathematics (Howe, 2000). Pepin et al. (2017) summarized proficient mathematics teaching as sharing resources, developing a clear identification of what it means to be an expert teacher (those who are teacher leaders in their field, understanding how students think, how they learn, cultivating successful learning environments, encouraging mathematics discourse, creating classroom norms, building relationships that focus on learning, and following up with reflection of one's practice), and developing colleagues as experts. There were three teachers involved in this case study research with no less than eight years of experience each (as cited in Pepin et al., 2017).

Teacher Efficacy

Although first investigated by the Rand Corporation in the 1970s (Klassen et al., 2011), teacher efficacy originated from Bandura's idea of self-efficacy (Swars, 2005), which suggests people have influence over their own actions and that successful performance is the major reason for change to take place because success raises the expectation that mastery will continue to take place (Bandura, 1977; Katz & Stupel, 2016). In Katz and Stupel's (2016) qualitative action research study, elementary math teacher beliefs of teachers who were ready to exit the profession at the end of the school year were addressed. There were six teacher participants who taught elementary mathematics at the same elementary school. These teachers were not beginners as they had taught mathematics for five to 15 years. The researchers sought to understand the experiences of the teacher participants. The research included open interviews, observations, and interventions. The research revealed that teacher-efficacy beliefs were major factors in their classroom instruction. It gave suggestions for more teacher support and motivation to be cultivated.

Bandura (1977) stated self-efficacy beliefs control the vast majority of how human beings function, perform, cope and behave. He also explained self-efficacy as the primary factor in producing outcomes because self-efficacy influences expectations of success, how much effort is put forth, and the amount of persistence toward reaching a goal. Self-efficacy Is the result of reflection regarding repeated success or repeated failures (Fry, 2009).

Beliefs have a great deal "in common with concepts such as attitudes, values, judgements, opinions, dispositions, implicit theories, preconceptions, and perspectives" (Thomson et al., 2019, p. 2) as determined in the mixed methods sequential explanatory (quantitative and qualitative) study they conducted regarding teacher efficacy of pre-service through novice teaching time periods. There were 245 participants in the quantitative study who were graduates of an elementary teacher program. The quantitative results showed efficacy of participants increased while they were enrolled in the teacher prep program but decreased in their first years of teaching. There were 55 participants in the qualitative study who were recruited during their sophomore year but interviewed during the first two years of teaching. The qualitative results gave explanation for the changes in efficacy, which included knowledge base, grade-band or content-knowledge, and appropriate strategies for teaching.

Teacher efficacy is defined as "individuals' judgments of their capabilities to accomplish certain levels of performance" (Swars, 2005, p. 139) "and their ability to affect student performance" (Katz & Stupel, 2016, p. 421). Teacher implementation of successful instructional practices in mathematics and personal teacher efficacy represents the teacher's belief in their ability and skill set to be a successful teacher. Teacher self-efficacy is also believed to have a significant impact on outcomes for teachers and students, and it is shown to have positive effects on teachers' beliefs regarding instruction (Klassen et al., 2011). Teacher efficacy is also linked to the use of instructional strategies in the classroom and the teacher's willingness to embrace and experiment with innovation (Swars, 2005). Since changes in beliefs lead to changes in teaching practices (Thomson et al., 2019); teacher efficacy plays a crucial role in overall instructional development of students (Katz & Stupel, 2016).

Teacher efficacy was birthed from four sources: "Mastery experiences, physiological and emotional states, vicarious experiences (observation of others), and social persuasion" (Katz & Stupel, 2016, p. 422). Mastery experiences provide the most important and authentic evidence of future success and mastery. Physiological states are based on moods and are typically used in error by teachers to predict the ability and performance of students.

Teachers who were considered to have high efficacy generally used strategies that included questioning and strategies that catered to the needs of students. They were also more inclined to try innovative strategies and take risks in the classroom. These teachers were willing to serve as facilitators and allow students to own their learning (Swars, 2005). These teachers are persistent and resilient, especially when things do not go their way, embrace errors and use them to improve achievement, along with promoting student engagement by holding students accountable for their learning (Katz & Stupel, 2016). Further, these teachers are reported as having high expectations, and are more likely to have students who learn by, implementing informative innovations in the classroom, take responsibility for students' learning, and possess effective classroom management. These teachers are more likely to have greater psychological and inner resources to encourage students to engage in complex problem solving and seek conceptual understanding, and are more apt to take risks and are not fearful of student conflict.

Teacher beliefs have strong influences on instructional practices (Beswick & Callingham, 2014). Their quantitative study regarding teacher beliefs was conducted among 294 primary pre-service teachers and 86 secondary pre-service teachers. The data were collected from the participants via an online survey that addressed knowledge of math content and pedagogy. The nine Likert items linked to belief statements revealed that despite the differences in their beliefs, their teaching practices were very similar.

Teachers with high self-efficacy are more likely to express thoughts of their profession positively, which positively impacts their commitment to their professions, makes them more likely to stay in the profession, and helps develop collaborative relationships with colleagues, leaders, and parents (Katz & Stupel, 2016). These teachers are the leaders of change and they view difficulties as opportunities for growth, attributing failure to lack of effort or knowledge on the part of the professional (Jamil et al., 2012). According to Jamil et al.'s (2012) study linking teacher's performance, personality, and beliefs to self-efficacy, 509 pre-service teachers from the final year of a university's teacher education program participated. These pre-service teachers were surveyed twice and data were collected through observation by professors. The assessment consisted of items regarding efficacy in instructional strategies, classroom management, and student engagement. The findings suggest that more out-going teachers have higher self-efficacy, those who were more anxious and negative were not as confident, teachers with stronger constructivism beliefs were more efficacious, and that mastery during their performance had no effect on self-efficacy.

Teachers with low self-efficacy use teacher-directed strategies that limit students' learning (Swars, 2005). They also have several difficulties in teaching, have less professional satisfaction, often experience professional stress, and are more likely to be depressed because they view challenging tasks as lack of ability (Klassen et al., 2012). Teachers with low self-efficacy are also more likely to leave the profession as a result of perceived failure (Jamil et al., 2012).

Teacher Beliefs Matter

Teacher efficacy beliefs play a vital role in classroom interactions and instruction (Katz & Stupel, 2016) and serve as a very important factor in the educational environment for children, having a direct impact on their academic experiences. Teachers' beliefs guide and determine their behaviors, including their planning, decision-making, and choice of instructional practices (Jung et al., 2019). Their large longitudinal study regarding teacher education and beliefs is linked to kindergarten mathematics learning outcomes (Jung et al., 2019). There were 5,845 kindergarten students (who remained in the same school and did not repeat grades) in the sample. There was a parent questionnaire and a teacher survey used. The variables included home activities, family income, and teachers' beliefs as having impact on students' math achievement. The study concluded that the type of instruction mattered more than teacher beliefs, but they deemed it important to include that teachers with stronger beliefs gave more math instruction and therefore students performed better in mathematics.

Teacher beliefs influence the way teachers behave, believe, and act as a direct correlation of what they see and analyze. Teacher beliefs inform their teaching practices and therefore affect the manner in which students learn (Jamil et al., 2012). Teachers provide experiences to students according to their beliefs about children. Their beliefs are tied to curriculum and instructional practices they use (Jung et al., 2019). Teacher beliefs serve as a lens through which the events of a classroom are judged, which in turn affect teacher self-efficacy (Jamil et al., 2012). They are also related to how long teachers deliver mathematics instruction, how often it is delivered, and in what manner the instruction is delivered (Jung et al., 2019). Students in classrooms of teachers with high self-efficacy have more successful experiences because the instruction and beliefs are student-centered and more positive, motivating students to learn with less anxiety, which allows students to engage in higher order thinking (Jamil et al., 2012). Teacher efficacy affects instruction and therefore has a significant effect on students' mathematics gains (Katz & Stupel, 2016).

Mathematics Teacher Efficacy

There is a limited amount of research that focuses on developmental trends in mathematics teaching efficacy (Thomson et al., 2019); however, despite intensive professional development programs and reform guidelines, most elementary teachers possess low efficacy regarding mathematics instruction. According to Boaler (2016), "appreciating the importance of mathematical mindsets and developing the perspective and strategies to change students' mindsets involve some careful thinking about our own learning and relationships with mathematics" (p. 8). Most elementary teachers do not have positive views regarding mathematics instruction and this perspective significantly impacts the quality of instruction and student learning (Thomson et al., 2019). Therefore, they generally lack a growth mindset in mathematics and are unable to approach mathematics with the confidence and excitement needed to invite learning for students (Boaler, 2016). Many elementary teachers have at some point in their learning, been told "they cannot do mathematics or that math is not for them" (Boaler, 2016, p. 8). This makes teacher efficacy a significant predictor of usage of mathematics instructional strategies.

Highly efficacious teachers are more likely to be more effective mathematics teachers than their counterparts with lower efficacy (Swars, 2005). It is also important to note that having high efficacy in mathematics' teaching does not necessarily mean teachers will have high efficacy in other disciplines; however, effective math teaching does have a positive effect on student learning (Thomson et al., 2019). Prior learning, past mathematics experiences, and emotions toward mathematics are other factors that impact the development of mathematics teaching efficacy, along with conceptual understanding of mathematics concepts for teaching, and knowledge-base in mathematics instruction. The sources of efficacy beliefs are classified as "enactive/mastery experiences, vicarious experiences, verbal (social) persuasion, and physiological reactions" (Thomson et al., 2019, p. 3). The four factors are explained in mathematical context as:

- Enactive mastery experiences--- personal experiences that individuals rely on for managing their efforts toward accomplishing a task. Since high efficacy is generally related to a sense of success, successful experiences in mathematics have a powerful impact on teaching efficacy and mathematics learning. Prior learning is influential on teacher success since teachers' attitudes are shaped by their prior experiences with mathematics. Therefore, enactive mastery experiences are vital to provide students with positive mathematical experiences.
- Vicarious experiences --- a source of efficacy related to observing a model or expert perform a specific task. These experiences come from what an individual has seen accomplished by others, but it can be used to increase one's personal efficacy. This arises by observing a model successfully complete the task. Additionally, collaborative activities can fall into this category and be labeled as positive experiences. They afford teachers time to reflect on their instructional

practice. Reflection can have a positive influence on efficacy in teaching mathematics and pedagogical content knowledge.

- Social persuasion --- the feedback provided by instructors, mentors, administrators, or peers. The role of social persuasion is dependent on the validity or credibility of the source of the persuasion.
- Physiological and emotional arousal --- described as information conveyed to the individual by physiological and emotional states. The arousal level can be perceived positively as anticipation or negatively as anxiety. Mathematics anxiety can be a powerful factor in determining levels of mathematics teaching efficacy (Thomson et al., 2019, p. 3).

Teachers with high mathematics efficacy are also more likely to have access to and/or engage in reform strategies (Swars, 2005; Thomson et al., 2019). High math teacher efficacy is also reported as related to the teachers' individual experiences with mathematics in school. If they had a positive experience, they typically have higher efficacy because they perceive themselves as effective in mathematics instruction (Swars, 2005). According to Bandura, enactive mastery experiences are considered to be a major source of self-efficacy, based on mastery by sustained efforts of success (Bandura, 1977). Teachers with low math efficacy generally have a negative relationship with mathematics due to negative math experiences in the past (Swars, 2005). These teachers most likely experience lower self-efficacy due to failure with previous mathematics experiences in school.

Primary teachers are more predisposed to have an instrumentalist view of mathematics (Beswick & Callingham, 2014). This view shows mathematics as a set of useful skills for purpose and practicality. Early math skills are one of the most consistent indications of students' future school outcomes (Jung et al., 2019).

Mindsets in Mathematics

There is limited research regarding mindset; however, Boaler (2016) is considered to be an expert on mathematical mindset. In Boaler's research on the most recent Program for International Students Assessment (PISA) scores, she discovered that the highest-achieving students in the world are those with a growth mindset, and they outrank the other students by the equivalent of more than a year of mathematics. Boaler (2016) wrote, "Mathematics is a broad, multi-dimensional subject, and when the teachers embrace the multidimensionality of mathematics, in their teaching and through their assessment, many more students can gain access to mathematics and be excited by it" (p. 208). This speaks to the mindset of the teachers who are delivering the instruction. Since math is complex content, teachers who care about their students and their students' achievement provide opportunities for students to feel good about mathematics. These teachers also communicate to students that math is a subject that is based on growth. The first step in creating and sustaining instruction from a growth mindset in mathematics is to create positive norms in the classroom. Those norms have to be established as essential conditions for learning and mathematics has to be viewed as an active growth subject. Students also need to view themselves as important factors in their own learning process.

Norms:

- Believe in students
- Foster mistakes (Lemov, 2021, p. 111)
- Embrace failure and struggle
- Focus on depth rather than speed

- Encourage questions (Boaler, 2016, p. 172)

Teacher Experience

Kini and Podolsky's (2016) review of 30 research studies published since 2003 suggests that teachers become more effective the more years of experience they have. The review targets teacher effectiveness on student outcomes of public school students (K--12). The study compares teachers with several years of experience to beginning teachers. The findings conclude that teacher experience has a positive relationship with student achievement. Not only is student achievement affected, but other areas related to school have a positive outcome as well. More experienced teachers are also shown to increase overall school outcomes related to achievement.

Hill's (2010) study also found a linear relationship between experience and mathematical knowledge as a result of a performance assessment administered to teachers to assess mathematical knowledge. Hill's (2010) literature supports a linear relationship between teacher experience and mathematical knowledge (p. 533). The intent of the study was to assess elementary teacher mathematical knowledge and performance focused on numbers and operations. The literature in this study points to teacher knowledge relating to the quality of their work in the classroom. This quantitative study surveyed 625 teacher participants. The study showed more experienced teachers have more mathematical knowledge that can be attributed to more on the job learning, supported by curricular resources, collaboration with colleagues, experiences of students, and professional development opportunities.

Location Type

In a study conducted by Ortlieb and Cheek in 2008, the researchers observed four second-grade classrooms over 10 weeks. There were clearly defined differences in schooling, specifically reading, provided in rural and urban schools. The environment and experiences, ways of life, and prior knowledge play a large role in how students learn and teachers give instruction in each setting. According to the study, rural students are more likely to see their teachers outside of the school setting in the community and therefore better relationships are developed. Urban students are less likely to see their teachers outside of school because their teachers are less likely to live in their immediate community. Rural students are also embedded in the family economic means because they participate at earlier ages in wages and earnings, giving them unique experiences to bring into the classroom. Urban teachers are less likely to allow students to work together while rural teachers often group students and ask them to work together. Urban schools have a higher transiency rate than rural schools where rural teachers often attended school in the community in which they now teach.

Primary Versus Intermediate

Bowie et al. (2019) conducted an exploratory study in South Africa. In the study, the researchers administered a 50-question multiple choice assessment online twice to students in the 1st-year (488 students) and 4th-year (282 students) to cohorts of students majoring in education. The study concluded pre-service first and fourth year primary teachers were in need of additional in-service opportunities regarding mathematics instruction. This conclusion was supported by the results from the collective group, as the fourth year students did not perform as well as the first year students, meaning learning in mathematics was regressing over time. This is concerning as the fourth year students are closer to their interactions with classroom teaching than the first year students (who are closer to high school studies).

Best Practices in Mathematics Instruction

According to the research referenced in the 2014 NCTM publication, the following serve as a basis for "effective mathematics teaching" (Principles to Actions: Ensuring Mathematical Success for All, 2014, p. 9):

- Teachers should facilitate students' engagement with challenging problems and meaningful opportunities to learn
- Make connections and infuse reasoning
- Connect conceptual and procedural knowledge
- Use meaningful problems to invite discourse
- Give immediate feedback in order to promote reflection and revision
- Prompt the development of metacognition and self-advocacy (NCTM, 2014)

Teachers, especially elementary, make a difference in student learning; therefore, they must hold high expectations for students, anticipate errors and mistakes, teach self-awareness in learning strategies, address varying levels, integrate content, practice reflection, teach actively, and create and sustain a supportive culture for learning (Orlich, 1998). In addition, it is very important for students to know their teacher believes in them. Students' perceptions about themselves shape their beliefs in themselves and others (Boaler, 2016). According to Boaler (2016), the messages teachers send to students about their potential for learning has a significant impact on their future endeavors. Educators should refrain from fixed mindset perceptions. They should communicate to all students that they are capable of achieving. Teachers' words are powerful and the beliefs they have about students have lasting effects; therefore, it is vital that teachers use encouraging words with students to promote positivity.

Given that teachers play a large role in introducing any new educational concept (Stanic & Kirkpatrick, 2003); teachers' expectations should include the notion that all students can succeed (Boaler, 2016). Teachers should refrain from judging a student's ability or potential based on speed, since this was not an appropriate indicator of success. Teachers need to communicate to students that mistakes are accepted and they also facilitate growth. The most effective classrooms are those where the students are challenged to take risks, develop grit, and feel good about solving problems. Angela Duckworth (2016) described grit as a combination of perseverance and passion. Difficult tasks give the brain opportunities to grow and find connections. Teachers who promote best practice encourage struggle and lessons learned from failure instead of giving negative, fixed mindset messages. Persistence and hard work are valued over fast mathematics. Productive struggle and risk-taking encourages growth and innovation of new pathways.

According to Boaler (2016), teachers create false hopes for students when they tell them they are smart. This label gives them a fixed mindset and can be damaging to students when they begin to struggle or fail. This is when they question whether or not they really are smart; and they are left with negative feelings. Educators have to be cautious of providing negative feedback to students and should avoid limiting them by giving them too much assistance, because this takes away from the students' thinking. Unfortunately, the didactic contract was established in so many classrooms (Brousseau et al., 1970). This contract is present when students do not feel they should struggle and teachers give them opportunities to opt out of learning by rescuing them (Boaler, 2016).

Since mathematics involves the study of patterns (Boaler, 2016), teachers need to recognize that teaching math is really synonymous with teaching a pattern. This allows students to see trends and formulate generalizations for mathematics. In *Prelude to Mathematics*, W. W. Sawyer (1983) defined mathematics as “the classification and study of all possible patterns” (p. 17). Devlin (2001) stated “mathematics is not about numbers, but about life. It is about ideas and the world in which we live; it is full of creativity” (p. 99). He went on to explain “when students make and see connections between methods, they start to understand real mathematics, and they enjoy the subject much more” (p. 184).

It is also very important to engage students in visual thinking about mathematics, since this provides another perspective to the brain for understanding (Boaler, 2016). Students engage with math at higher levels when they are able to draw and visualize concepts, which allows them to make connections and explore additional layers of mathematical mastery and processing. Since it is important to use various mathematical representations in math practice, visuals should be incorporated to assist with conceptual understanding and practical application, especially for higher order thinking and problem solving.

When teachers ask students what they think would work prior to teaching them the method, they are asking them to use intuition, which is useful with all grade levels of mathematics. Intuition is a welcome invitation to “open and free thinking” (Boaler, 2016, p. 189). Intellectual freedom promotes creativity and innovation. Dewey (2008) suggested that by “suggestive questioning,” the teacher can pull desired information from students.

Boaler (2016) also placed an emphasis on depth over speed. She challenged that speed does not necessarily imply understanding. Some of the world’s most successful mathematicians speak of taking their time and digging deep. Dewey (2008) pointed to difficulties and effort as occurrences that promote depth of knowledge and depth in thinking. Boaler (2016) and Dewey (2008) insisted math is about depth of thinking, formulating, and recognizing relationships. An important way to support high-achieving students is to allow them to problem solve and collaborate with peers. Children generally dislike math because it is abstract, and they fail to see its relevance. This is indicative of the math they usually study in the classroom; however, it is not representative of the real world. Math has been called the new civil right, because it is vital to practical functions of life and society (Boaler, 2016). Therefore, it is important that teachers convey to students the practicality of mathematics.

The Common Core standards include mathematical practices and modeling. The practices include concepts and skills that are vital to conceptual understanding of mathematics. Modeling occurs when students are able to apply knowledge to a real-world problem using data to solve the problem and represent the situation. Although students are not usually aware of modeling, it is an important practice for demonstrating mastery of mathematics (Boaler, 2016).

Questioning and reasoning are also vital to mathematics, and it is important that educators integrate both into the instruction in the classroom. As educators prepare students for college and career, they are preparing them to pose questions of situations and data. Students who ask informative and intriguing questions are those who are most successful in future careers and work (Boaler, 2016). Reasoning and appropriate use of technology are closely related. Reasoning is an important skill for analysis, investigation, and checking for errors. Reasoning provides a process for thinking and applying logic. Reasoning is a key element of mathematics and problem solving, providing students with opportunities to justify and explain their thinking. Technology and manipulatives are useful in assisting students to visualize mathematics. These resources assist students in engaging in creative problem solving. Educators should intentionally create opportunities to engage with technology that encourages thinking and reasoning, rather than those that prompt speed and routine procedures.

The NCTM (2016) also stressed the importance of goal-setting in mathematics for specific learning, promotion of reasoning, and problem-solving. NCTM also highlighted making representations in mathematics, prompting discourse about mathematics, and development of meaningful and targeted questioning. It pointed out mathematics fluency and mastery of conceptual understanding as highly important and encourages strengthening perseverance through productive struggle for learning. NCTM (2014) promoted the use of evidence to support students' mathematical thought processes.

In Doug Lemov's (2021) *Teach Like a Champion 3.0*, the author refers to great teaching as "an art" (p. xxxv). The book targets actionable strategies for effective learning. The strategies outlined include: Transfer of knowledge and skills, continuous checking for understanding, relationship-building, revisions, discourse and praise, group work, taking risks, and other student driven strategies.

Through reform movements, Schifter's (1998) new definition of mathematics instruction involves student engagement and understanding rather than memorization and presentations of math facts. She pointed out that the roles of teachers and students have undergone major changes and that teaching now involves the art of facilitation and discourse. Learning now involves investigation, hypothesizing, and finding innovative approaches. Polya's (1965) advice to teachers includes knowing the subject and knowing the students. He encourages guessing and proving by the students and fosters positive mindset attitudes.

Challenges

Mathematics reform has had a major impact on today's instruction. Past methods were driven by the teacher; however, instruction has since shifted to student-centered practices (Klein, 2001). It is believed that meaningful learning takes place in an active environment, where the teacher is the facilitator of discovery. This points to the constructivism approach (Swarner, 1998). Since teachers' conceptual understanding also has a significant effect on student learning (Melville et al., 2013), there is a need for competent teachers (Swarner, 1998). In a 2013 qualitative narrative study involving three teachers who were reluctant to engage with reform-based mathematics instruction (Melville et al., 2013), the uncertainties about math instruction, content, and methods for improving one's own practice are addressed. The researchers met with the teachers four times throughout a school year and recorded narrative. The research concluded that knowledge-base is the greatest factor in implementing reform-based math, therefore requiring supportive environments for teachers to change their instruction. There is a very real challenge for teachers who are not accustomed to teaching from the belief that all students should be given opportunities to learn through investigation and problem solving. Teachers' beliefs are important, and teachers gain their beliefs from their years spent in the classroom as both students and teachers.

Teachers have a sense of uncertainty toward reforms due to negative perceptions associated with learning and relearning how to teach mathematics (Melville et al., 2013). Teachers' sense of authority is also challenged by understanding and teaching mathematics because mathematics is abstract. If mathematics teachers only develop a surface understanding of mathematics materials, there exists a strong risk that they would not be able to develop a conceptual understanding and encourage mathematical reasoning through problem solving with their students. "We often teach to our strengths and in the areas of our teaching practice, where we doubt our efficacy, we may avoid teaching that content or using those teaching methods" (Melville et al., 2013, p. 2). Math was a source of anxiety and concern for many elementary teachers because as generalists they were not exposed to extended practice, problem solving, or conceptual understanding. Teachers lack appropriate preparation in mathematics and there is a teacher shortage, especially in mathematics (Stanic & Kirkpatrick, 2003). Another challenge involves the teachers' will to improve their own practice. Many mathematicians have little interest in digging deep to invest in methods to present math more effectively; therefore, teachers are left with surface knowledge. An experiment conducted by Furinghetti (2007) involving 15 participants with no teaching experience, targeted algebra 1 instruction. The results yielded the conclusion that teachers must dig deep and explore mathematics in order to find strategies for effective presentation in the classroom. Therefore, Furinghetti (2007) explained, "Mathematical facts, without some understanding of why they are what they are, are almost impossible to learn" (p. 133).

Many parents and educators have the misconception that students should be taught the same way they were taught in the classroom. Most of today's educators memorized facts, formulas, and algorithms; followed specific procedures and practiced repetition (Principles to Actions: Ensuring Mathematical Success for All, 2014). Parents also expect teachers to directly transport knowledge to students, rather than cultivate students' individual thinking processes (Stanic & Kirkpatrick, 2003).

Summary

In 1975, the competence of elementary school teachers in mathematics was a lingering issue for the mathematics' education community according to a study of 61 doctoral programs (Swadener, 1978). The survey indicated competence in elementary mathematics teachers is linked to the responsibility of the university department that oversees math teacher instruction. It suggested better outcomes for elementary math teachers when the methods course is taught by the mathematics department rather than the education department. This same problem continues to persist throughout the 21st century. Although literature concerning the level of mathematical competence is almost nonexistent, there is a widespread feeling that, in general, elementary school teachers have very limited background in mathematics. In most states, universities and college programs do not require elementary teachers to complete more than one college-level mathematics course; therefore, it is implied that elementary teachers have minimal understanding in mathematics. It is also unlikely that the mathematical competence and understanding of elementary school teachers would increase unless they have some form of additional concentration for instructional growth in mathematics. One of the most important concerns of school mathematics is the practical use of mathematics (Österman & Bråting, 2019), especially among elementary school teachers. According to Dewey (2008), teachers need to have a thorough understanding of a subject and the student in order to guide them in the appropriate direction. This requires social and emotional understanding along with subject matter expertise, while considering the diversity, ability, and interests of the students. In support of Dewey's point, these elements combined lead to a comprehensive, practical education. They point to a well-functioning education. Therefore, the elementary teachers who understand mathematics, possess strong self-efficacy in their ability and the ability of their students, and possess a growth mindset, are better positioned to instruct students effectively for understanding mathematics (Österman & Bråting, 2019). Bandura (1977) claimed self-efficacy has a positive influence on the effort students make and on their achievement. His philosophy also points to self-efficacy as a greater predictor of mathematics problem solving over other factors. Students' confidence in mathematics is significant to problem-solving competence (Ayotola & Adedeji, 2009). Further, self-efficacy beliefs predict academic outcomes, which was suggested in the quantitative study that addressed the relationship between students' math achievement and students' self-efficacy.

Ayotola and Adedeji (2009) used 352 student participants, randomly selected. The results of their study revealed there was no difference in math achievement of secondary males and females, and there was no significant difference in efficacy among the two groups. There was, however, a strong positive relationship between students' self-efficacy and math achievement.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

This chapter discussed the research methodology including research questions, null hypotheses, sample population, instrumentation data collection processes, and data analyses. After thorough review of the literature, there was a need to examine the mindset and self-efficacy of elementary teachers who use best practices. The statement of the problem, which detailed the need for this research, the purpose of the study, and the significance of the study are in Chapter 1. The independent variables included location type, years of experience, and grade level area (primary versus intermediate instructor levels). The dependent variables were mindset, self-efficacy, and use of best practice in mathematics instruction. Chapter 3 includes the methodology, null hypotheses that was tested, the rationale for the research design, the methods that were used to design the survey instrument, issues with trustworthiness, survey design, sources and collection techniques, procedures, and limitations and delimitations of the study. This chapter concluded with a method of analysis that lead to the descriptive and inferential findings.

Research Design

This quantitative study identified the current levels of mindset, self-efficacy, and use of best practice in mathematics instruction among Indiana elementary teachers to determine if there was a significant difference in the teachers' use of best practices in mathematics that affect the self-efficacy and mindset of K–6 elementary teachers in the state of Indiana. This quantitative study explored whether significant differences existed in dependent variables based on teachers' years of experience, location type, or grade level area among K–6 elementary teachers in the state of Indiana. The data was collected through electronic survey methodology with no direct interaction between the researcher and the participants during the study. The survey can be found in Appendix A with a winter 2022 administration. The survey was delivered via email with follow-up reminders. The composite scores from the teacher survey provided the dependent variable data. The survey consisted of Likert-scale items with a math construct consisting of bounded self-efficacy and mindset items to elementary teachers who teach kindergarten through sixth grade across the State of Indiana. The analysis took place through ANOVAs, Independent t-tests, and a simultaneous multiple regression (Gravetter & Wallnau, 2017).

Research Questions

To predict the impact of self-efficacy and mindset on best practices in mathematics instruction, this study addressed the following questions:

1. What is the state of self-efficacy, mindset, and best practices of math instruction among Indiana elementary teachers?
2. Is there a statistically significant difference based on location type on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers?
3. Is there a statistically significant difference based on years of experience on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers?

4. Is there a statistically significant difference based on grade level area on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers?
5. Do the self-efficacy and mindset composite scores explain a statistically significant amount of variance within the best practices of math instruction composite scores for Indiana elementary teachers?

Null Hypotheses

The following null hypotheses were addressed in this study:

The first research question was answered using descriptive statistics.

H_o1 (i.e., R.Q. 2): There is not a statistically significant difference based on location type on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers.

H_o2 (i.e., R.Q. 3): There is not a statistically significant difference based on years of experience on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers.

H_o3 (i.e., R.Q. 4): There is not a statistically significant difference based on grade level area on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers.

H_o4 (i.e., R.Q.5): The self-efficacy and mindset composite scores do not explain a statistically significant amount of variance within the best practices of math instruction composite score for Indiana elementary teachers.

Purpose Statement

The purpose of this quantitative study was to gather information from elementary teachers who use best practices in mathematics instruction to examine the impact of self-efficacy and mindset. This research examined the impact self-efficacy and mindset have on the use of best practices in mathematics instruction. The study addressed whether or not location type, years of experience, and differences in primary and intermediate teachers existed regarding impact on teachers' mathematics self-efficacy and mindset. The research rationalized the mindset and efficacy trends of characteristics found in elementary teachers who use best practices in mathematics. The research gave insight into what teachers who use best practice do to get students engaged in learning mathematics. This study could also inform hiring practices and recruitment of effective elementary teachers, as well as characteristics of educational leaders who use best practice in mathematics. The research proposed that those teachers who use best practices in mathematics possess a conceptual knowledge of mathematics and are able to effectively communicate and explain content to students, believe in their own mathematics teaching ability, and possess a growth mindset that promotes a safe, trusting learning environment for students to learn. Teachers who inspire the desire in students to learn mathematics make content meaningful, important, and engaging. Teachers who effectively communicate and explain the mathematics are those who understand the content and possess the critical thinking skills necessary to solve complex content. Teachers with positive mathematical mindsets create safe learning environments and foster classrooms where growth is promoted and facilitated.

The independent variables that were explored in this study included location type, years of experience, and primary (grades K–2) versus intermediate (grades 3–6) level teachers. The literature review suggested location type might have had an effect on students' achievement as there may be a tendency for lower-knowledge teachers to work in high-need locations. This means the students in most need lack access to the teachers who are more likely to use best practices. Hill's (2010) literature supported a linear relationship between teacher experience and mathematical knowledge (p. 533). The study showed more experienced teachers (i.e., teachers with more than 20 years of experience) having more on the job learning, supported through curricular resources, collaboration with colleagues, student experiences, and more opportunities for professional development). Also, it was important to note that intermediate (grades 3–6) elementary teachers were more inclined to have greater mathematical conceptual knowledge and "more positive attitudes towards mathematics" (Youmans et al., 2018, p. 1083) than their primary (grades K–2) counterparts. Youmans et al. (2018) conducted a mixed methods study that addressed early mathematics knowledge, pedagogy, and beliefs of 178 early education (early childhood educators, kindergarten, first grade) teachers. The participants were surveyed electronically, and results revealed teachers were neither in receipt of early math training nor did they possess early math instructional qualifications. Early math educators who preferred to use manipulatives felt it important to foster positive attitudes in math at early ages. Teachers also preferred to teach content that was fun and engaging with concrete connections. Teachers were least comfortable with their instruction when they lacked understanding and ideas in how to teach the content area and were less engaged.

Rationale for Research Design

My quantitative study was designed to determine if there was a significant difference in the current levels of self-efficacy, mindset, and best practices of math instruction among Indiana elementary teachers. Additionally, the study also attempted to explain if there was a statistically significant amount of variance within the best practices of math instruction composite scores for Indiana elementary teachers based on the teachers' self-efficacy and mindset composite scores. The survey utilized a sample of the population and measured elements of best practice in mathematics instruction, self-efficacy, and mindset toward mathematics of the elementary teachers who chose to participate. This survey was classified as a voluntary response sample technique. The quantitative study recorded survey responses from Indiana elementary teachers to highlight the best practices used in elementary mathematics instruction, gauge the level of teachers' self-efficacy, and assess the mindset (fixed versus growth) of teachers. The purpose of the survey instrument and the rationale of completing the study were identified in Chapters 1 and 2 (i.e., purpose of the study and literature review, respectively). Following the planning of the survey design, this section also included defining the population, sampling, constructing the instrument, conducting the survey, and analyzing the data steps. Each of these steps were discussed in this chapter.

Survey Design/Instrumentation

The survey that was used in the study can be found in Appendix A. The survey found in Appendix A is the survey participants were administered. Appendix B presents the same survey instrument with direct links to the supporting research in the literature review. The survey addressed the use of best practice in mathematics and levels of self-efficacy and mindset. Each survey statement is linked to research from Chapter 2 that highlighted the importance of addressing this area in the development of the composite scores for best practice in math instruction, self-efficacy, and mindset. This was done to ensure the validity of the study.

The survey instrument contained four main sections. The first three sections consisted of statements tied to the research on best practices in mathematics instruction, self-efficacy, and mindset. Each of these areas have their own section within the survey; however, the section headings did not show on the survey presented to the sample of elementary teachers in order to avoid influencing the ratings given by respondents (Gravetter & Wallnau, 2017). The fourth section of the survey addressed demographic information that included but was not limited to: location type, years of experience, and elementary teaching grade level (i.e., intermediate or primary), along with any other demographic information that could have been used to develop a comprehensive response to the research questions.

Trustworthiness of Data Collection

Along with linking the instrument statements to research in Chapter 2, additional steps were taken to ensure the validity of the survey instrument and to increase the overall effectiveness of the survey instrument, as it related to validity (Gravetter & Wallnau, 2017). The Indiana State University Educational Leadership PhD cohort of 2020–2021 also had access to review the survey. The students in the cohort were asked to review the statements to ensure ease of comprehension of each statement by individuals who chose to participate. They looked for phrasing that could induce bias by leading the sample to predetermined answers and to ensure that respondents would only think about items individually (i.e., one at a time). One of their goals was to minimize the time needed to participate in the survey. Another goal of the reviewing cohort was to make sure the instructions are clear and easy for the sample population to understand. The feedback received from the cohort was used to ensure the effectiveness of the survey instrument.

For a composite score to be generated, steps were taken to ensure the survey instrument had an acceptable level of reliability within each of the three areas (Gravetter & Wallnau, 2017). The composite scores approximated the overall level of utilization of best practice in mathematics instruction, self-efficacy, and mindset the teachers reported. It was important that the composite score was based on highly reliable statements for each of the sections in which they corresponded. Upon completion of the data collection window, a Cronbach's Alpha test was conducted to determine whether internal reliability existed among the statements comprising each area that served as a dependent variable within the study. A Cronbach's Alpha score of a minimum of .7 or higher was required to generate a composite score from the series of statements.

If a Cronbach's Alpha score of .7 or higher was generated for each area, this sufficiently supported enough reliability to form a composite score (Gravetter & Wallnau, 2017). If any areas had not met the .7 required level, the problematic items would have been dropped from the analysis. The Cronbach's Alpha test allowed for SPSS, a statistical software, to eliminate an item from the test and generate a new statistical value. If the removal of a single item resulted in a Cronbach's Alpha score of .7 or higher, the removed item indicated that its level of reliability was not compatible with the other statements and would have therefore been removed from the statements that formed the composite score for the area.

If removing a single item did not result in forming a reliable composite score, exploratory factor analysis would have been necessary (Gravetter & Wallnau, 2017). In this process, all the statements in a specific area that were not deemed reliable in forming the composite score would have been taken to see if any of the statements loaded on the same factor, as determined by assessing if the statements have an eigenvalue of 1.0 or higher. If this exploratory factor analysis produced two or more factors with eigenvalues of 1.0 or higher, the group of statements with the highest eigenvalue would have been utilized to generate the composite score. The statements then would have been utilized in a Cronbach's Alpha test to ensure a .7 or higher statistical score. If the exploratory factor analysis failed to generate a group of statements identified as reliable, that area would have been removed from the inferential testing.

Data Sources and Collection

The study sample was taken from the teaching population of the state of Indiana. A formal request was presented to the Indiana Department of Education to obtain Indiana elementary teacher email addresses. A copy of the request can be found in Appendix C. After obtaining approval of the Indiana State University Institutional Review Board, an email requesting participation in the study was sent to the teachers. The sample email can also be found in the Appendix D. The survey participants were informed of their anonymity, since no identification information was collected (e.g., such as names, IP addresses). The participants were also asked to volunteer their participation in the survey; therefore, they could choose not to continue participation at any point by exiting the survey (Gravetter & Wallnau, 2017).

The study was conducted via random sampling procedures (Gravetter & Wallnau, 2017). Every 10th email address from the Department of Education list was sent an invitation to participate through email. The email contained the link to the survey and instructions for completion. The survey was developed in Qualtrics. The email also contained my Indiana State University email address, as well as the chair of the study, Dr. Brad Balch's, email address. This provided participants with contact information for both Dr. Balch and me, in the event they needed further guidance for completion of the survey. Additionally, the email informed participants of the three-week window for survey completion. After the first week, another email was sent out to all participants either thanking them for, or reminding them of, voluntary participation for the remaining week(s).

Data Procedures

Once the window of time for the survey completion terminated, the data was exported from Qualtrics into SPSS (Gravetter & Wallnau, 2017). The file was reviewed for accuracy and the coding was examined to ensure statistical information generated from the study was accurate. Any participant who did not respond to at least 80% of the statements was removed from the data file to avoid negative impact from incomplete surveys.

After the IBM SPSS Version 27 data file was inspected properly, the previously described Cronbach's Alpha tests were conducted. Each of the steps to address reliability were conducted to ensure sufficient levels of reliability existed to form the composite scores. As stated earlier in this section, if an area was not deemed reliable with the responses, the area was to be removed from the study, preventing the generation of a composite score. After the successful identification of reliable statements for each area, a new variable was generated in SPSS that was the result of the average rating given to each statement in that area. The new variables were the composite scores found within the inferential tests in this study (Gravetter & Wallnau, 2017).

Method of Analysis

Each of the questions presented in this research study were answered using descriptive statistics and inferential testing. For null hypotheses one through three, if an area was deemed unreliable to form the composite score, the research question associated with the dependent variable was to be removed from the study. That area would also have been removed as a predictor variable from the fourth null hypothesis (Gravetter & Wallnau, 2017).

The first research question was be answered by closely examining the descriptive statistics with the sample survey responses. These descriptive standards included, but were not limited to, the means, standard deviations, frequencies, and percentages of each statement or area. In the descriptive section of chapter four, the demographic variables allowed for the data file to be separated in order to develop a more complete picture of the responses of the participants based on location type, years of experience, grade level area, or any other demographic breakdown that provided significant descriptive information for this study (Gravetter & Wallnau, 2017).

The second and third research questions (Nulls 1–3) utilized a one-way ANOVA test to determine which null hypotheses were retained. The one-way ANOVA test allowed a determination of a statistically significant difference on a dependent variable score among the different levels of the independent variable. The dependent variables for these null hypotheses were determined using best practices in mathematics instruction, self-efficacy, and mindset composite scores for each by averaging the Likert scale survey statement in each of the sections. The independent variables for these null hypotheses were the teacher's location type, years of experience, and grade level area (i.e., primary versus intermediate). The location type independent variable had three levels: urban, suburban, rural. The years of experience independent variable had three levels: 0–5 years, 6–15 years, and 16 years or more years. The one-way ANOVA was the appropriate statistical test to conduct when the independent variable had three or more levels, which was the case for the second and third null hypotheses (Nulls 2–3). The grade level area independent variable had two levels: primary (grades K–2) and intermediate (grades 3–6). The independent samples *t*-test was the appropriate statistical test to conduct when the independent variable had two levels, which was the case for the fourth null hypotheses (Gravetter & Wallnau, 2017).

To ensure accuracy of the findings, the assumptions of the one-way ANOVA were examined. The one-way ANOVA is robust to violations of the assumption of homogeneity of variance (Gravetter & Wallnau, 2017). If the homogeneity of variance assumption were violated, the inferential statistics was to still be interpreted, although the choice of the post-hoc test would still need to be altered. If the assumption of homogeneity of variance was met, the Tukey HSD post hoc test would have been the post hoc test chosen for determining where the statistically significant difference existed, among the three comparisons that were required for the second and third null hypothesis. Consequently, if the assumption of homogeneity of variance were violated, the Games-Howell post hoc test would have been conducted, since it does not assume equal variances within the calculations. If the assumption of normality had been violated, an assumption of parametric test would have been required; therefore, the non-parametric Kruskal-Wallis test would have been used. This non-parametric test is equivalent to the one-way ANOVA; however, it does not require the dependent variable to be normally distributed on all levels of the independent variable.

If significant differences existed on any of the dependent variables within the null hypotheses 2 through 3, the appropriate post hoc test would have been utilized to determine where the difference lied among the three levels. The Eta-squared effect size would have been calculated and interpreted to demonstrate the overall impact the independent variable had on the dependent variable scores. The 95% confidence interval for the mean difference also would have been presented for any significant difference found between the three levels of the independent variable that would have been used for the first three null hypotheses (Gravetter & Wallnau, 2017).

The fifth research question (Null 4) utilized a simultaneous multiple regression test. This test determined whether the self-efficacy and mindset composite scores explained a statistically significant amount of variance within the best practices of math instruction composite score for

Indiana elementary teachers. The predictor variables for this regression test were self-efficacy and mindset composite scores, pending all scores could be reliably generated. The criterion variable was the use of best practices in mathematics among elementary teachers. Simply put, this test allowed the determination of knowing if the level of self-efficacy and mindset for the teacher would improve the likelihood of predicting if that teacher would utilize best practices in mathematics instruction.

To ensure the accuracy of the findings, the assumptions of simultaneous multiple regression were examined. The simultaneous multiple regression test required a dependent variable that was at least interval in nature (Gravetter & Wallman, 2017). The assumption of linearity of the logic, independent residuals, and no multicollinearity were examined to ensure inferential findings of this null hypothesis were not biased.

Delimitations

1. The study population was limited to a random sample of Indiana teachers in K–6 elementary schools, identified by the IDOE. The survey was electronic and voluntary.
2. The study was administered in the winter of the school year.
3. Randomly selected teachers' participation was not guaranteed as the invite was sent to the participants' school email accounts.

Limitations

The data from the study was limited to the integrity of the following:

1. Participants self-reported truthful data and information on survey instruments.
2. Participants possessed the skills to accurately utilize technology for survey completion.
3. Number of participants in the study was enough to minimize the impact of less-than-integral responses.

Summary

This chapter explored various methodological analyses within this study. The research questions and the null hypotheses were presented, and the inferential testing decisions were explained. The study was widely conducted to determine whether statistical differences among the three areas (best practice usage in mathematics, self-efficacy, and mindset) were present within Indiana teachers based on location type, years of experience, and grade level area. This study also sought to determine whether the areas of self-efficacy and mindset explain the usage of best practices in mathematics instruction.

CHAPTER 4

FINDINGS OF THE DATA ANALYSIS

The purpose of this quantitative study was to gather information from elementary teachers who use best practice to examine the impact of self-efficacy and mindset. The research addressed whether location type, years of experience, and differences in primary and intermediate teachers existed, regarding impact on teachers' mathematics self-efficacy and mindset. Only public-school elementary teachers in the state of Indiana were eligible to participate in the study. One thousand, five hundred invites were sent out. Three hundred forty email addresses bounced back, with 274 responding, leaving a response rate of 23.6%. Data were collected from Indiana elementary teachers who voluntarily responded regarding best practice, mindset, and self-efficacy. The variables were analyzed and compared using one-way ANOVAs, independent t-tests, and simultaneous multiple regression. The data were collected via an email sent to respondents. The email contained a link to the survey and assured participants of anonymity. I developed the survey to include statements in three categories regarding best practice, mindset, and self-efficacy. I also collected demographic information.

The survey consisted of 24 statements, that were divided evenly between best practice, mindset, and self-efficacy, with four additional questions regarding demographics. Eight questions were asked per each dependent variable. Other questions addressed each elementary teacher's school's geographic location, grade level of current instruction, whether teachers were responsible for instruction in all subjects or specialized in specific subjects, and how many years of teaching experience respondents had. Each grouping of eight questions were combined to form three composite scores. Each composite score proved sufficient levels of reliability, to form composite scores that will appear in inferential testing, detailed later in this chapter (Gravetter & Wallnau, 2017). The best practice statements combined for a Cronbach's alpha score of .856. The mindset grouping of statements had a Cronbach's alpha score of .783. And the self-efficacy statements yielded a Cronbach's alpha score of .773. These met the minimum of .7 and allowed me to conclude reliability within the formation of composite scores. Since all scores prove reliable, the three composite scores in the study were calculated using every question of the survey.

Except for the demographic questions (i.e., 24 – 28) at the end of the survey, all questions were worded as statements, based on a six-point Likert scale. Respondents were able to identify their responses through choices offered: *strongly agree, agree, somewhat agree, somewhat disagree, disagree, and strongly disagree.* The study was conducted by random sampling (Gravetter & Wallnau, 2017). A list of elementary teachers' public-school emails was obtained from the Indiana Department of Education in March 2022. I identified every tenth email address, sending out a total of 1500 emails to elementary teachers in Indiana. The survey was sent out during that same month via Qualtrics software. The survey was sent via respondents' public school email addresses which were accessible via the Indiana State Board of Education. Any addresses that were shown as duplicates were not chosen from the list, prior to the survey administration. Any addresses that could not receive the email were sent back, changing the number of possible respondents to 1160. During the survey, a total of 274 (23.6%) were opened and started. Of those started, 155 (13.4%) were completed and included in the data analysis.

Responses were collected for three weeks. Any participant who did not respond to at least 80% of the statements was removed from the data file to avoid negative impact from incomplete surveys. Upon completion of the survey collection, the Qualtrics program imported the data to SPSS for analysis.

Research Questions

In an effort to predict the impact of self-efficacy and mindset on best practices in mathematics instruction, this study will address the following questions:

1. What is the state of self-efficacy, mindset, and best practices of math instruction among Indiana general education elementary teachers?
2. Is there a statistically significant difference based on location type on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana general education elementary teachers?
3. Is there a statistically significant difference based on years of experience on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana general education elementary teachers?
4. Is there a statistically significant difference based on grade level area on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana general education elementary teachers?
5. Does the self-efficacy and mindset composite scores explain a statistically significant amount of variance within the best practices of math instruction composite scores for Indiana general education elementary teachers?

Null Hypotheses

H_o1 (i.e., R.Q. 2): There is not a statistically significant difference based on location type on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers.

H_o2 (i.e., R.Q. 3): There is not a statistically significant difference based on years of experience on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers.

H_o3 (i.e., R.Q. 4): There is not a statistically significant difference based on grade level area on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers.

H_o4 (i.e., R.Q.5): The self-efficacy and mindset composite scores do not explain a statistically significant amount of variance within the best practices of math instruction composite score for Indiana elementary teachers.

Descriptive Data

Of the 155 elementary teachers that responded to the survey, within this study, there were 54 (34.8%) rural school-teacher respondents, 44 (28.4%) suburban school-teacher respondents, and 57 (36.8%) urban school-teacher respondents. Also, 75 (48.4%) of the respondents identified as primary (K-2) teachers and 80 (51.6%) of the respondents identified as intermediate (3-6) teachers. When I looked at the breakdown of the teachers, I also noticed 142 (91.6%) indicated they taught all subjects throughout the school day, and 13 (8.4%) of the respondents indicated they specialized in one subject. Of the respondents, 31 (20%) had less than 5 years of teaching experience, 57 (36.8%) respondents had been teaching for 5 – 15 years and 67 (43.2%) indicated they had been teaching for more than 15 years.

The average composite scores of the best practices group of questions had a mean of 4.66 with *SD* = .67. The average composite score for self–efficacy rendered a mean of 4.68 and an *SD* = .70. And the mindset composite score gave a mean of 4.50 with an *SD* = .68.

To provide more insight, I will examine each statement to look at the responses of the respondents. In examining the composite scores of best practices, and when asked about their depth of student understanding through questioning techniques, the most frequent response was agreed, with 80 (52.9%) respondents. When looking at the respondents who reported consistently providing time for students to analyze their thoughts in order to increase problem-solving ability, 141 (90.9%) demonstrated at least some level of agreement. The most frequent response of respondents felt they frequently reflected on their instructional decisions to consistently improve their ability to meet individual needs of students was 79 (51%). While the most frequent response of those who utilize a deep understanding of math content in order to adapt their teaching strategies to maximize growth was 85 (54.8%).

Additionally, regarding best practices, some level of agreement existed among 146 (94.8%) of respondents who consistently made lessons meaningful by providing practical real-world connections to math. Teachers who participated in the survey reported at some level of agreement with providing ample opportunities for engagement in mathematical discourse surrounding content at a frequency of 130 (82.8%). And with some level of agreement 118 (76.1%) teachers stated they provided time for students to explore content deeply to develop mathematical persistence, and 129 (83.3%) teachers spent as much time working on student conceptual knowledge while teacher procedures (such as formulas) for problem solving.

When examining teacher self-efficacy, 101 (65.1%) teachers responded at some level of agreement that they had been provided with ample professional development to feel comfortable changing instructional practices when needed in mathematics, while 126 (80.3%) teachers mostly agreed they frequently collaborated with other teachers to enhance their ability to teach math. Over half of respondents, 79 (51%), responded they take the time to reflect on success and failures of lessons to improve over time. Of the respondents, 153 (98.7%) overwhelmingly agreed at some level of agreement they believed they could improve student performance in math. A large number, 148 (95.5%), also agreed at some level they believed they had strong content knowledge in math. The majority of respondents, 132 (85.1%), also agreed at some level they used student-centered instructional techniques over teacher-centered instruction daily. Most of the respondents, 110 (79%), agreed at some level they do not stress about math; and most, 137 (88.5%), also agreed at some level they did not have a negative relationship with math.

The section on teacher mindset revealed the majority of respondents, 138 (89%), agreed at some level to looking forward to teaching math each day. At some level of agreement, 130 (83.9%) of all respondents also responded they consistently communicated math as a subject of growth to their students. Most respondents, 136 (87.7%), also agreed on some level that they give students time to see trends and patterns in math. And 127 (81.9%) of respondents agreed at some level they consistently explore students' thoughts about what might work to solve a problem before a procedural method is demonstrated to solve the problem. More respondents than not, 119 (76.8%), agreed at some level that they give time for students to demonstrate creativity and innovate in math. While also astoundingly agreeing, 143 (92.3%) agreed with the statement they always respond to student mathematical discourse by focusing on correct thinking versus incorrect thinking, to promote a growth-oriented learning environment. At some level of agreement, 128 (82.6%) of respondents do not provide opportunities for students to opt out of mathematical thinking and 129 (83.3%) agreed at some level that they excel at providing extended practice time to allow students to develop understanding in math.

Breakdown of Rural Respondents

Table 1 shows responses of teachers from elementary schools in rural areas. There were 54 (34.8%) respondents reporting in this setting. Table 1 presents the descriptive data for the respondents in the rural school setting relative to the use of best practice in mathematics classrooms.

Table 1

Rural Responses on Best Practices

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Probing for Depth of Student understanding	0 (0%)	1 (1.9%)	16 (29.6%)	0 (0%)	28 (51.9%)	9 (16.7%)
Provide time for students to Analyze	0 (0%)	1 (1.9%)	4 (7.4%)	19 (35.2%)	21 (38.9%)	9 (16.7%)
Frequently Reflect on Instructional decisions	0 (%0)	0 (0%)	1 (1.9%)	6 (11.1%)	28 (51.9%)	19 (35.2%)
Utilize deep Understanding Of Math content	0 (0%)	0 (0%)	1 (1.9%)	8 (14.8%)	33 (61.1%)	12 (22.2%)
Consistently	0	2	1	17	24	10

Make lessons Meaningful	(0%)	(3.7%)	(1.9%)	(31.5%)	(44.4%)	(18.5%)
Have students Engage in Math discourse	0 (0%)	6 (11.1%)	4 (7.4%)	19 (35.2%)	19 (35.2%)	6 (11.1%)
Provide time To explore Content deeply	0 (0%)	5 (9.3%)	9 (16.7%)	17 (31.5%)	19 (35.2%)	4 (7.4%)
Conceptual and procedural	0 (0%)	2 (3.7%)	7 (13.0%)	11 (20.4%)	29 (53.7%)	5 (9.3%)

In general, the data showed elementary teachers in rural areas had some level of agreement with the use of best practices identified for mathematics instruction. The data also showed that 51.9% of rural respondents agreed with probing for depth of student understanding by using questioning techniques which was very similar to the whole sample percentage of 52.9%. In both the whole sample and the rural respondents, more than 90% of participants had some level of agreement with providing time for students to analyze their thoughts in order to increase their ability to problem-solve in math. The whole and rural samples also show an overwhelming response of more than 95% having some level of agreement with the teacher frequently reflecting on their instructional decisions to consistently improve their ability to meet students' individualized needs and utilizing their deep understanding of math content to adapt teaching strategies and maximize student growth. And quite similarly, both the whole sample and the rural sample showed 94.2 % and 94.4%, respectively, teachers having some level of agreement with consistently making lessons meaningful. `

Just over 80% of respondents in both samples reported a level of agreement with having students engage in mathematical discourse. Additionally, in the whole sample, 23.8% of the respondents showed some level of disagreement with providing time for students to explore content deeply for students to develop mathematical persistence, while in rural areas 26% responded similarly. And 83.3% of the whole sample showed some agreement with working on students' conceptual knowledge and teaching procedures, while the rural samples responded the same with 86.4% having some level of agreement.

Table 2 shows respondents from elementary schools in rural areas. There were 54 (34.8%) respondents reporting in this area. Table 2 presents the descriptive data for the elementary teachers in the rural school setting relative to teachers' self-efficacy in mathematics classrooms.

Table 2

Rural Responses on Self-Efficacy

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Provided ample Professional Development	2 (3.7%)	12 (22.2%)	9 (16.7%)	16 (29.6%)	10 (18.5%)	5 (9.3%)
Frequently collaborate To enhance own ability	0 (0%)	3 (5.6%)	9 (16.7%).	15 (27.8%)	18 (33.3%)	9 (16.7%)
Consistently Reflect on Successes and failures	0 (0%)	0 (0%).	4 (7.4%)	8 (14.8%)	26 (48.1%)	16 (29.6%)
Can improve student Performance	0 (0%)	0 (0%)	1 (1.9%)	4 (7.4%)	25 (46.3%)	24 (44.4%)

Have strong content knowledge	0 (0%)	0 (0%)	1 (1.9%)	13 (24.1%)	20 (37.0%)	20 (37.0%)
Use student - Centered Instruction	0 (0%)	4 (7.4%)	5 (9.3%)	20 (37.0%)	18 (33.3%)	7 (13.0%)
Do not stress about teaching math	0 (0%)	1 (1.9%)	16 (29.6%)	0 (0%)	28 (51.9%)	9 (16.7%)
Do not have Negative relationship	3 (5.6%)	2 (3.7%)	11 (20.4%)	8 (14.8%)	17 (31.5%)	13 (24.1%)

The whole sample showed 34.8% of teachers had some level of disagreement with being provided ample professional development, whereas 42.6% of the rural respondents responded the same way. Both samples had more than 77% level of agreement with frequently collaborating with colleagues to enhance their own ability, whereas an overwhelming majority in both samples had some level of agreement consistently reflecting on successes and failures of lessons to improve over time. In both samples, over 98% of teachers had some level of agreement that they can improve student performance. Similarly, 95.5% of teachers in the whole sample reported having strong content knowledge, like 98.1% of the rural sample. Both samples showed the participants' level of disagreement with the use of student-centered instructional techniques with only 16.7% for rural and 14.8% for the whole responding in this manner. With respect to not stressing about teaching math, 70.4% of the rural respondents, and 70.9% of whole sample respondents had some level of agreement. And the whole sample has 88.5% of whole sample respondents but only 70.4% of rural respondents reporting a level of agreement with not having a negative relationship with mathematics.

Table 3 shows responses of teachers from elementary schools in rural areas. There were 54 (34.8%) respondents reporting in this setting. Table 3 presents the descriptive data for the respondents in the rural school setting relative to the mindset of teachers in mathematics.

Table 3

Rural Responses on Mindset

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Look forward To teaching Math Daily	1 (1.9%)	2 (3.7%)	4 (7.4%)	9 (16.7%)	18 (33.3%)	20 (37.0%)
Communicate math as Subject of growth	0 (0%)	3 (5.6%)	4 (7.4%)	9 (16.7%)	28 (51.9%)	10 (18.5%)
Provide time To see Trends and patterns	0 (0%)	1 (1.9%)	3 (5.6%)	20 (37.0%)	20 (37.0%)	10 (18.5%)
Explore Problem Solving	0 (0%)	2 (3.7%)	9 (16.7%)	13 (24.1%)	21 (38.9%)	9 (16.7%)
Give time To demonstrate creativity	0 (0%)	7 (13.0%)	7 (13.0%)	20 (37.0%)	12 (22.2%)	8 (14.8%)

Respond to discourse Focused on correct	0 (0%)	1 (1.9%)	3 (5.6%)	26 (48.1%)	16 (29.6%)	8 (14.8%)
Do not allow Opt-out	0 (0%)	5 (9.3%)	3 (5.6%)	14 (25.9%)	22 (40.7%)	10 (18.5 %)
Excel at providing Extended practice	0 (0%)	1 (1.9%)	9 (16.7%)	26 (48.1%)	13 (24.1%)	5 (9.3%)

The whole sample (89%) and rural samples (87%) show comparable results regarding looking forward to teaching math daily. And similarly, 83.9% of the whole sample and 87.1% of the rural sample respondents communicate math as a subject based on growth. As it relates to giving students time to see trends and patterns in mathematics, 87.7% of the whole sample and 92.5% of the rural sample responded with some level of agreement. Both groups also compare well regarding the exploration of problem solving prior to demonstrating the procedural method of solving problems with 81.9% of the whole sample and 79.9% of the rural sample responding with some level of agreement.

Likewise, both samples showed a level of disagreement with giving time to demonstrate creativity and innovation at 26% for the rural sample and 23.2% for the whole sample. The majority response for responding to mathematical discourse by focusing on what is correct in the thinking rather than focusing on incorrect answers, resulted in 92.3% for the whole sample and

92.5% for the rural sample. When looking at those respondents who do not allow students to opt-out, there was some level of disagreement at 17.4% of the whole sample and 14.9% of the rural sample. Comparably, when asked if they excelled at providing extended practice time to allow students to develop their understanding in mathematics, the whole sample agreed at 83.3% while the rural sample agreed at 81.4%.

Breakdown of Suburban Respondents

Table 4 shows responses of teachers from elementary schools in suburban areas. There were 44 (28.4%) respondents reporting in this setting. Table 4 presents the descriptive data for the respondents in the suburban school setting relative to the use of best practice in mathematics classrooms.

Table 4

Suburban Responses on Best Practices

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Probing for Depth of Student understanding	0 (0%)	0 (0%)	2 (4.5%)	15 (34.1%)	21 (47.7%)	6 (13.6%)
Provide time for students to Analyze	0 (0%)	2 (4.5%)	2 (4.5%)	19 (43.2%)	14 (31.8%)	7 (15.9%)
Frequently Reflect on Instructional decisions	0 (0%)	0 (0%)	1 (2.3%)	5 (11.4%)	23 (52.3%)	15 (34.1%)
Utilize deep Understanding Of Math content	0 (0%)	1 (2.3%)	0 (0%)	7 (15.9%)	22 (50.0%)	13 (29.5%)

Consistently Make lessons Meaningful	0 (0%)	0 (0%)	2 (4.5%)	15 (34.1%)	19 (43.2%)	8 (18.2%)
Have students Engage in Math discourse	0 (0%)	3 (6.8%)	3 (6.8%)	19 (43.2%)	14 (31.8%)	5 (11.4%)
Provide time To explore	1 (2.3%)	4 (9.1%)	7 (15.9%)	16 (36.4%)	15 (34.1%)	1 (2.3%)
Conceptual and Procedural	1 (2.3%)	2 (4.5%)	5 (11.4%)	15 (34.1%).	15 (34.1%)	6 (13.6%)

The suburban responses compare closely to the whole sample for each question. As it relates to probing for depth of understanding, the suburban respondents reported 95.5% while the whole sample reported 94.2% and both samples reported 91% (suburban) and 90.9% whole sample for providing time for students to analyze their thoughts to increase problem solving. Both groups reported reflecting frequently on instructional decisions at higher than 95% (whole: 96.8%, suburban: 97.7%). Most of both groups also had a level of agreement with utilizing their deep understanding of math content to adjust teaching strategies at 95.4% for the whole group and 97.7% for the whole sample. Each group also had a level of agreement with making lessons meaningful at more than 90% (i.e., whole sample: 94.2%, suburban sample: 95.5%).

While the whole sample had a level of disagreement at 5.7% for having students engage in mathematical discourse, the suburban sample's level of disagreement was 13.6%. The samples were comparable at providing time to explore content deeply to develop mathematical persistence with 76.1% of the whole sample having some level of agreement and 72.7% of the suburban sample having some level of agreement. The samples are also alike when it comes to preparing students both conceptually and procedurally with the urban sample reporting 81.8% of level of agreement and 83.3% of the whole sample reporting.

Table 5 shows responses of teachers from elementary schools in suburban areas. There were 44 (28.4%) respondents reporting in this setting. Table 5 presents the descriptive data for the respondents in the suburban school setting relative to teachers' self-efficacy in mathematics classrooms.

Table 5

Suburban Responses on Self-Efficacy

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Provided ample Professional Development	3 (6.8%)	7 (15.9%)	5 (11.4%)	12 (27.3%)	15 (34.1%)	2 (4.5%)
Frequently collaborate To enhance own ability	1 (2.3%)	1 (2.3%)	5 (11.4%)	10 (22.7%)	15 (34.1%)	12 (27.3%)
Consistently Reflect on Successes and failures	0 (0%)	0 (0%)	1 (2.3%)	8 (18.2%)	18 (40.9%)	17 (38.6%)
Can improve student Performance	0 (0%)	0 (0%)	0 (0%)	5 (11.4%)	16 (36.4%)	23 (52.3%)

Have strong content knowledge	0 (0%)	1 (2.3%)	1 (2.3%)	4 (9.1%)	19 (43.2%)	19 (43.2%)
Use student - Centered Instruction	0 (0%)	1 (2.3%)	7 (15.9%)	15 (34.1%)	14 (31.8%)	7 (15.9%)
Do not stress about teaching math	1 (2.3%)	4 (9.1%)	5 (11.4%)	9 (20.5%)	17 (38.6%)	8 (18.2%)
Do not have Negative relationship	0 (0%)	1 (2.3%)	2 (4.5%)	4 (9.1%)	19 (43.2%)	18 (40.9%)

The data in the whole sample shows 65.1% of respondents feel they have been provided ample professional development and likewise the suburban response reflects this data with 65% having some level of agreement for ample professional development. When asked about frequently collaborating to enhance their own ability to enhance teaching, the whole sample reported a level of agreement at 81.3% and the suburban sample reported 84.1%. Both samples showed an elevated level of reflection on successes and failures to improve lessons, with the suburban sample reporting at 97.7% and the whole sample reporting at 96.2%.

The whole sample has some level of agreement it can improve student performance at a frequency of 98.7% while the suburban sample has some level of agreement at a frequency of 100%. And more than 90% of the respondents in both groups reported they have a strong content knowledge to draw from in math (i.e., whole: 95.5%, suburban: 94.5%). Regarding use of student-centered instruction, the whole group reported 14.8% at a level of disagreement whereas the suburban group reported 18.2% at a level of disagreement. The samples were similar as it relates to those who do not stress about math, with 77.2% of the suburban sample having some level of agreement and the whole sample reporting at 70.9%. The suburban sample (6.8%) differs slightly from the whole sample (11.7%) with the level of disagreement for not having a negative relationship with mathematics.

Table 6 shows responses of teachers from elementary schools in rural areas. There were 44 (28.4%) respondents reporting in this setting. Table 6 presents the descriptive data for the respondents in the rural school setting relative to teachers' mindset in mathematics.

Table 6

Suburban Responses on Mindset

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Look forward To teaching Math Daily	0 (0%)	2 (4.5%)	2 (4.5%)	13 (29.5%).	11 (25.0%)	16 (36.4%)
Communicate math as Subject of growth	0 (0%)	4 (9.1%)	5 (11.4%)	11 (25.0%)	13 (29.5%)	11 (25.0%)
Provide time To see Trends and patterns	0 (0%)	2 (4.5%)	4 (9.1%)	15 (34.1%)	17 (38.6%)	6 (13.6%)
Explore Problem Solving	1 (2.3%)	1 (2.3%)	6 (13.6%)	13 (29.5%)	15 (34.1%)	8 (18.2%)

Give time To demonstrate creativity	0 (0%)	5 (11.4%)	6 (13.6%)	15 (34.1%)	13 (29.5%)	5 (11.4%)
Respond to discourse Focused on correct	0 (0%)	1 (2.3%)	2 (4.5%)	17 (38.6%)	18 (40.9%)	6 (13.6%)
Do not allow Opt-out	1 (2.3%)	2 (4.5%)	10 (22.7%)	8 (18.2%)	13 (29.5%)	10 (22.7%)
Excel at providing Extended practice	0 (0%)	4 (9.1%)	5 (11.4%)	18 (40.9%)	14 (31.8%)	3 (6.8%)

Most respondents in both samples look forward to teaching math each day with the whole sample reporting 89% and the suburban sample reporting 91% levels of agreement. Whereas 20.5% of the suburban sample and 16.1% of the whole sample showed some levels of agreement with communicating math as a subject based on growth. 87.7% of the whole sample showed a level of agreement with providing students time to see trends and patterns and likewise 86.4% of the suburban sample showed a level of agreement.

As it relates to problem solving involving exploration and procedural methods, only 16.9% of the whole sample showed a level of disagreement while the suburban sample showed an 18.2% level of disagreement. When asked about giving students time to be creative and innovative, a quarter (25%) of the suburban sample showed a level of disagreement while 23.2% of the whole sample showed a level of disagreement. And in responding to discourse focused on correct versus incorrect responses, the whole sample had a 92.3% level of agreement, and the suburban sample had a 93.2% level of agreement. According to the data in the whole sample, 82.6% of students reported having some level of agreement with not allowing students to opt out, while the suburban sample showed 70.4% of some level of agreement in this category. And when asked about providing extended practice to allow students to develop understanding, the whole sample reported a 16.7% level of disagreement whereas, the suburban sample reported 20.5%.

Breakdown of Urban Respondents

Table 7 shows responses of teachers from elementary schools in urban areas. There were 57 (36.8%) respondents reporting in this setting. Table 7 presents the descriptive data for the respondents in the urban school setting relative to the use of best practice in mathematics classrooms.

Table 7

Urban Responses on Best Practices

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Probing for Depth of Student understanding	1 (1.8%)	1 (1.8%)	4 (7.0%)	15 (26.3%)	33 (57.9%)	3 (5.3%)
Provide time for students to Analyze	1 (1.8%)	2 (3.5%)	2 (3.5%)	16 (28.1%)	25 (43.9%)	11 (19.3%)
Frequently Reflect on Instructional decisions	2 (3.5%)	0 (0%)	1 (1.8%)	5 (8.8%)	28 (49.1%)	21 (36.8%)
Utilize deep Understanding Of Math content	1 (1.8%)	1 (1.8%)	2 (3.5%)	5 (8.8%)	30 (52.6%)	18 (31.6%)

Consistently Make lessons Meaningful	1 (1.8%)	1 (1.8%)	2 (3.5%)	10 (17.5%)	33 (57.9%)	10 (17.5%)
Have students Engage in Math discourse	1 (1.8%)	1 (1.8%)	7 (12.3%)	16 (28.1%)	25 (43.9%)	7 (12.3%)
Provide time To explore Content deeply	1 (1.8%)	3 (5.3%)	7 (12.3%)	14 (24.6%)	25 (43.9%)	7 (12.3%)
Conceptual And Procedural	1 (1.8%)	2 (3.5%)	6 (10.5%)	14 (24.6%)	26 (45.6%)	8 (14.0%)

While the urban sample shows strong similarities to the whole sample with 89.4% urban and 94.2% whole sample, there was a significant difference in frequency of those who strongly agreed to probing for depth of understanding in students. The whole sample reported 11.6%, while the urban sample showed 5.3% strongly agreeing. The whole sample showed 90.9% of respondents showing some level of agreement with providing time for students to analyze their thoughts to increase problem-solving ability and the urban sample showed 91.2% level of agreement. The whole sample showed a level of disagreement for frequently reflecting on instructional decisions at a level of disagreement at 3.2% while the urban sample showed the level of disagreement at 5.3%. The whole sample showed a level of agreement for utilizing deep understanding of math content at 95.4%, while the urban sample showed the frequency of 92.9%.

Of the responses to making lessons meaningful, 7.1% of the urban sample showed some level of disagreement and 5.7% of the whole sample showed a level of disagreement. Of those participants reporting some level of disagreement with having students engage in mathematical discourse, 8% of the whole sample reported this, with 15.9% of the urban sample reporting. Consequently 76.1% of the whole sample showed some level of agreement with providing students with time to explore math content deeply to develop persistence in students, while 80.6% of the urban sample had some level of agreement with this statement. Lastly, 83.3% of the whole sample reported working with students on conceptual and procedural methods to problem solving, while the urban sample reported 84.2% level of agreement.

Table 8 shows responses of teachers from elementary schools in urban areas. There were 57 (36.8%) respondents reporting in this setting. Table 8 presents the descriptive data for the respondents in the urban school setting relative to teachers' self-efficacy in mathematics.

Table 8

Urban Responses on Self-Efficacy

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Provided ample Professional Development	7 (12.3%)	3 (5.3%)	6 (10.5%)	17 (29.8%)	19 (33.3%)	5 (8.8%)
Frequently collaborate To enhance own ability	1 (1.8%)	6 (10.5%)	3 (5.3%)	13 (22.8%)	27 (47.4%)	7 (12.3%)
Consistently Reflect on Successes and failures	1 (1.8%)	0 (0%)	0 (0%)	10 (17.5%)	35 (61.4%)	11 (19.3%)
Can improve student Performance	1 (1.8%)	0 (0%)	0 (0%)	5 (8.8%)	30 (52.6%)	21 (36.8%)

Have strong content knowledge	2 (3.5%)	0 (0%)	2 (3.5%)	7 (12.3%)	28 (49.1%)	18 (31.6%)
Use student - Centered Instruction	2 (3.5%)	0 (0%)	4 (7%)	16 (28.1%)	26 (45.6%)	9 (15.8%)
Do not stress about teaching math	5 (8.8%)	6 (10.5%)	8 (14.0%)	7 (12.3%)	20 (35.1%)	11 (19.3%)
Do not have Negative relationship	2 (3.5%)	0 (0%)	5 (8.8%)	10 (17.5%)	22 (38.6%)	18 (31.6%)

While the comparisons for being provided ample professional development shows comparable levels of disagreement and agreement, the whole sample shows 7.7% strongly disagree, while the urban sample showed 12.3% strongly disagreed. The whole sample shows 81.3% of respondents having some level of agreement with frequently collaborating with colleagues to enhance their own ability, while the urban sample yielded 82.4%. An overwhelming majority of respondents reported having some level of agreement above 95% in both samples (i.e., whole sample: 96.2%, urban sample: 98.2%) consistently reflecting on students' successes and failures. Likewise, both samples, urban and whole (i.e., 98.2%, 98.7% respectively) showed some level of agreement that they can improve student performance.

The majority of the whole sample and the urban sample respondents have a level of agreement with having strong content knowledge to draw from at 95.5% and 93% respectively. Of those respondents using student-centered instruction versus teacher-driven techniques, 10.5% of the urban sample showed a level of disagreement, while 14.8% of the whole sample showed a level of disagreement. While 29% of the whole sample reported some level of disagreement with not stressing about teaching math, 33.3% of the urban sample had some level of disagreement. And similarly, 88.5% of the whole sample reported some level of agreement with not having a negative relationship with math, while 87.7% of the urban sample had some level of agreement.

Table 9 shows responses of teachers from elementary schools in urban areas. There were 57 (36.8%) respondents reporting in this setting. Table 9 presents the descriptive data for the respondents in the urban school setting relative to teachers' mindset in mathematics.

Table 9

Urban Responses on Mindset

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Look forward To teaching Math Daily	2 (3.5%)	2 (3.5%)	2 (3.5%)	18 (31.6%)	23 (40.4%)	10 (17.5%)
Communicate math as Subject of growth	1 (1.8%)	3 (5.3%)	5 (8.8%)	7 (12.3%)	27 (47.4%)	14 (24.6%)
Provide time For trends and patterns	1 (1.8%)	1 (1.8%)	7 (12.3%)	15 (26.3%)	28 (49.1%)	5 (8.8%)
Explore Problem Solving	1 (1.8%)	1 (1.8%)	7 (12.3%)	14 (24.6%)	29 (50.9%)	5 (8.8%)
Give time To demonstrate creativity	1 (1.8%)	4 (7.0%)	6 (10.5%)	11 (19.3%)	29 (50.9%)	6 (10.5%)

Respond to discourse Focused on correct	1 (1.8%)	0 (0%)	4 (7.0%)	15 (26.3%)	32 (56.1%)	5 (8.8%)
Do not allow Opt-out	1 (1.8%)	2 (3.5%)	3 (5.3%)	12 (21.1%)	31 (54.4%)	8 (14.0%)
Excel at providing Extended Practice	1 (1.8%)	2 (3.5%)	4 (7.0%)	20 (35.1%)	19 (33.3%)	11 (19.3%)

The urban responses strongly mirror the whole sample responses for all statements. The urban responses for those who look forward to teaching math daily have a level of agreement frequency of 89.5% while the frequency for the whole sample is 89%. The respondents who communicated math as a subject based on growth had a level of disagreement of 15.9% and the whole sample level of disagreement for this statement was 16.1%. When asked if they provided time for students to see trends and patterns, the urban sample level of agreement was 84.1% with the whole sample level of agreement at 87.7%. Of those respondents who explore students' thoughts prior to introducing procedural models, the urban respondents reported some level of disagreement frequency data totaling 15.9%, whereas the level of disagreement for the whole group was reported as 16.9%.

When asked about giving time to students to create and innovate the whole sample showed a level of agreement of 76.8% with the urban sample showing 80.7%. And when comparing the urban level of disagreement (8.8%) for those who respond to students' discourse focusing on correct answers versus incorrect answers, to the whole sample level of disagreement (7.7%), the data showed a remarkably close similarity. When looking at respondents' level of agreement with not providing students opportunities to opt out of mathematical thinking, the frequency of the whole sample was 82.6% and the urban sample was 89.4%. The frequency of respondents reporting they had a level of agreement with excelled at providing extended practice time to allow students to develop a mathematical understanding for the urban sample was 87.7% while the whole sample was 83.3%.

Breakdown of Primary and Intermediate Respondents

Intermediate and Primary Best Practices

The teachers who taught Primary (K-2) had a strong level of agreement, 96%, with probing for depth of student understanding, which was slightly more than the level of agreement of the intermediate sample, which had a 92.4% level of agreement. And when looking at consistently providing time for students to analyze their thoughts for problem-solving, the intermediate group had a level of disagreement of 11.4%, whereas the primary level of disagreement was only 6.7%. The intermediate respondents who frequently reflect on their instructional decisions to meet the needs of students, had a level of agreement of 95%, with the primary sample slightly larger at 98.7%. The primary level of agreement for utilizing their deep understanding of math content to adapt teaching strategies was 97.4% with the level of agreement responses of the intermediate group totaling 94.9%.

The intermediate group reported a 91.2% level of agreement with making lessons meaningful, whereas the level of agreement of the primary sample was higher at 97.4%. And when looking at providing opportunities for students to engage in mathematical discourse, the intermediate level of agreement was 83.6%, with the primary level of agreement remarkably similar at 84%. When asked about providing time for students to explore content deeply, the intermediate respondents had a 30% level of disagreement, which was significantly higher than the level of disagreement of the primary sample, 17.3%. And when looking at spending time on conceptual and procedural knowledge, the level of disagreement for the intermediate respondents was 20.1% whereas the primary sample was slightly lower at 13.3%.

.Primary and Intermediate Self-Efficacy

The primary teachers also felt strongly in their level of disagreement with being provided ample professional development (28%); however, the level of disagreement of the intermediate group was significantly larger at 41.3%. The intermediate sample had a 22.5% level of disagreement with the statement regarding frequently collaborating with other teachers to enhance their ability to teach, while the primary sample had a lower level of disagreement with the statement (14.6%). When asked about consistently taking time to reflect on successes and failures, the primary group's level of agreement was overwhelming with 98.7%, while the intermediate sample had a slightly lower level of agreement at 93.7%. And when looking at improvement of students' performance, the primary group had an absolute level of agreement of 100%, while the intermediate sample was slightly lower at 97.4%.

The primary teachers who believed they have strong content knowledge had a 98.7% level of agreement whereas the intermediate sample had a 92.4% level of agreement in this area. And in observing the use of student-centered instructional techniques, the primary sample reported a level of disagreement of 12% with the intermediate group reporting slightly higher at 17.6%. The primary sample was not as stressed about teaching math, since their level of agreement with the statement about not stressing about teaching math was 78.6% with the level of agreement of the intermediate sample at 63.6%. And when looking at not having a negative relationship with mathematics, the level of agreement of the primary sample (83.4%) was slightly lower than the intermediate sample (89.9%).

Intermediate and Primary Mindset

The intermediate sample had an 84.9% level of agreement with looking forward to teaching math each day, whereas the level of agreement for the primary group was slightly lower (83.4%). As it relates to consistently communicating that math is a subject based on growth, the intermediate respondents had a level of agreement of 86.2%, whereas the primary sample had a level of agreement of 81.3%. And when analyzing giving students time to see trends and patterns in math, the primary sample had a level of disagreement of just 9.3% and the intermediate level of disagreement was higher at 15.1%. The primary sample had a level of agreement of 82.7% with exploring students' thoughts about what might work to solve problems, whereas the intermediate sample was very close at an 81.2% level of agreement.

When asked to identify their level of agreement with giving time to demonstrate creativity and innovation, the intermediate respondents had a 71.1% level of agreement while the primary sample had a significantly higher level of agreement of 82.6%. When looking at responses regarding responding to students' mathematical discourse based on correct thinking, the intermediate respondents reported an 89.9% level of agreement whereas the primary sample was slightly lower at 82.6%. And when observing providing opportunities for students to opt out of their thinking, the intermediate respondents had an 18.9% level of disagreement, with the primary sample having a 15.9% level of disagreement. The statement regarding excelling at providing extended practice time to allow students to develop their understanding in math, reported the level of agreement for the intermediate respondents at 86.2% with the primary group reporting lower at 80%.

.Breakdown of Respondents with Less than 5 Years of Experience

Table 10 shows responses of teachers from elementary schools with less than 5 years of experience. There were 31 (20.0%) respondents reporting. Table 10 presents the descriptive data for the respondents with less than 5 years of teaching experience regarding their use of best practice in the mathematics classroom.

Table 10

Less than 5 Years - Responses on Best Practices

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Probing for Depth of Student understanding	0 (0%)	0 (0%)	1 (3.2%)	11 (35.5%)	17 (54.8%)	2 (6.5%)
Provide time for students to Analyze	0 (1.3%)	0 (3.8%)	0 (6.3%)	10 (32.3%)	15 (48.4%)	6 (19.4%)
Frequently Reflect on Instructional decisions	0 (0%)	0 (0%)	2 (6.5%)	2 (6.5%)	10 (32.3%)	17 (54.8%)
Utilize deep Understanding Of Math content	0 (0%)	0 (0%)	1 (3.2%)	4 (12.9%)	15 (48.4%)	11 (35.5%)
Consistently Make lessons Meaningful	0 (0%)	0 (0%)	2 (6.5%)	9 (29.0%)	14 (45.2%)	6 (19.4%)

Have students Engage in Math discourse	0 (0%)	0 (0%)	4 (12.9%)	12 (38.7%)	9 (29.0%)	6 (19.4%)
Provide time To explore Content deeply	0 (0%)	1 (3.2%)	5 (16.1%)	7 (22.6%)	16 (51.6%)	2 (6.5%)
Conceptual And Procedural	0 (0%)	0 (0%)	2 (6.5%)	11 (35.5%)	15 (48.4%)	3 (9.7%)

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The sample of respondents with less than five years of teaching experience, when asked about probing for depth of student understanding in mathematics, there were 0% of respondents who strongly disagreed and disagreed with the statement whereas the whole sample showed 1.9% in those areas combined. Overwhelmingly 100% of respondents with less than five years of teaching experience had a level of agreement with the statement that they provide time for students to analyze their thoughts in order to increase problem-solving ability; however, the whole sample revealed a frequency of 90.9%. When asked about reflection on instructional decisions to meet needs of students, the whole sample reported a level of agreement of 96.8%, and the sample of teachers with less than five years of teaching experience had a level of agreement of 93.5%. Of the respondents with less than five years of teaching experience who utilize a deep understanding of math content, the level of agreement frequency was 96.8% while the level of agreement frequency for the whole sample was 95.4%.

When asked to identify whether or not there was agreement with the teachers consistently make lessons meaningful to the real world, the urban sample had a level of agreement at 93.5%, with the whole sample level of agreement at 94.2%. Teachers with less than five years of teaching experience who had a level of disagreement with students engage in mathematics discourse in the urban areas had a frequency of 12.9%, while the same factors in the whole sample resulted in an 8% level of disagreement. The respondents with less than five years of teaching experience who had a level of agreement with providing time to explore content deeply totaled 80.7% whereas the whole sample's level of agreement for this statement totaled just 76.1%. And when asked about teaching conceptual and procedural, the group with less than five years of teaching experience had a level of agreement of 93.5%, with the whole sample as low as 83.3%.

Table 11 shows responses of teachers from elementary schools with less than 5 years of experience. There were 31 (20.0%) respondents reporting. Table 11 presents the descriptive data for the respondents with less than 5 years of teaching experience regarding their self-efficacy in mathematics.

Table 11

Less than 5 Years - Responses on Self-Efficacy

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Provided ample Professional Development	3 (9.7%)	3 (9.7%)	7 (22.6%)	7 (22.6%)	10 (32.3%)	1 (3.2%)
Frequently collaborate To enhance own ability	0 (0%)	2 (6.5%)	4 (12.9%)	10 (32.3%)	9 (29.0%)	6 (19.4%)
Consistently Reflect on Successes and failures	0 (0%)	0 (0%)	2 (6.5%)	4 (12.9%)	17 (54.8%)	8 (25.8%)
Can improve student Performance	0 (0%)	0 (0%)	0 (0%)	2 (6.5%)	17 (54.8%)	12 (38.7%)

Have strong content knowledge	0 (0%)	0 (0%)	3 (9.7%)	5 (16.1%)	12 (38.7%)	11 (35.5%)
Use student - Centered Instruction	0 (0%)	0 (0%)	4 (12.9%)	9 (29.0%)	14 (45.2%)	4 (12.9%)
Do not stress about teaching math	3 (9.7%)	4 (12.9%)	2 (6.5%)	8 (25.8%)	11 (35.5%)	3 (9.7%)
Do not have Negative relationship	1 (3.2%)	1 (3.2%)	2 (6.5%)	4 (12.9%)	14 (45.2%)	9 (29.0%)

. As it related to being provided with ample professional development, the sample with less than five years of teaching experience had a level of disagreement at 42% while the whole sample had a level of disagreement at 34.8%. When asked about collaborating frequently to enhance their own ability, the sample with less than five years of teaching experience had a level of agreement of 80.6% with the whole sample’s frequency being 81.3%. And when taking a closer look at those who consistently reflect on successes and failures, the level of agreement was 93.5% with the level of agreement for the whole sample totaling 96.2%. Of those respondents who believe they can improve students' performance, the sample with less than five years of teaching experience had a remarkably overwhelming report of 100%, with the whole sample reporting as 98.7%.

When asked about teacher content knowledge to draw on, the group with less than five years of teaching experience reported a level of agreement at 91.3% with the whole sample at 95.5%. The sample with less than five years of teaching experience that reported somewhat disagreement with using student-centered instruction versus teacher-directed techniques was 12.9%, whereas the whole sample had a level of disagreement at 14.8%. When looking at the statement about not stressing about teaching math, the sample with less than five years of teaching experience had a level of disagreement of 29.1% and the whole sample had a level of disagreement of 29%. The whole sample has a level of agreement frequency of 88.5% with the teachers with less than five years of teaching experience having a level of agreement frequency of 87.3%.

Table 12 shows responses of teachers from elementary schools with less than 5 years of experience. There were 31 (20.0%) respondents reporting. Table 12 presents the descriptive data for the respondents with less than 5 years of teaching experience regarding their mind-set in mathematics.

Table 12

Less than 5 Years - Responses on Mindset

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Look forward To teaching Math Daily	2 (6.5%)	2 (6.5%)	1 (3.2%)	9 (29.0%)	13 (41.9%)	4 (12.9%)
Communicate math as Subject of growth	0 (0%)	1 (3.2%)	2 (6.5%)	11 (35.5%)	9 (29.0%)	8 (25.8%)
Provide time For trends and patterns	0 (0%)	0 (0%)	3 (9.7%)	8 (25.8%)	16 (51.6%)	4 (12.9%)
Explore Problem Solving	1 (3.2%)	0 (0%)	3 (9.7%)	10 (32.3%)	13 (41.9%)	4 (12.9%)
Give time To demonstrate creativity	0 (0%)	1 (3.2%)	2 (6.5%)	10 (32.3%)	15 (48.4%)	3 (9.7%)

Respond to discourse Focused on correct	0 (0%)	0 (0%)	3 (9.7%)	13 (41.9%)	13 (41.9%)	2 (6.5%)
Do not allow Opt-out	2 (6.5%)	2 6.5%)	4 (12.9%)	8 (25.8%)	11 (35.5%)	4 (12.9%)
Excel at providing Extended practice	0 (0%)	0 (0%)	4 (12.9%)	10 (32.3%)	12 (38.7%)	5 (16.1%)

In teachers with less than five years of teaching experience, there are a few significant differences in mindset. When looking at respondents who look forward to teaching math daily, teachers with less than five years of teaching experience reported a level of agreement at 83.8% with the whole sample reporting an 89% level of agreement. Whereas, of those who communicated math as a subject based on growth, the teachers with less than five years of teaching experience sample yielded a level of agreement of 90.3% with the whole sample yielding a level of agreement at 83.9%. When taking a closer look at providing time for students to see trends and patterns, the level of disagreement for the sample of teachers with less than five years of teaching experience totaled 9.7%, with the whole sample reporting a level of disagreement at 12.2%.

The sample of teachers with less than five years of teaching experience had a level of agreement totaling 87.1% with the whole sample totaling 81.9%. When probed about giving students time to innovate and create, the whole sample showed a level of disagreement at 23.2% whereas, the sample of teachers with less than five years of teaching experience was significantly different at 9.7%. Of the respondents with less than five years of teaching experience, the level of agreement for responding to students' discourse focused on correct versus incorrect answers was 90.3% and the whole sample response level of agreement was 90.3%. For those respondents asked to identify their level of agreement with not allowing students to opt out, the teachers with less than five years of teaching experience sample totaled 74.2% but the whole sample was 82.6%. When analyzing the response of those who reported excelling at providing extended practice, the whole sample had a level of disagreement of 16.7%, whereas the level of disagreement for the teachers with less than five years of teaching experience was 12.9%.

Breakdown of Respondents with 5 - 15 Years of Experience

Table 13 shows responses of teachers from elementary schools between 5 and 15 years of experience. There were 57 (36.8%) respondents reporting. Table 13 presents the descriptive data for the respondents with less than 5 years of teaching experience regarding their use of best practices in the mathematics classroom.

Table 13

5-15 Years - Responses on Best Practices

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Probing for Depth of Student understanding	0 (0%)	2 (3.5%)	3 (5.3%)	17 (29.8%)	26 (45.6%)	9 (15.8%)
Provide time for students to Analyze	0 (0%)	3 (5.3%)	5 (8.8%)	21 (36.8%)	19 (33.3%)	9 (15.8%)
Frequently Reflect on Instructional decisions	1 (1.8%)	0 (0%)	1 (1.8%)	6 (10.5%)	31 (54.4%)	18 (31.6%)
Utilize deep Understanding Of Math content	0 (0%)	1 (1.8%)	1 (1.8%)	8 (14.0%)	33 (57.9%)	14 (24.6%)

Consistently Make lessons Meaningful	0 (0%)	2 (3.5%)	2 (3.5%)	13 (22.8%)	29 (50.9%)	11 (19.3%)
Have students Engage in Math discourse	0 (0%)	5 (8.8%)	4 (7.0%)	21 (36.8%)	18 (31.6%)	9 (15.8%)
Provide time To explore Content deeply	0 (0%)	5 (8.8%)	8 (14.0%)	20 (35.1%)	15 (26.3%)	9 (15.8%)
Conceptual And Procedural	0 (0%)	2 (3.5%)	8 (14.0%)	15 (26.3%)	23 (40.4%)	9 (15.8%)

The sample of teachers with five to fifteen years of teaching experience showed 91.2% reported a level of agreement for probing for depth of understanding, while the whole sample reported a level of agreement of 94.2% in this area. For providing students time for students to analyze their thoughts to increase problem-solving ability, the teachers with five to fifteen years of teaching experience, the level of disagreement was 14.1% with the whole sample's level of disagreement at 9%. The level of agreement of those who frequently reflect on instructional decisions for students' needs for the sample of the teachers with five to fifteen years of teaching experience was 96.4% with the whole sample reporting a level of agreement, similarly at 96.8%. When looking at those teachers who utilize deep understanding of mathematical content, the sample of teachers with five to fifteen years of teaching experience had a level of agreement at 93%, with the whole sample slightly higher at 95.4%.

Of those who reported consistently making lessons meaningful, the sample of teachers with five to fifteen years of teaching experience reported level of disagreement at 7% with the whole sample's level of disagreement totaling 5.7%. When identifying teachers who have students engage in mathematical discourse, the whole sample had a level of disagreement frequency that totaled 16.1% with the sample of teachers with five to fifteen years of teaching experience following closely, with a level of disagreement of 15.8%. When looking at providing time to explore content deeply, the sample of teachers with five to fifteen years of teaching experience reported a level of agreement at 77.2% of respondents, while the whole sample's level of agreement was reported at 76.1%. The sample of teachers with five to fifteen years of teaching experience had a level of disagreement with teaching conceptually and procedurally at 17.5%, whereas the level of disagreement for the whole sample was close at 16.8%.

Table 14 shows responses of teachers from elementary schools between 5 and 15 years of experience. There were 57 (36.8%) respondents reporting. Table 14 presents the descriptive data for the respondents with 5-15 years of teaching experience regarding their self-efficacy in mathematics.

Table 14

5-15 Years - Responses on Self-Efficacy

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Provided ample Professional Development	5 (8.8%)	9 (15.8%)	9 (15.8%)	18 (31.6%)	13 (22.8%)	3 (5.3%)
Frequently collaborate To enhance own ability	1 (1.8%)	5 (8.8%)	10 (17.5%)	11 (19.3%)	22 (38.6%)	8 (14.0%)
Consistently Reflect on Successes and failures	0 (0%)	0 (0%)	1 (1.8%)	13 (22.8%)	28 (49.1%)	15 (26.3%)
Can improve student Performance	0 (0%)	0 (0%)	1 (1.8%)	7 (12.3%)	29 (50.9%)	20 (35.1%)

Have strong content knowledge	1 (1.8%)	1 (1.8%)	1 (1.8%)	10 (17.5%)	24 (42.1%)	20 (35.1%)
Use student - Centered Instruction	1 (1.8%)	2 (3.5%)	5 (8.8%)	17 (29.8%)	23 (40.4%)	9 (15.8%)
Do not stress about teaching math	3 (5.3%)	1 (1.8%)	17 (29.8%)	5 (8.8%)	17 (29.8%)	14 (24.6%)
Do not have Negative relationship	1 (1.8%)	3 (5.3%)	6 (10.5%)	8 (14.0%)	22 (38.6%)	17 (29.8%)

The sample of teachers with five to fifteen years of teaching experience reported a level of disagreement of 40.4% with being provided with ample professional development, with the whole sample's level of disagreement slightly lower at 34.8%. The sample group of teachers with five to fifteen years of teaching experience reported a level of agreement of 71.9% with the whole sample reporting a significantly higher difference of 81.3% when probing on whether they frequently collaborate with colleagues to enhance their own ability. When looking at the statement regarding consistent reflection on successes and failures, the level of agreement of the whole group's frequency was 96.2%, while the level of agreement of the sample of teachers with five to fifteen years of teaching experience was 98.2%. Of the respondents, the sample of teachers with five to fifteen years of teaching experience had a high level of agreement (98.2%) with the statement regarding improving teacher performance, as did the whole sample at 98.7%.

Only 5.4% of the sample of teachers with five to fifteen years of teaching experience had a level of disagreement with having strong content knowledge, while the whole sample showed a similar 5.5% level of disagreement with the statement. As it relates using student-centered instruction in the math classroom, the whole sample showed a frequency of 85.1% level of agreement, with the sample of teachers with five to fifteen years of teaching experience showing an 85.9% level of agreement. The sample of teachers with five to fifteen years of teaching experience showed a level of disagreement of 36.9% with not stressing about teaching math, and the whole sample's level of disagreement was 29%. The whole sample respondents reported an 11.7% level of disagreement with the sample of teachers with five to fifteen years of teaching experience reported a 17.6 % level of disagreement with not having a negative relationship with mathematics.

Table 15 shows responses of teachers from elementary schools between 5 and 15 years of experience. There were 57 (36.8%) respondents reporting. Table 15 presents the descriptive data for the respondents with 5 - 15 years of teaching experience regarding their mindset in mathematics.

Table 15

5-15 Years - Responses on Mindset

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Look forward To teaching Math Daily	0 (0%)	4 (7.0%)	3 (5.3%)	19 (33.3%)	15 (26.3%)	16 (28.1%)
Communicate math as Subject of growth	0 (0%)	5 (8.8%)	7 (12.3%)	7 (12.3%)	24 (42.1%)	14 (24.6%)
Provide time For trends and patterns	0 (0%)	2 (3.5%)	8 (14.0%)	20 (35.1%)	19 (33.3%)	8 (14.0%)
Explore Problem Solving	0 (0%)	2 (3.5%)	9 (15.8%)	13 (22.8%)	26 (45.6%)	7 (12.3%)
Give time To demonstrate creativity	1 (1.8%)	9 (15.8%)	9 (15.8%)	13 (22.8%)	14 (24.6%)	11 (19.3%)

Respond to discourse Focused on correct	0 (0%)	1 (1.8%)	5 (8.8%)	18 (31.6%)	27 (47.4%)	6 (10.5%)
Do not allow Opt-out	0 (0%)	4 (7.0%)	7 (12.3%)	13 (22.8%)	26 (45.6%)	7 (12.3%)
Excel at providing Extended practice	1 (1.8%)	1 (1.8%)	7 (12.3%)	25 (43.9%).	15 (26.3%)	8 (14.0%)

As it relates to looking forward to teaching math daily, the sample of the teachers with five to fifteen years of teaching experience had a level of agreement at 87.7% and likewise the whole sample showed a level of agreement at 89%. And 78.9% of the sample of teachers with five to fifteen years of teaching experience reported communicating math as a subject based on growth, whereas the whole sample reported at 83.9%. When looking at providing students with time to see trends and patterns, the whole sample had a level of disagreement at 12.2%, with the sample of teachers with five to fifteen years of teaching experience having a level of disagreement at 17.5%, showing a significant difference. Regarding consistently exploring students' thoughts about problem-solving, the sample of the teachers with five to fifteen years of teaching experience had a level of agreement at 80.7% while the whole sample had a close level of agreement at 81.9%.

When observing the respondents for time given to students to demonstrate creativity and innovation, the sample of teachers with five to fifteen years of teaching experience had a level of disagreement of 33.4%, while the level of agreement for the whole sample was significantly lower at 23.3%. And the analysis of the respondents responding to discourse focused on correct answers revealed the level of agreement for the sample of teachers with five to fifteen years of teaching experience was 89.4% and the level of agreement for the whole sample was 92.3%. Those respondents having a level of agreement with not allowing students to opt out was 80.7% for the sample of teachers with five to fifteen years of teaching experience and 82.6% for the whole sample. The level of agreement for excelling at providing extended practice for the sample of the teachers with five to fifteen years of teaching experience was 83.1%, and the level of agreement of the whole sample was narrowly close at 83.3%.

Breakdown of Respondents with More than 15 Years of Experience

Table 16 shows responses of teachers with more than 15 years of experience from elementary schools. There were 67 (43.2%) respondents reporting. Table 16 presents the descriptive data for the respondents with more than 15 years of teaching experience regarding their use of best practices in mathematics classrooms.

Table 16

More than 15 Years - Responses on Best Practices

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Probing for Depth of Student understanding	1 (1.5%)	0 (0%)	2 (3.0%)	18 (26.9%)	39 (58.2%)	7 (10.4%)
Provide time for students to Analyze	1 (1.5%)	2 (3.0%)	3 (4.5%)	23 (34.3%)	26 (38.6%)	12 (17.9%)
Frequently Reflect on Instructional decisions	1 (1.5%)	0 (0%)	0 (0%)	8 (11.9%)	38 (56.7%)	20 (29.9%)
Utilize deep Understanding Of Math content	1 (1.5%)	1 (1.5%)	1 (1.5%)	8 (11.9%)	37 (55.2%)	18 (26.9%)

Consistently Make lessons Meaningful	1 (1.5%)	1 (1.5%)	1 (1.5%)	20 (29.9%)	33 (49.3%)	11 (16.4%)
Have students Engage in Math discourse	1 (1.5%)	5 (7.5%)	6 (9.0%)	21 (31.3%)	31 (46.3%)	3 (4.5%)
Provide time To explore Content deeply	2 (3.0%)	6 (9.0%)	10 (14.9%)	20 (29.9%)	28 (41.8%)	1 (1.5%)
Conceptual And Procedural	2 (3.0%)	4 (6.0%)	8 (11.9%)	14 (20.9%)	32 (47.8%)	7 (10.4%)

The level of agreement for the whole sample for probing for the depth of student understanding was 94.2%, while the level of agreement for the sample of the teachers with more than fifteen years of teaching experience was slightly higher at 95.5%. When observing the responses for consistently providing time for students to analyze their thoughts to increase problem-solving ability, the whole group and the sample of the teachers with more than fifteen years of teaching experience showed similar levels of agreement, at 90.9% and 91% respectively. In reviewing frequently reflecting on instructional decisions to meet students' needs, the level of agreement for the sample of the teachers with more than fifteen years of teaching experience (98.5%) was slightly higher than the whole sample (96.8%) as well. In looking at the utilization of deep understanding of math content, the sample of the teachers with more than fifteen years of teaching experience reported a level of agreement of 95.5% while the whole sample showed 95.4%.

When looking at consistently making lessons meaningful, there was a 5.7% level of disagreement for the whole sample, with a 4.5% level of disagreement for the sample of the teachers with more than fifteen years of teaching experience. When having students engage in mathematical discourse, the sample of the teachers with more than fifteen years of teaching experience showed a level of disagreement of 18% while the whole sample had a level of disagreement of 16.1%. In providing time for students to explore content deeply, the sample of the teachers with more than fifteen years of teaching experience had a level of agreement of 73.1% whereas the whole sample had a level of agreement, just slightly higher, of 76.1%.

Table 17 shows responses of teachers with more than 15 years of experience from elementary schools. There were 67 (43.2%) respondents reporting. Table 17 presents the descriptive data for the respondents with more than 15 years of teaching experience regarding their self-efficacy in mathematics.

Table 17

More than 15 Years - Responses on Self-Efficacy

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Provided ample Professional Development	4 (6.0%)	10 (14.9%)	4 (6.0%)	20 (29.9%)	21 (31.3%)	8 (11.9%)
Frequently collaborate To enhance own ability	1 (1.5%)	3 (4.5%)	3 (4.5%)	17 (25.4%)	29 (43.3%)	14 (20.9%)
Consistently Reflect on Successes and failures	1 (1.5%)	0 (0%)	2 (3.6%)	9 (13.4%)	34 (50.7%)	21 (31.3%)
Can improve student Performance	1 (1.5%)	0 (0%)	0 (0%)	5 (7.5%)	25 (37.3%)	36 (53.7%)

Have strong content knowledge	1 (1.5%)	0 (0%)	0 (0%)	9 (13.4%)	31 (46.3%)	26 (38.8%)
Use student - Centered Instruction	1 (1.5%)	3 (4.5%)	7 (10.4%)	25 (37.3%)	21 (31.3%)	10 (14.9%)
Do not stress about teaching math	3 (4.5%)	7 (10.4%)	5 (7.5%)	11 (16.4%)	26 (38.8%)	15 (22.4%)
Do not have Negative relationship	1 (1.5%)	0 (0%)	3 (4.5%)	7 (10.4%)	21 (31.3%)	35 (52.22%)

When looking at being provided with ample professional development, there was a 26.9% level of disagreement from the sample of the teachers with more than fifteen years of teaching experience and a 34.8% level of disagreement for the whole sample. And when observing if there was a level of agreement with teacher frequently collaborating to enhance their own ability, the whole sample reported 81.3% while the sample of the teachers with more than fifteen years of teaching experience reported significantly higher at 89.5% level of agreement. Regarding consistently reflecting on successes and failures, the whole sample had a level of agreement at 96.2% with the sample of the teachers with more than fifteen years of teaching experience having a level of agreement slightly lower at 94.9%. When exploring improving student performance, the whole group had a level of disagreement of only 1.2% and the sample of the teachers with more than fifteen years of teaching experience had a level of 1.5%. And likewise, there was also a 1.5% level of disagreement for the sample of the teachers with more than fifteen years of teaching experience, but the whole sample had a 5.5% level of disagreement.

In looking at using student-centered instruction, the whole group revealed a level of agreement at 85.1% but the sample of the teachers with more than fifteen years of teaching experience was just slightly lower at 83.6%. And when looking at the respondents who do not stress about teaching math, the whole group had a level of agreement at 70.9% with the sample of the teachers with more than fifteen years of teaching experience showing moderately more at 77.6%. And the whole group reported at an 88.5% level of agreement for not having a negative relationship with mathematics, while the sample of the teachers with more than fifteen years of teaching experience reported at a higher level of agreement at 94%.

Table 18 shows responses of teachers with more than 15 years of experience from elementary schools. There were 67 (43.2%) respondents reporting. Table 18 presents the descriptive data for the respondents with more than 15 years of teaching experience regarding their mindset in mathematics.

Table 18

More than 15 Years - Responses on Mindset

Statement	Strongly Disagree N (%)	Disagree N (%)	Somewhat Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Strongly Agree N (%)
Look forward To teaching Math Daily	1 (1.5%)	0 (0%)	4 (6.0%)	12 (17.9%)	24 (35.8%)	26 (38.8%)
Communicate math as Subject of growth	1 (1.5%)	4 (6.0%)	5 (7.5%)	9 (13.4%)	35 (52.2%)	13 (19.4%)
Provide time For trends and patterns	1 (1.5%)	2 (3.0%)	3 (4.5%)	22 (32.8%)	30 (44.8%)	9 (13.4%)
Explore Problem Solving	1 (1.5%)	2 (3.0%)	10 (14.9%)	17 (25.4%)	26 (38.8%)	11 (16.4%)
Give time To demonstrate creativity	0 (0%)	6 (9.0%)	8 (11.9%)	23 (34.3%)	25 (37.3%)	5 (7.5%)

Respond to discourse Focused on correct	0 (0%)	2 (3.0%)	1 (1.5%)	27 (40.3%)	26 (38.8%)	11 (16.4%)
Do not allow Opt-out	0 (0%)	3 (4.5%)	5 (7.5%)	13 (19.4%)	29 (43.3%)	17 (25.4%)
Excel at providing Extended practice	0 (0%)	6 (9.0%)	7 (10.4%)	29 (43.3%)	19 (28.4%)	6 (9.0%)

In observing the respondents that look forward to teaching math daily, the whole sample reported a level of agreement of 89% while the sample of the teachers with more than fifteen years of teaching experience had a slightly higher 92.5% level of agreement. The whole sample group showed 83.9% level of agreement in consistently communicating that math is a subject based on growth to students, while the sample of the teachers with more than fifteen years of teaching experience had an 85% level of agreement. When looking at giving students time to see trends and patterns in math, the whole sample had an 87.7% level of agreement and the sample of the teachers with more than fifteen years of teaching experience had a slightly higher 91% level of agreement. Those whole sample respondents who consistently explore students' thoughts and procedural skills for problem solving showed an 81.9% level of agreement and the sample of the teachers with more than fifteen years of teaching experience showed an awfully close 80.6% level of agreement.

In the analysis of giving students time to demonstrate creativity and innovation, the whole sample had a 23.2% level of disagreement, with the sample of the teachers with more than fifteen years of teaching experience having a 20.9% level of disagreement. In responding to students' mathematical discourse by focusing on correct thinking versus incorrect thinking, the sample of the teachers with more than fifteen years of teaching experience had a level of agreement of 95.5% and the whole sample had a level of agreement of a slightly lower 92.3%. When looking at not providing students with an opportunity to opt out of mathematical thinking, the sample of teachers with more than fifteen years of teaching experience had a 12% level of disagreement while the whole sample had a 17.4% level of disagreement. And in observing the data on excelling in providing extended practice time to allow students to develop their mathematical understanding, the sample of teachers with more than fifteen years of teaching experience had a level of agreement of 80.6% while the whole sample had a slightly higher level of agreement at 83.3%.

Inferential Data

The null hypotheses were developed and tested for each described by the research questions. The following represent the null hypotheses:

$H_0 1$ (i.e., R.Q. 2): There is not a statistically significant difference based on location type on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers.

$H_0 2$ (i.e., R.Q. 3): There is not a statistically significant difference based on years of experience on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers.

$H_0 3$ (i.e., R.Q. 4): There is not a statistically significant difference based on grade level area on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers.

$H_0 4$ (i.e., R.Q.5): The self-efficacy and mindset composite scores do not explain a statistically significant amount of variance within the best practices of math instruction composite score for Indiana elementary teachers.

The first null hypothesis focused on whether any of three composite scores found within the study demonstrated a statistically significant difference based on location type (rural, suburban, urban) on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers. Three separate one-way ANOVAs, one for each of the composite scores within this study, (i.e., best practice composite scores, mindset composite scores, and self-efficacy composite scores) were utilized to decide if such a difference based on location type existed. This is the appropriate inferential test for analyzing scores on the individual dependent variables (i.e., best practice composite scores, mindset composite scores, and self-efficacy composite scores) with an independent variable (i.e., location type) with more than two levels (i.e., rural, suburban, and urban) (Gravetter & Wallnau, 2017). A one-way ANOVA was used in the event a post-hoc test would need to be conducted if differences were found.

The assumptions of a one-way ANOVA were tested to ensure validity of the inferential findings (Gravetter & Wallnau, 2017). There were no outliers on the dependent variables due to no data points being more than 1.5 standard deviations away from the edge of the box within the box plots. The dependent variable scores also showed a normal distribution for all groups, proven by the non-significant Shapiro-Wilk's test, $p > .05$. The assumption of homogeneity of variance was met with a non-significant Levene's Test of Equality of Variance, for all three one-way ANOVA tests. There were no violations of assumptions within this null hypothesis.

The means on self-efficacy were not statistically significantly different among the rural, suburban, and urban location types. When exploring the composite scores of the best practices of the rural sample ($M = 4.67$, $SD = .64$), the best practices of the suburban sample ($M = 4.61$, $SD = .60$), and the best practices of the urban sample ($M = 4.69$, $SD = .77$), there was no significant difference among the three groups. This was determined with a non-significant one-way ANOVA with the model of non-significance for best practices as $F(2, 152) = .19$, $p = .82$. And when exploring the composite scores of the self-efficacy of the rural sample ($M = 4.65$, $SD = .67$), the self-efficacy of the suburban sample ($M = 4.78$, $SD = .61$), and the self-efficacy of the urban sample ($M = 4.68$, $SD = .77$), there was no significant difference among the three groups. This was determined with a non-significant one-way ANOVA with the model of non-significance for self-efficacy as $F(2, 152) = .64$, $p = .53$. Then when analyzing the composite scores of the mindset of the rural sample ($M = 4.51$, $SD = .70$), the mindset of the suburban sample ($M = 4.44$, $SD = .74$), and the mindset of the urban sample ($M = 4.55$, $SD = .61$), there was no significant difference among the three groups. This was determined with a non-significant one-way ANOVA with the model of non-significance for mindset as $F(2, 152) = .32$, $p = .73$. The model indicated there was no statistically significant difference based on location type. The rural, suburban, and urban teachers did not show any significant differences as self-reported. With non-significant findings, there was no need to analyze the post hoc tests (Gravetter & Wallnau, 2017). Since there were no violations of assumptions and no significant differences based on location type, the first null hypothesis was retained.

The second null hypothesis focused on whether any of three composite scores found within the study demonstrated a statistically significant difference based on years of experience (i.e., less than 5 years, 5- 15 years, more than 15 years) on the best practices, mindset, and self-efficacy composite scores among Indiana elementary teachers. Three separate one-way ANOVA, one for each of the composite scores within this study, (i.e., best practice composite scores, mindset composite scores, and self-efficacy composite scores) were utilized to decide if such a difference based on years of experience existed. This is the appropriate inferential test for analyzing scores on the individual dependent variables (i.e., best practice composite scores, mindset composite scores, and self-efficacy composite scores) with an independent variable (i.e., years of experience) with more than two levels (i.e., less than 5 years, 5- 15 years, more than 15 years) (Gravetter & Wallnau, 2017). A one-way ANOVA was used in the event a post hoc test would need to be conducted if differences were found.

The assumptions of a one-way ANOVA were tested to ensure validity of the inferential findings (Gravetter & Wallnau, 2017). There were no outliers on the dependent variables due to no data points being more than 1.5 standard deviations away from the edge of the box within the box plots. The dependent variable scores also showed a normal distribution for all groups, proven by the non-significant Shapiro -Wilk's test, $p > .05$. The assumption of homogeneity of variance was met with a non-significant Levene's Test of Equality of Variance. There were no violations of assumptions within this null hypothesis.

The means on self-efficacy were not statistically significantly different among the teachers with less than 5 years, 5 - 15 years, and more than 15 years of experience. When exploring the composite scores of the best practices of the teachers with less than 5 years *(M* = 4.80, *SD* = .54), the best practices of the teachers with between 5 and 15 years (*M* = 4.65, *SD* =.70), and the best practices of the teachers with more than 15 years (*M* = 4.60, *SD* =.71), there was no significant difference among the three groups. This was determined with a non-significant one-way ANOVA with the model of non-significance for best practices as $F(2, 152) = .89$, $p = .41$. And when exploring the composite scores of the self-efficacy of the sample of teachers with less than 5 years (*M* = 4.59, *SD* = .62), the self-efficacy of the teachers with between 5 and 15 years (*M* = 4.57, *SD* =.68) and the self-efficacy of the teachers with more than 15 years (*M* = 4.80, *SD* =.73), there was no significant difference among the three groups. This was determined with a non-significant one-way ANOVA with the model of non-significance for self-efficacy as $F(2, 152) = 1.92$, $p = .15$. Then when looking at the composite scores of the mindset of the teachers with less than 5 years (*M* = 4.49, *SD* = .56), the mindset of the teachers with between 5 and 15 years (*M* = 4.44, *SD* = .76) and the mindset of the teachers with more than 15 years (*M* = 4.57, *SD* = .66), there was no significant difference among the three groups. This was determined with a non-significant one-way ANOVA with the model of non-significance for mindset as $F(2, 152) = .53$, $p = .59$. The model indicated there was no statistically significant difference based on years of experience. The teachers with less than 5 years of experience, the teachers with between 5 and 15 years of experience, and the teachers with more than 15 years of experience did not show any significant differences as self-reported.

This indicated the variances on the dependent variables among the three levels were equal to each other and not significant. With non-significant findings, there was no need to analyze the post hoc tests (Gravetter & Wallnau, 2017). Since there were no violations of assumptions and no significant differences based on years of experience, the second null hypothesis was retained.

The third null hypothesis focused on whether there was a statistically significant difference demonstrated based on teaching level, primary (K-2) or intermediate (3-6). Because there were only two levels of the independent variable, three independent samples *t*-tests were conducted (Gravetter & Wallnau, 2017). The independent samples *t*-test focused on whether any of three composite scores found within the study demonstrated a statistically significant difference based on teaching level (primary or intermediate) on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana elementary teachers. Three separate independent samples *t*-tests (best practice composite scores, mindset composite scores, and self-efficacy composite scores) were utilized to decide if such a difference based on location type existed. This is the appropriate inferential test for analyzing scores on the individual dependent variables (best practice composite scores, mindset composite scores, and self-efficacy composite scores) with an independent variable (teaching level) with just two levels (primary and intermediate). The independent samples *t*-tests were used to compare the means of the two groups to determine if differences were found (Gravetter & Wallnau, 2017).

The assumptions of the independent samples *t*-tests were tested to ensure validity of the inferential findings (Gravetter & Wallnau, 2017). There were no outliers on the dependent variables due to no data points were more than 1.5 standard deviations away from the edge of the box within the box plots. The dependent variable scores also showed a normal distribution for both groups, proven by the non-significant Shapiro -Wilk's test, $p > .05$. The assumption of homogeneity of variance was met with a non-significant Levene's Test of Equality of Variances. There were no violations of assumptions within this null hypothesis.

The means on self-efficacy were not statistically significantly different among the primary and intermediate teaching types. When exploring the composite scores of the best practices of the primary group (M = 4.72, SD = .55), and the best practices of the intermediate sample (M = 4.60, SD =. 77), there was no significant difference among the two groups. This was determined with a non-significant independent samples t-test with the model of non-significance for best practices as $t(153) = 1.06$, $p = .29$, two-tailed. And when exploring the composite scores of the self-efficacy of the primary sample (M = 4.79, SD = .61) and the self-efficacy of the intermediate sample (M =4.57, SD = .76), there was no significant difference among the two groups. This was determined with a non-significant independent samples t-test with the model of non-significance for self-efficacy as $t(153) = 1.94$, $p = .06$, two tailed. Then when analyzing the composite scores of the mindset of the primary sample (M = 4.54, SD = .60), and the mindset of the intermediate sample (M = 4.48, SD =.74), there was no significant difference among the two groups. This was determined with a non-significant independent samples t-test with the model of non-significance for mindset as $t(149.85) = .56$, $p = .58$, two-tailed. This indicated there was no statistically significant difference based on teaching type. The primary and intermediate teachers did not show any significant differences as self-reported.

There was a violation of the mindset assumption of homogeneity of variance, which is robust to violation and will self-correct. This indicated the variances on the dependent variables among the two levels were equal to each other and not significant (Gravetter & Wallnau, 2017). Due to the assumption of equal variances being violated within the test, the degrees of freedom self-adjusted. Since there were no significant differences based on teaching type, the third null hypothesis was retained.

The fourth null hypothesis focused on whether mindset and self-efficacy predicted the use of best practices. Because this hypothesis determined if the two variables were correlated strongly enough for a prediction, a simultaneous multiple regression was conducted (Gravetter & Wallnau, 2017). There is one criterion variable (best practices) and two predictor variables (mindset and self-efficacy). The multiple regression test will determine the strength of the relationship between the predictor variables and the criterion variables.

The assumptions of the linear regression were tested to ensure validity of the inferential findings (Gravetter & Wallnau, 2017). The Independence of Residuals assumption was met by conducting the Durbin Watson Test. Since the Durbin Watson coefficient was 2.077, the assumption looks to have been met since scores ranging between 1 and 3 have been met. The Assumption of No Multi-Collinearity was shown by the linear relationship that existed between the predictor variables (x) and the criterion variable (y) via a scatterplot of the data. The Assumption of Heteroscedasticity was met due to the residuals being equal for all predicted values of the criterion variable on the scatterplot and are not too strongly correlated. The Collinearity Tolerance variable for mindset and self-efficacy was .621, which was above the .2 minimum needed for the assumption. The Assumption of Detecting Outliers was met by ensuring there were no data points that fell outside of the general pattern of data. The Normality of Residuals was met by looking to see that the residuals were normally distributed in the model. There were no violations of assumptions.

With a multiple correlation coefficient of $R = .799$, there is a strong correlation between the predictors and the criterion. The coefficient of multiple determination gives the proportion of total variance in the criterion (best practice) that is shared with the linear combination of the predictor variables (mindset and self-efficacy) (Gravetter & Wallnau, 2017). The coefficient of multiple determination (R^2) value of .638, 63.8% of the variance in the use of best practices in math instruction can be explained by mindset and self-efficacy scores. The adjusted R^2 provides an unbiased estimate of R^2 for the population, because it adjusts R^2 based on the number of predictors related to the number of subjects. R^2 was .638 and the adjusted R^2 was .633 in examining both predictors. The .005 difference between R^2 and the adjusted R^2 is shrinkage of the model. The standard error of the estimate (.410) measured amount of variability in the points used for the regression line.

The multiple regression showed that at least one of the predictor variables (mindset and self-efficacy) was strong enough to be used to predict scores for the criterion variable (best practices). This was determined with a significant regression model that was represented with $F(2, 152) = 133.72$, $p < .001$. An ANOVA was then conducted to test the significance of R^2 within the model (Gravetter & Wallnau, 2017). It revealed that mindset and self-efficacy can be used to predict elementary teachers' use of best practices. The ANOVA was significant, $F(2, 152) = 133.72$, $p < .001$, therefore determining a linear relationship between mindset and self-efficacy and best practices as presented in Table 19.

Table 19

Unstandardized and Standardized Partial Regression Coefficients for Best Practice Scores

Independent Variables	B	β	t	Sig.
Self- Efficacy	.388	.399	6.436	.000
Mindset	.488	.488	7.879	.000

Using simultaneous regression, the model showed two predictors (i.e., mindset and self-efficacy) that significantly predicted best practice score. Mindset was a significant predictor of best practices, $t(2, 152) = 7.879$, $p < .001$. Self-efficacy was a significant predictor of best practices, $t(2, 152) = 6.436$, $p < .001$.

Mindset had an unstandardized partial regression coefficient of .488, which meant best practices was predicted to increase .488 units with a one unit increase in mindset while removing the effects of self-efficacy. Self-efficacy had an unstandardized partial regression coefficient of .388, which meant self-efficacy was predicted to increase .388 units with a one unit increase in self-efficacy while removing the effects of mindset. The standardized partial regression coefficients (β weight) for each predictor (standard) gives the opportunity to measure the impact of mindset and self-efficacy on best practice through the use of z-scores (Gravetter & Wallnau, 2017). Mindset had a standardized partial regression coefficient (β weight) of .488, self-efficacy had a standardized partial regression coefficient (β weight) of .399. This provided the amount of impact each variable had regarding the prediction of best practice scores. Mindset had the greatest impact on predicting best practice, followed by self-efficacy. All of the coefficients were positively correlated, both standardized and unstandardized and both were significant at the predictor variables, $p < .001$. Since one of the predictors was strong enough to predict, the fourth null hypothesis was rejected.

Summary

This chapter detailed the various methodological analyses used to reject or retain the null hypotheses in this study. The research questions and null hypotheses were presented and tested. The descriptive statistics were generated and charted with comparisons made from specific sample groups based on variables to the whole sample. Inferential testing descriptive data was presented to determine the outcomes of the null hypotheses. The data was used to determine the retention of the first three null hypotheses, which meant there were not any statistically significant differences among these areas (i.e., best practice usage in mathematics, self-efficacy, and mindset) present within Indiana elementary teachers based on location type, years of experience, and grade (teaching) level area. The data also pointed to a rejection of the fourth null. The rejection of the fourth null hypothesis indicated a correlation of self-efficacy and mindset to use of best practice in mathematics instruction. Chapter 5 is going to give possible reasons for the lack of significance and significance found in Chapter 4 by retaining and rejecting the null hypotheses. Chapter 5 will also suggest the implications of the significance as well as how to expand the research.

CHAPTER 5

SUMMARY OF FINDINGS, IMPLICATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The purpose of this quantitative study was to gather information from elementary teachers who use best practice to examine the impact of self-efficacy and mindset. The research focused on location type (i.e., rural, suburban, urban), teaching level (i.e., primary and intermediate), and years of experience (i.e., less than 5 years, 5 –15 years, more than 15 years). The review of the data revealed there were not any statistically significant differences among best practice usage in mathematics, self-efficacy, and mindset. The research also showed a correlation between mindset and self-efficacy and indicators of usage of best practices in the mathematics classroom. Data were collected from Indiana elementary teachers, analyzed, and compared using one-way ANOVAs, independent *t*-tests, and simultaneous multiple regression. This chapter will focus on the findings, their implications, and meanings, as well as future research topics in this area.

Summary of Findings

In analyzing the inferential data to determine the outcomes of the null hypotheses, the first three null hypotheses were retained, which meant there were not any statistically significant differences among best practice usage in mathematics, self-efficacy, and mindset present within Indiana elementary teachers based on location type, years of experience, and grade (teaching) level area (primary and intermediate). The fourth null was accepted, indicating there was a linear relationship between self-efficacy and mindset to use of best practice in mathematics instruction. Therefore, I found statistical belief that the state of self-efficacy, mindset, and best practices of math instruction among Indiana general education elementary teachers was similar.

The lack of significant difference in the composite scores of location type (rural, suburban, urban) of teachers in best practices, self-efficacy, and mindset among Indiana general education elementary teachers could be attributed to:

- The teacher evaluation system is similar across the state; therefore, it promotes common exemplar teaching practices and mindsets throughout the state of Indiana. In Indiana, the most widely used evaluation system is the RISE system, which is used in some way by approximately 198 of the 294 school districts (Balonan-Rosen, 2016).
- There could be a lack of training across the board for all teachers. Teachers are only required to obtain training for license renewal every five years. The training is general and not necessarily geared towards a specific area. It is based solely on teacher choice. Some teachers earn professional growth points through coursework at the university and others earn points by attending professional development.
- Most elementary teachers are only required to take one undergraduate math methods course during their preparation programs.
- As noted in the data, no matter where they live, they have the same level of self-confidence in their own math ability.
- Teachers tend to teach in the way they were taught, algorithmically (procedurally) rather than conceptually, as supported in the study by Youmans et al. (2018).
- Teachers across the state of Indiana use the same state standards which are requirements for guiding curriculum alignment. All Indiana teachers use the Indiana Academic

Standards. The standards have been revised several times; however, they are aligned to the state assessment, ILEARN, and therefore drive the pacing guide and standards in Indiana schools.

There could also have been no statistically significant difference based on years of experience on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana general education elementary teachers due to:

- Elementary teachers tend to have an overreliance on curricular resources, which means they teach directly from the book. As supported by Ma (1999), the textbook is a good curricular resource, but teachers must feel the freedom not to use the textbook as well.
- Some teachers believe the textbook is the curriculum. Students' ideas and interests should drive the curriculum (Ma, 1999).
- Some elementary teachers were repeatedly told they were not good at mathematics, leaving them with a fixed mindset about their own mathematics ability. This can have grave effects on how they view mathematics, which is also pointed out by Thomson et al. (2019) and Boaler (2016).
- Lack of consistent collaboration, geared towards learning the content, and lesson planning amongst colleagues might also contribute to no significant difference. Elementary teachers do not necessarily have a collaboration block carved into their schedules, whereas secondary teachers have a designated period during the school day for planning. Additionally, the time is not necessarily designated for learning content as it is more geared toward planning what content students will learn. Elementary teachers are also not mandated to plan together. The structure of the planning time differs from school to school throughout the state.

Potential reasons for the lack of statistically significant differences based on grade level area on the self-efficacy, mindset, and best practices of math instruction composite scores among Indiana general education elementary teachers could be because:

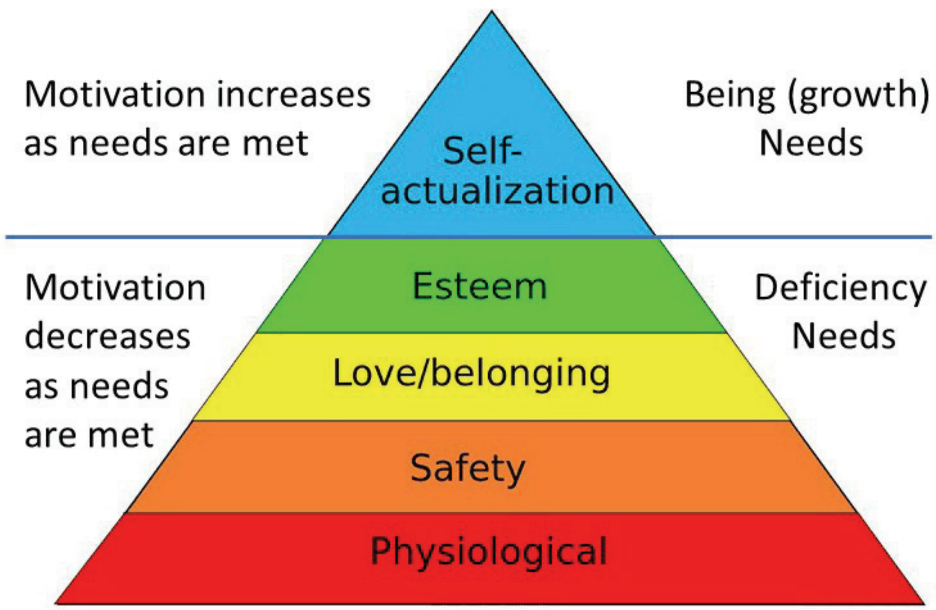
- Elementary math teachers share the same non-differentiated undergraduate courses. And some elementary teacher prep programs require only one math methods course in their undergraduate studies.
- It also seems that low quality mathematics education programs reinforce low quality teacher knowledge, leaving teachers without additional opportunities to acquire the knowledge they do not get in school (Ma, 1999).
- There may be an overreliance on using the textbook as the only teaching resource by elementary teachers (Ma, 1999).
- Teachers in the U.S. have the same level of expectations for teaching and learning. According to Ma (1999), most teachers cannot reach the goals outlined in the state standards because they are unaware of what it will take to be successful. The knowledge base of U. S. teachers is *fragmented* and disconnected which can be linked to the poor mathematics teaching and learning in the U. S. Additionally, most schools and districts do not support attainment of that success (Ma, 1999).
- Teachers teaching math at all elementary levels are not well equipped. Teachers' "knowledge package" is not fully developed. A well-developed knowledge package is the result of a well-connected knowledge base of procedural and conceptual mathematics that has been intertwined together for complete understanding (Ma, 1999).

- Some teachers also believe they do not need to continuously update their skills and continue to focus on how to teach mathematics, which is supported by Schifter's (1998) work.
- Teachers were repeatedly told they were not good in mathematics; therefore like most elementary teachers, they focus on reading. When a teacher's knowledge is limited, they unknowingly tend to limit how and what they teach. This is supported in Melville et al. (2013).
- Elementary teachers were not taught math like mathematicians (Polya, 1965). Mathematicians are taught to solve problems in multiple ways (Ma, 1999). There may not be specialization among grade levels, by subject (specifically mathematics).

The correlation between self-efficacy and mindset composite might predict best practices of math instruction composite scores for Indiana general education elementary teachers as due to:

- The elementary teachers that had enough initiative to take the survey might be more likely to have a growth mindset and therefore might be more likely to use best practices and want to improve instruction.
- The elementary teachers who took this survey may have developed their understanding of mathematics and math teaching strategies after they became teachers. This may have taken place in school-based professional development, as well as through the general requirement for license renewal in Indiana to acquire professional growth points every five years. The professional growth points are obtained through coursework from a university or college or through professional development opportunities.

- Correlation could be because the teachers with strong self-efficacy and a growth mindset are teachers who work harder at self-actualization, and therefore, they work harder to show self-actualization.
    - Consistent with Maslow's hierarchy, self-actualization is a growth need where self-esteem and self-actualizing needs are considered higher order needs. In the hierarchy, when the self-actualization needs are met, a person can reach their full potential. In order for these needs to be met, motivation is necessary. Self-actualization can occur because of positive relationships and an appreciation for interactions and experiences. This is possible in mathematics, because teachers who have positive interactions with mathematics will want more of these experiences and will therefore work harder for more positive experiences.



- Teachers with a growth mindset are more likely to try transformative and innovative teaching practices. Consistent with Carol Dweck, these teachers will want to fulfill their talents and be successful while formulating their practices about things that work. They have the self-awareness to change practices to try strategies they believe will work.

- According to Polya (1965), math teachers must feel confident about their mathematical knowledge and feel as if they can effectively instruct their students. Having a higher level of confidence in their ability will lessen the stress and anxiety of teaching math by strengthening teachers' self-efficacy and self-awareness. And Bandura (1977) states efficacy determines the amount of effort one puts forth. And with math being a high struggle subject, more effort is needed and therefore more efficacies exists.

Implications

As important as it is to provide students with a no opt out option, it is just as important to ensure our teachers are prepared with a no opt out option. Higher education teaching programs should re-think their programs and focus on math methods more during undergraduate studies. As stated in the review of literature in Chapter 2, most teaching programs only require teachers to take one math methods course. This has proven insufficient; therefore, higher education programs should add another math methods course that focuses on mathematics strategies, conceptual knowledge, and inquiry. The initial methods class already focuses on mathematics procedures. Elementary teachers would have less anxiety and feel more prepared to teach mathematics if they were given more time for exploration of a deep understanding during their undergraduate studies.

There may need to be a series of more intense math methods at the collegiate level where we ensure teachers understand math, understand how to communicate math to students, and understand the thinking that needs to be facilitated in teaching. Highlighted in Ma's (1999) book, *The Conference on the Mathematical Preparation of Elementary School Teachers* agrees that it makes the most sense to address issues with elementary mathematics education during the teacher preparation period in college. These methods courses should include:

- According to Mary Kay Stein and Margaret Smith (2018), in their book published by the NCTM, they accentuate the key to pedagogy as teaching students to think. In doing so, we must teach teachers to think. Dewey (2008) and Polya (1965) promote thinking as an activity leading to problem-solving. This type of thinking is based on intense planning. It requires both knowledge of content and knowledge of student thinking about that content, along with pedagogical moves that will lead a discussion that will be meaningful to students. In facilitating this type of rich mathematical discourse, teachers are encouraged to follow five important steps: anticipating, monitoring, selecting, sequencing, and connecting. Questioning plays a crucial role in facilitating thinking. In order for teachers to learn to teach students how to think, they must also learn to question students effectively. Considering the 94.2% level of agreement of the teachers in this survey, teachers who use best practice should be strong at probing for depth of student understanding using teacher questioning techniques while teaching math. And the level of agreement of 90.9% of teachers in the sample indicated that it is important to consistently provide time for students to analyze their thoughts in order to increase their ability to problem-solve in math.
- With only 52.9% of respondents agreeing that they probe for depth of student understanding through questioning techniques, teachers may benefit from instruction on deconstruction of standards and effective questioning in the Math methods course that focuses on conceptual understanding.

- Create more opportunities for authenticity in the classroom. Authentic learning answers the question *When are we ever going to use this*? It gives students that connection to the real world, allows them to create and do and think. It also gives them the opportunity to present a unique and innovative outcome. The classroom is preparing students for the real world; therefore, it should mirror and represent the real world. This will make learning meaningful for students. According to Dewey, students should have opportunities to learn more about themselves and the world while learning valuable content knowledge and learn to work with each other (Dewey, 1938). He goes on to argue that students should be able to make choices, develop creatively, and ask questions. This is an authentic replication of the real world. They should have opportunities to apply their learning in the classroom. When looking at the survey, it was evident that there was more of a need for providing time for students to explore content deeply, with only 76.1% showing some agreement. One suggestion for obtaining authenticity comes from the 1988 Eisenhower program, where teachers were asked to create projects to improve their own math and science teaching. This is valuable, because in addition to having authentic experiences, this gave teachers examples to embed in the curriculum. Focus on the connection between conceptual and procedural mathematics. A complete education in mathematics includes both. According to the NCTM Principles to Action, (NCTM, 2014), mathematics teaching requires teachers to have a deep knowledge of the math content, a vision for how students learn, and an articulation for the vertical transfer of content across grade levels. The NCTM (2016) goes on to explain that teachers should be able to articulate/communicate math in a way that all students can understand it. Teachers should spend time working on students' conceptual knowledge as well as procedural skills in problem solving (NCTM, 2014). And Dweck (2016) stated that even more important than developing the mindset is passing it on to students. She says teachers must teach for understanding because when the teacher's focus is understanding, students are more apt to believe they can grow their individual abilities. Best practice usage in mathematics allows students to capitalize on mistakes by revising work, students will expand their knowledge and understanding of mathematics seeing math as more "doable" rather than not.

- Another possibility might include teachers taking a conceptual based approach to mathematics in the early grades and then introducing a more procedural approach to mathematics in the later grades. This helps ensure that students are thinking early on and sets a pattern for thinking and problem solving prior to introducing algorithms into mathematics. This would increase the likelihood of students doing better on the mathematics portion of ILEARN because it addresses conceptual understanding of mathematics.
- As mentioned in regards to a professional development plan during the initial practitioner period, the mandate to participate in professional development focused on project based learning, will also promote thinking and problem solving.
- Additionally, it could be beneficial to prioritize a vertical articulation of mathematics standards for guaranteed and viable curriculum. This is done in English/Language Arts, however, it could be beneficial to solidify the Mathematical foundation for students. This articulation could also be embedded into PLC's using **Dufour's** model (Dufour, 2012).
- The prioritization would include tiered assessments to identify and assist with addressing deficiencies that are carried with students from year to year. It will also help with

avoiding the gaping deficiencies that tend to present themselves later in students' academic careers. The extension of the prioritization can be implemented through strategies used to address those who master the content and those who do not.

- Colleges and university prep programs should also implement a "methods" of mindset course, focused on developing a growth mindset and grit for all teachers, especially those who teach mathematics. These courses will be designed to empower the teachers to make mistakes, develop self-belief, value struggle, be creative, give collegial praise, learn mathematics as a growth subject, and develop a growth mindset coupled with willpower. Leaders and administrators need to focus on growing teachers' mindsets. Since, according to Hattie, the teacher has the single largest impact on student achievement, it is important to have teachers who believe in their own competencies as well as have the mindset that they can grow their students. Angela Duckworth defines grit as the "intersection of passion and perseverance applied toward long-term achievement, with no particular concern for rewards or praise" (Duckworth, 2016, p. 8). Some of the grit a person has is linked to their genes, but grit also grows through experiences (Duckworth, 2016). Grit comes from productive struggle. Teachers need opportunities to experience productive struggle to appreciate and encourage students' productive struggle. Productive struggles happen when failures and mistakes are made. When failures and mistakes are made in a thriving learning environment, participants develop self-awareness and can solve problems effectively. This is in alignment with the views of the majority of the teachers (51%) in the study, where they outright agreed that they consistently take time to reflect on successes and failures of their own math lessons for improvement. With the lowest percentage of the whole sample for mindset agreeing at 76.8%, that they give time for students to demonstrate creativity and innovation in math, I suggest the math methods course focus on authentic outcomes and expanding teacher creativity and innovation in math. This course should explore “out of the box” thinking, conceptual understanding, project-based and problem-based learning.

Grit is developed over time and is a key ingredient in personal success as well as self-confidence. The survey data (95.4% level of agreement) consistently supports the need for teachers who use best practices to use their deep understanding of math content in order to adapt their teaching strategies to maximize students’ growth which emphasizes the power of sustaining growth through grit and mindset. Consistent with Jo Boaler, (2016)) growth-minded teachers teach math as a subject of growth and learning, and they encourage students to become mathematicians; therefore, teacher prep programs need to awaken the mathematicians in their elementary teachers. Just as Dweck (2016) maintained there are mindset misconceptions that need to be cleared up, this course is the appropriate place to clear up misconceptions, and help teachers not only develop the mindset, but also pass on the growth mindset, which is key. Teachers should refrain from limiting students with fixed mindsets by making comments about being “smart”. Additionally, they should maintain ambitious standards for students and teach the students how to reach these standards. Teachers with growth mindsets focus on the process of learning. These teachers are also truthful with their students and help them remove gaps and barriers to learning.

Since fixed minded individuals see themselves as finished products, it is important to promote continuous learning and emphasize to teachers that they are not finished products in any subject area, especially mathematics (Dweck, 2016). Future teachers should be required to participate in Specialized Mathematics Professional Development that links conceptual and procedural knowledge and focuses on mathematical best practices. This should be infused into the license renewal process. Good teachers practice and promote life-long learning. Since teachers must take classes or professional development for license renewal, they should be required to develop and submit to the IDOE a professional development plan for life-long learning. Professional development should be targeted in reading and math best practices through formal professional development plans. The NCTM categorizes those mathematical practices as: problem solving, reasoning, and constructing meaningful arguments in every area of instruction, which includes assessment, curriculum, technology usage and overall instructional design. Since the data suggests at least 30% of the elementary teachers do not feel they have had ample PD in mathematics, it is incumbent upon the educational leadership to afford them the PD needed to strengthen their self-efficacy and mindset which could lead to their usage of best practices in the classroom.

This mandatory professional development plan should be developed during the initial practitioner timeframe; however, it should be a licensure renewal requirement to update the plan and take the necessary related coursework. There should be plans that are standardized across the state as well as individualized requirements. At the elementary level, the standardized plan should include exposure for all elementary teachers within their initial practitioner timeframe (especially those who deliver math instruction) to key elements of project-based learning. Project-based learning promotes critical thinking, problem solving, deductive reasoning, authentic instruction, integration of technology, connections to the real world, an integration of procedural and conceptual skills, growth mindset, and collaboration. Professional development should promote true life-long learning with teachers developing an individualized plan for continued learning and investment in education. In the area of Best Practice, only 51% of the respondents felt they frequently reflected on their instructional decisions to consistently improve their ability to meet individual needs of students, and similarly 51%, responded they take the time to reflect on success and failures of lessons to improve over time; therefore, I suggest that teacher preparation programs and districts focus on reflection of effective use of instructional best practices in mathematics. This could be introduced through professional development and implemented through the Professional Learning Communities (PLCs) during teacher collaboration time.

Additionally, I suggest professional development and incorporation of math learning stations in order to differentiate instruction effectively to maximize individualized student growth since the most frequent response of those who utilized a deep understanding of math content in order to adapt their teaching strategies to maximize growth was 54.8%.

Colleges also must change their perception of elementary mathematics. Their view of elementary math as “basic skills math” lessens the importance of the subject. It should therefore be regarded as the “foundational and fundamental” mathematics for students, placing more importance and emphasis on the mathematics that is taught at the elementary level (Ma, 1999). After all, it is math that sustains any future and further knowledge and learning of mathematics. Elementary mathematics is not a set of disconnected topics linked back to algorithms.

Working conditions should also support learning mathematics for the teaching staff. Districts should build in regular, mandatory collaboration time with colleagues (especially for vertical and longitudinal articulation). In accordance with the message of Ma (1999), teachers should have time built into the day to learn math and explore strategies for learning and doing math, as well as collaborate with colleagues to enhance their professional practices. When teachers view learning and problem solving as a team effort, they will teach it as such, which is supported in the data. More than 80% of teachers felt it was important to collaborate with other teachers to enhance their own ability to teach math. This time can be used for collegial discussions regarding mathematics as well as to study the mathematics teaching resources that are available. The Chinese used their dedicated collaboration time to complete “careful and critical investigations of the textbook” (Ma, 1999, p. 132), along with studying “what to teach [and] how to teach” the mathematics (Ma, 1999, p. 133).

Based on the higher mindset, correlation findings, I strongly recommend specialization or departmentalization of mathematics amongst grade level teachers. According to Duckworth (2016), “people are more satisfied with their jobs when they do something that fits their personal interests”. Therefore, those who either want to teach math, or believe they can improve student achievement in math (with only 1.3% of teachers disagreeing at some level in the survey) or have shown they are successful at it or possess a growth mindset about the subject, should teach the subject. Math is not a good fit for every teacher. Since most elementary teachers were told they were not good at math, it is less likely that all of them feel they are good at teaching math. Therefore, math instruction should happen with teachers that want to learn, grow, and teach mathematics. These teachers are also able to make key connections in mathematics because they are genuinely interested and enjoy the content. It is important to make lessons meaningful by providing practical real-world connections to math content while they are teaching (94.2% level of agreement of surveyed respondents). This is more likely to happen in classrooms where teachers look forward to teaching math daily (89% level of agreement), which data suggests was remarkably similar to the 88.5% level of agreement of teachers who did not have a negative relationship with mathematics.

Recommendations for Future Research

Since this study only included elementary teachers in Indiana, due to my interest in Indiana student achievement, future research might include additional states, especially those who do not use common core standards. A study that involved additional non-common core states would give meaningful data regarding the status of use of best practices, self-efficacy, and mindset of elementary teachers. This would give additional information regarding methods courses at the collegiate level, and professional development needs. This might also show significant differences as I widen the scope of participants in each area.

Other research may include secondary mathematics teachers in Indiana. This will allow me to look at a comparison of elementary versus secondary teachers' use of best practices, self-efficacy, and mindset. This study would be informative to compare each area at both levels, with a closer look at teacher preparation programming.

Additional research might also include undergraduate students in current elementary teacher preparation programs. This would give teacher prep programs valuable information to make improvements. This could be crucial when looking at familiarity of best practices, how well-prepared students feel, and the status of their growth mindset prior to graduation. This could also be used to create a hiring rubric to identify teachers with these qualities. Another comparison might also include adding high school juniors and seniors, since it is believed that the elementary mathematics teacher does not require additional math beyond what was learned in high school. This could be used to determine if they are leaving high school equipped to teach elementary mathematics. This study could also expand to compare the impact of self-efficacy and mindset on the use of best practice in mathematics for both Common Core states and non-Common Core states. Future research could include a comparison of use of best practices, self-efficacy, and mindset in reading to use of best practices, self-efficacy, and mindset in mathematics. This would give information on the strengths and weaknesses of teachers in the two areas, preparation in the two areas, and effectiveness in the two areas.

A study of conceptual versus procedural mathematics amongst elementary teachers could also be beneficial to districts and higher education. I would also like to see a study on the self-efficacy and mindset of juniors and seniors in high school as it relates to mathematics to assess confidence levels and perceived competency before students attend college. Additionally, with a p-value of .06 in self-efficacy, for grade level (primary vs immediate), I did not find a significant difference; however, I would like to extend the study for a larger sample size. Perhaps my findings would have been significant if my sample size had been slightly larger than 155 completed respondents.

I am surprised the one-way ANOVA for years of experience did not render significant results because a common belief, as supported by the research, is that more veteran teachers are better in their professions due to more opportunities for professional development and collaboration with colleagues over time. However, more veteran teachers often tend to be less willing to try new and innovative practices; therefore, I would suggest additional research that expands the study to explore the mindset of newer teachers versus the mindset of more veteran teachers.

Summary

Chapter 5 included an introduction to the chapter, followed by a summary of findings from chapter 4. Next, the implications of the study were discussed with possible reasons for the non-significant and positive significant correlation findings. The section concludes with recommendations for future research and this summary.

This quantitative study showed no statistically significant difference in the first three null hypotheses; therefore, the hypotheses were retained. And there was a positive correlation in the fourth hypothesis; therefore, that null was rejected. This study showed mindset and self-efficacy as a predictor of elementary teachers' use of best practices. The study revealed some possible reasons for the outcomes. By providing these reasons, teacher education programs, school districts, and school leaders will have more information with which to base hiring practices, teachers will have reflection pieces, and school leaders will have data to drive professional development offerings to elementary teachers in schools. School leaders will be able to make informed decisions regarding departmentalization and specialization of subject areas, creating authentic opportunities for students, build common collaboration time into daily schedules, and assist teachers with forming and growing their mindset towards mathematics. These modifications can help lower teacher anxiety about teaching mathematics and help them look forward to daily mathematics instruction. They will also help promote a positive relationship regarding mathematics for teachers. Boaler (2016) confirmed "when we encourage open mathematics and the learning messages that support it, we develop our own intellectual freedom, as teachers." As teachers we need to develop mindsets that afford students opportunities to succeed through failure. Boaler also went on to say that students need to be "introduced to creative, beautiful mathematics" full of questions and ideas that challenge "traditional boundaries" (p. 208). In true lifelong learning fashion, those math teachers who use best practices in instruction, continue to grow, learn with their students, invent and continuously reinvent themselves and their practice.

REFERENCES

Artino, A. R., Jr. (2012). Academic self-efficacy: From educational theory to instructional practice. *Perspectives on Medical Education*, *1*, 76–85. http://doi.org/10.1007/s40037-012-0012-5

Ayotola, A., & Adedeji, T. (2009). The relationship between mathematics self-efficacy and achievement in mathematics. *Procedia – Social and Behavioral Sciences*, *1*(1), 953–957. https://doi.org/10.1016/j.sbspro.2009.01.169

Balonan-Rosen, P. (2016). *With over 200 ways to measure teachers, Indiana's evaluation system can get messy*. StateImpact Indiana. Retrieved April 15, 2022, from https://indianapublicmedia.org/stateimpact/2016/09/19/indiana-teacher-evaluations-2/

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

Barnhill, K. (2011). *Changes in mathematics education during the twentieth century*. http://www.mcm.edu/mathdept/Kaitlyn_Barnhill_2011.pdf

Brousseau, G. (2014). *Theory of didactical situations in mathematics: Didactique des mathématiques, 1970-1990*. https://www.semanticscholar.org/paper/Theory-of-Didactical-Situations-in-Mathematics%3A-des-Brousseau/c0cdaa70e372bc7b66a00139c0aaa0b5db8f2207

Beswick, K., & Callingham, R. (2014). The beliefs of pre-service primary and secondary mathematics teachers, in-service mathematics teachers, and mathematics teacher educators (ED599715). In C. Nicol, P. Liljedahl, S. Oesterle, & D. Allan (Eds.), *Proceedings of the Joint Meeting 2-137 of PME 38 and PME-NA 36* (Vol. 2, pp. 137–144). ERIC. https://files.eric.ed.gov/fulltext/ED599715.pdf

Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. Jossey-Bass.

Bowie, L., Venkat, H., & Askew, M. (2019). Pre-service primary teachers' mathematical content knowledge: An exploratory study. *African Journal of Research in Mathematics, Science and Technology Education*, *23*(3), 286–297. https://doi.org/10.1080/18117295.2019.1682777

Brousseau, G., Brousseau, N., & Warfield, V. (2009). Rationals and decimals as required in the school curriculum. *The Journal of Mathematical Behavior*, *28*(2-3), 79–118. https://doi.org/10.1016/j.jmathb.2009.08.002

Butler, C. H. (1951). The reorganization report of 1923. *The Mathematics Teacher*, *44*(2), 90–96. https://doi.org/10.5951/mt.44.2.0090

Cipra, B. (1992). In *On the mathematical preparation of elementary school teachers: Report of a conference held at the University of Chicago*. Chicago; University of Chicago.

Commission on the reorganization of secondary education. (1920). *Reorganization of science in secondary schools* (ED543395). ERIC. https://files.eric.ed.gov/fulltext/ED543395.pdf

Curriculum and evaluation standards. (1989). National Council of Teachers of Mathematics.

Darling-Hammond, L. (2005). Teaching as a profession: Lessons in teacher preparation and professional development. *Phi Delta Kappan*, *87*(3), 237–240. https://doi.org/10.1177/003172170508700318

Data Center & Reports. (2021, December 29). Retrieved January 2, 2022, from https://www.in.gov/doe/it/data-center-and-reports/

Decker, P. J., & Cangemi, J. P. (n.d.). *Emotionally intelligent leaders and self-actualizing behaviors: Any relationship?* IFE PsychologIA. Retrieved April 15, 2022, from https://www.ajol.info/index.php/ifep/article/view/178759ha

Devlin, K. J. (2001). *The math gene: How mathematical thinking evolved and why numbers are like gossip*. Basic Books.

Dewey, J. (1916). Democracy and education. *EdTech Books*. https://edtechbooks.org/democracyandeducation

Dewey, J. (1938). *Experience and education*. Macmillan.

Dewey, J. (2008). Interest and effort in education. In J. A. Boydston (Ed.), *The middle works, 1899-1924 of John Dewey* (2nd ed., Vol. 7, pp. 151-198). Southern Illinois University Press.

Duckworth, A. (2019). *Grit*. Vermilion.

DUFOUR, R. I. C. H. A. R. D. (2020). *Learning by doing: A handbook for professional learning communities at work, Canadian version*. SOLUTION TREE.

Elementary and Secondary Education Act of 1965, P.L. 89-10, 20 U.S.C. § 239 (1965). https://www.govinfo.gov/content/pkg/STATUTE-79/pdf/STATUTE-79-Pg27.pdf#page=1

Elliott, S. (2013, November 27). *The basics of common core standards in Indiana: A reconsideration*. Chalkbeat Indiana. Retrieved January 3, 2022, from https://in.chalkbeat.org/2013/11/27/21101910/the-basics-of-common-core-standards-in-indiana-a-reconsideration

Elliott, S. (2014, September 8). *The basics of Indiana academic standards: A new beginning*. Chalkbeat Indiana. Retrieved January 3, 2022, from https://in.chalkbeat.org/2014/9/8/21100562/the-basics-of-indiana-academic-standards-a-new-beginning

Every Student Succeeds Act, 20 U.S.C. § 6301 (2015). https://www.congress.gov/bill/114th-congress/senate-bill/1177

Fry, S. (2009). *Characteristics and experiences that contribute to novice.* Retrieved January 3, 2022, from https://files.eric.ed.gov/fulltext/EJ857478.pdf

Furinghetti, F. (2007). Teacher education through the history of mathematics. *Educational Studies of Mathematics*, *66*, 131–143. https://doi.org/10.1007/s10649-006-9070-0

Furr, J. (1996). *A brief history of mathematics education in America.* History. Retrieved January 4, 2022, from http://jwilson.coe.uga.edu/EMAT7050/HistoryWeggener.html

Goals 2000: Educate America Act, 20 U.S.C. §6063 (1994, March 31). https://www.congress.gov/bill/103rd-congress/house-bill/1804

Gravetter, F. J., & Wallnau, L. B. (2017). *Statistics for the behavioral sciences* (10th ed.) Cengage.

Greene, K. (2021, April 8). *Evidence-based math instruction: What you need to know*. Understood. https://www.understood.org/en/school-learning/for-educators/teaching-strategies/evidence-based-math-instruction-for-struggling-students

Hattie, J., & Zierer, K. (2018). *10 Mindframes for visible learning: Teaching for success*. Routledge.

Herman, A. (2019). America' STEM crisis threatens our national security. *American Affairs*, *3*, Article 1. https://americanaffairsjournal.org/2019/02/americas-stem-crisis-threatens-our-national-security/

Herrera, T. A., & Owens, D. T. (2001). The "new new math"?: Two reform movements in mathematics education. *Theory Into Practice*, *40*(2), 84–92. https://doi.org/10.1207/s15430421tip4002_2

Hiebert, J., & Lefevre, P. (1986). Conceptual and procedural knowledge in mathematics: An introductory analysis. In J. Hiebert (Ed.), *Conceptual and procedural knowledge* (pp. 1–27). Erlbaum.

Hill, H. C. (2010). The nature and predictors of elementary teachers' mathematical knowledge for teaching. *Journal for Research in Mathematics Education*, *41*(5), 513–545. https://doi.org/10.5951/jresematheduc.41.5.0513

Howe, R. (2000). Book review: Knowing and teaching elementary mathematics by Liping Ma. *Humanistic Mathematics Network Journal*, *1*(23), Article 10. https://doi.org/10.5642/hmnj.200001.23.10

Indiana Academic Standards Mathematics: Grades 3-5. (n.d.). Retrieved February 8, 2022, from https://www.in.gov/sboe/files/2014-05-09_3-5_Math_draft_041414.pdf

Jamil, F. M., Downer, J. T., & Pianta, R. C. (2012). Association of pre-service teachers' performance, personality, and beliefs with teacher self-efficacy at program completion (EJ1001446). *Teacher Education Quarterly*, *39*(4), 119–138. ERIC. https://files.eric.ed.gov/fulltext/EJ1001446.pdf

Jeannotte, D., & Kieran, C. (2017). A conceptual model of mathematical reasoning for school Mathematics. *Educational Studies in Mathematics*, *96*(1), 1–16. https://doi.org/10.1007/s10649-017-9761-8

Jung, E., Zhang, Y., & Chiang, J. (2019). Teachers' mathematics education and readiness beliefs, and kindergarteners' mathematics learning. *International Journal of Education in Mathematics, Science and Technology*, *7*(2), 22–39. https://www.ijemst.com/index.php/ijemst/article/view/644

Katz, S., & Stupel, M. (2016). Enhancing elementary-school mathematic teachers' efficacy beliefs: A qualitative action research. *International Journal of Mathematical Education in Science and Technology*, *47(3)*, 421–439. https://doi.org/10.1080/0020739X.2015.1080314

Kilpatrick, J. (2012). The new math as an international phenomenon. *Zentralblatt Didaktit derMathematik (ZDM) – Mathematics Education*, *44*(4), 563–571. https://doi.org/10.1007/s11858-012-0393-2

Kini, T., & Podolsky, A. (2016). Does teaching experience increase teacher effectiveness? A review of the research. *Learning Policy Institute*. https://doi.org/10.54300/625.642

Klassen, R. M., Tze, V., Betts, S., & Gordon, K. (2011). Teacher efficacy research 1998–2009: Signs of progress or unfulfilled promise? *PsycEXTRA Dataset*, *23*(1), 21–43. https://doi.org/10.1037/e625142010-001

Klein, D. (2001). *A brief history of American K-12 mathematics education in the 20th century* (ED474731). ERIC. Retrieved February 20, 2020, from https://eric.ed.gov/?id=ED474731

Klein, D., Askey, R., Milgram, R. J., Wu, H., Scharlemann, M., & Tsang, B. (1999). *An open letter to United States Secretary of Education.* http://www.oaknorton.com/imathpdfs/4-AN%20OPEN%20LETTER%20TO%20UNITED%20STATES%20SECRETARY%20OF%20EDUCATION.doc

Kliebard, H. M. (2002, April 12). *Changing course: American curriculum reform in the 20th century*. Google Books. https://books.google.com/books/about/Changing_Course.html?id=vIyW0QEzHfsC

Lemov, D. (2021). *Teach like a champion 3.0*. Jossey-Bass.

Lithner, J. (2007). A research framework for creative and imitative reasoning. *Educational Studies in Mathematics*, *67*(3), 255–276. https://doi.org/10.1007/s10649-007-9104-2

Lowery, N. V. (2002). Construction of teacher knowledge in context: Preparing elementary teachers to teach mathematics and science. *School Science and Mathematics*, *102*(2), 68–83. https://doi.org/10.1111/j.1949-8594.2002.tb17896.x

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teacher's understanding of fundamental mathematics in China and the United States*. Lawrence Erlbaum Associates.

Mathematical Association of America. (1962). On the mathematics curriculum of the high school. (1962). *The American Mathematical Monthly*, *69*(3), 189–193. https://doi.org/10.2307/2311046

Mcleod, S. (2020, December 29). *Maslow's hierarchy of needs*. Simply Psychology. Retrieved April 15, 2022, from https://www.simplypsychology.org/maslow.html

Melville, W., Kajander, A., Kerr, D., & Holm, J. (2013). Uncertainty and the reform of elementary math education. *International Scholarly Research Notices*, *2013*, 1–8. https://doi.org/10.1155/2013/845164

Morgan, P. L., Farkas, G., & Maczuga, S. (2015). Which instructional practices most help first-grade students with and without mathematics difficulties? *Educational Evaluation and Policy Analysis*, *37*(2), 184–205. https://doi.org/10.3102/0162373714536608

National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform.* U.S. Government Printing Office. https://www2.ed.gov/pubs/NatAtRisk/index.html

National Defense Education Act: Hearings before the Joint Subcommittee on Education of the Committee on Education and Labor, House of Representatives, eighty-seventh Congress, first session on H.R. 6774, H.R. 4253, H.R. 7378 and related bills to extend and improve the National Defense Education Act of 1958, and for other purposes (n.d.).

National Governors Association Center for Best Practices, Council of Chief State School Officers (2010). Common core state standards for English language arts. Washington, DC National Governors Association Center for Best Practices, Council of Chief State School Officers. - references - scientific research publishing. (n.d.). Retrieved February 8, 2022, from https://www.scirp.org/reference/ReferencesPapers.aspx?ReferenceID=1161189

No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. § 6319 (2002).https://www.govinfo.gov/content/pkg/BILLS-107hr1enr/pdf/BILLS-107hr1enr.pdf

Orlich, D. C. (1998).*Instructor's resource manual, teaching strategies: A guide to better instruction* (5th ed.). Houghton Mifflin.

Ortlieb, E. T., & Cheek, E. H., Jr. (2008). How geographic location plays a role within instruction: Venturing into both rural and urban elementary schools. *Educational Research Quarterly*, *32*(1), 51-68. https://www.proquest.com/scholarly-journals/how-geographic-location-plays-role-within/docview/61862853/se-2?accountid=8483

Osburn, J., Caruso, G., & Wolfensberger, W. (2011, September 8). *The concept of "best practice": A brief overview of its meanings, scope, usage, and shortcomings.* https://socialrolevalorization.com/wp-content/uploads/2019/09/Best-Practice-september-2011-2.pdf

Österman, T., & Bråting, K. (2019). Dewey and mathematical practice: Revisiting the distinction between procedural and conceptual knowledge. *Journal of Curriculum Studies*, *51*(4), 457–470. https://doi.org/10.1007/s10649-016-9727-2

Pepin, B., Xu, B., Trouche, L., & Wang, C. (2017). Developing a deeper understanding of mathematics teaching expertise: An examination of three Chinese mathematics teachers' resource systems as windows into their work and expertise. *Educational Studies in Mathematics*, *94*(3), 257–274. https://doi.org/10.1023/b:educ.0000006238.61235.48

Polya, G. (1965). *Mathematical discovery: On understanding, learning, and teaching problem solving* (Vol. 2). John Wiley and Sons.

Principles and standards for school mathematics. (2000). National Council of Teachers of Mathematics. NCTM Publishers.

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

Quinn, R. J. (1997). Effects of mathematics methods courses on the mathematical attitudes and content knowledge of preservice teachers. *The Journal of Educational Research*, *91*(2), 108–113. https://doi.org/10.1080/00220679709597528

Reys, B. J., & Fennell, F. S. (2003). Who should lead mathematics instruction at the elementary school level? A case for mathematics specialists. *Teaching Children Mathematics*, *9*(5), 277–282. https://doi.org/10.5951/tcm.9.5.0277

Rhodes, J. H. (2014). *An education in politics: The origins and evolution of No Child Left Behind*. Cornell University Press.

Riley, R. W. (1998). Our Teachers Should be Excellent, and They Should Look Like America. *Education and Urban Society*, *31*(1), 18–29. https://doi.org/10.1177/0013124598031001002

Ritchhart, R. (2015). *Creating cultures of thinking: The 8 forces we must master to truly transform our schools*. Jossey-Bass.

Rose, H., & Betts, J. R. (2004). The effect of high school courses on earnings. *Review of Economics and Statistics*, *86*(2), 497–513. https://doi.org/10.1162/003465304323031076

Sawyer, W. W. (1983). *Prelude to Mathematics*. Dover Publications Inc.

Schifter, D. (1998). Learning mathematics for teaching: From a teachers' seminar to the classroom. *Journal of Mathematics Teacher Education*, *1*, 55–87. https://doi.org/10.1023/A:1009911200478

Smith, M. S., & Stein, M. K. (2018). *5 practices for orchestrating productive mathematics discussions.* Corwin.

Soto-Johnson, H., Iiams, M., Hoffmeister, A., Boschmans, B., & Oberg, T. (2007). Supporting teacher learning: Our voyage with knowing and teaching elementary mathematics. *Teaching Children Mathematics*, *13*(9), 493–497. https://doi.org/10.5951/tcm.13.9.0493

Stanic, G. M. A., & Kilpatrick, J. (2003). *A history of school mathematics* (Vol. 1). National Council of Teachers of Mathematics.

Stedman, J. B. (1989, January 10). *Dwight D. Eisenhower mathematics and science education act: An analysis of recent legislative action and program evaluations.* ERIC. Retrieved January 2, 2022, from https://eric.ed.gov/?q=library%2Bscience&ft=on&ff1=autStedman%2C%2BJames%2BB. &id=ED304337

Swadener, M. (1978). Mathematics courses for elementary teachers. *The American Mathematical Monthly*, *85*(8), 678–680. https://doi.org/10.1080/00029890.1978.11994675

Swarner, C. (1998). *Mathematics reform: A call for balance* (ED420500). ERIC. https://files.eric.ed.gov/fulltext/ED420500.pdf

Swars, S. L. (2005). Examining perceptions of mathematics teaching effectiveness among elementary preservice teachers with differing levels of mathematics teacher efficacy. *Journal of Instructional Psychology*, *32*(2), 139-147. http://www.sciepub.com/reference/88740

Thomson, M. M., Walkowiak, T. A., Whitehead, A. N., & Huggins, E. (2019). Mathematics teaching efficacy and developmental trajectories: A mixed-methods investigation of novice K-5 teachers. *Teaching and Teacher Education*, *87*, Article 102953. https://doi.org/10.1016/j.tate.2019.102953

United States Department of Education. National Center for Education Statistics. (1992, February 16). High School and Beyond, 1980: Sophomore and senior cohort first follow-up (1982). High School and Beyond, 1980: Sophomore and Senior Cohort First Follow-Up (1982). Retrieved February 7, 2022, from https://www.icpsr.umich.edu/web/ICPSR/studies/8297

Vail Lowery, N. (2002). Construction of teacher knowledge in context: Preparing elementary teachers to teach mathematics and Science. School Science and Mathematics, 102(2), 68–83. https://doi.org/10.1111/j.1949-8594.2002.tb17896.x

What are the Indiana Academic Standards? (2021, November 10). *Mathematics*. IDOE. Retrieved January 3, 2022, from http://www.in.gov/doe/students/indiana-academic-standards/mathematics/

Wilson, M. S., & Goldenberg, M. P. (1998). Some conceptions are difficult to change: One middle school mathematics teacher's struggle. *Journal of Mathematics Teacher Education*, *1*(3), 269–293. https://doi.org/10.1023/a:1009990018385

Wilson, P. S., Cooney, T. J., & Stinson, D. W. (2005). What constitutes good mathematics teaching and how it develops: Nine high school teachers' perspectives. *Journal of Mathematics Teacher Education*, *8*(2), 83–111. https://doi.org/10.1007/s10857-005-4796-7

Wu, H. (1999). Basic skills versus conceptual understanding. A bogus dichotomy in mathematics education (EJ598435). *American Educator*, *23*(3), *14-19, 50-53.* ERIC. https://eric.ed.gov/?id=EJ598435

Youmans, A., Coombs, A., & Colgan, L. (2018). Early childhood educators' and teachers' early mathematics education knowledge, beliefs, and pedagogy (EJ1200249). *Canadian Journal of Education*, *41*(4), 1080–1104. ERIC. https://files.eric.ed.gov/fulltext/EJ1200249.pdf

APPENDIX A: SURVEY

Indicate the degree to which each statement describes you.
Strongly Agree- 6
Agree- 5
Somewhat Agree- 4
Somewhat Disagree-3
Disagree-2
Strongly Disagree-1

Evidence-Based Teaching Expectations

1. I am strong at probing for depth of student understanding using my questioning techniques while teaching math.
2. I consistently provide time for students to analyze their thoughts in order to increase their ability to problem-solve in math class.
3. I frequently reflect on my instructional decisions to consistently improve my ability to meet individual needs of students in math.
4. I utilize my deep understanding of math content in order to adapt my teaching strategies to maximize student growth.
5. I consistently make my lessons meaningful for students by providing practical real-world connections to the math content I am teaching.
6. I provide ample opportunity to have students engage in mathematical discourse with one another surrounding the content they are working through.
7. I provide time for students to explore content deeply, so students develop mathematical persistence.
8. I spend just as much time working on student conceptual knowledge as teaching them procedures (such as formulas) to solve problems.

Teacher Self-Efficacy

1. I have been provided ample professional development in mathematics for me to feel comfortable changing instructional practices when I need to.
2. I frequently collaborate with other teachers to enhance my ability to teach mathematics.
3. I consistently take time to reflect on successes and failures of my math lessons to improve over time.
4. I believe I can improve student performance in mathematics.

5. I believe I have strong content knowledge in mathematics to draw from.
6. I use student-centered instructional techniques over teacher-centered daily when teaching mathematics.
7. I do not stress about teaching math.
8. I do not have a negative relationship with mathematics.

Mindset

1. I look forward to teaching math each day.
2. I consistently communicate to my students that math is a subject based on growth.
3. I give students time to see trends and patterns in math.
4. I consistently explore students' thoughts about what might work to solve a problem before I ever demonstrate a procedural method aligned to the problem.
5. I give time for students to demonstrate their creativity and innovate within my math class.
6. I always respond to student mathematical discourse by focusing on what was correct in the thinking rather than what was wrong in order to create a growth-oriented learning environment.
7. I do not provide an opportunity for students to opt out of their mathematical thinking.
8. I excel at providing extended practice time to allow students to develop their understanding in math.

Demographics

1. What best classifies your school's geographic location? (Rural, Suburban, or Urban)
2. What grade level area do you teach? (Primary K-2, Intermediate 3-6)
3. Do you teach: (All subjects, specialize in one subject)
4. How many years of teaching experience do you have? (Less than 5, 5-15, More than 15)

APPENDIX B: SURVEY WITH REFERENCES

Indicate the degree to which each statement describes you.
Strongly Agree- 6
Agree- 5
Somewhat Agree- 4
Somewhat Disagree-3
Disagree-2
Strongly Disagree-1

Evidence-Based Teaching Expectations

1. I am strong at probing for depth of student understanding using my questioning techniques while teaching math. (Wilson et al., 2005)
2. I consistently provide time for students to analyze their thoughts in order to increase their ability to problem-solve in math class. (Wilson et al., 2005)
3. I frequently reflect on my instructional decisions to consistently improve my ability to meet individual needs of students in math. (Wilson et al., 2005)
4. I utilize my deep understanding of math content in order to adapt my teaching strategies to maximize student growth. (Wilson et al., 2005)
5. I consistently make my lessons meaningful for students by providing practical real-world connections to the math content I am teaching. (Dewey, Osterman & Brating, 2019)
6. I provide ample opportunity to have students engage in mathematical discourse with one another surrounding the content they are working through. (Pepin et al., 2017)
7. I provide time for students to explore content deeply, so students develop mathematical persistence. (Boaler, 2016)
8. I spend just as much time working on student conceptual knowledge as teaching them procedures (such as formulas) to solve problems. (Jeanotte & Kieran, 2017)

Teacher Self-Efficacy

1. I have been provided ample professional development in mathematics for me to feel comfortable changing instructional practices when I need to. (Howe, 1999)
2. I frequently collaborate with other teachers to enhance my ability to teach mathematics. (Howe, 1999)
3. I consistently take time to reflect on successes and failures of my math lessons to improve over time. (Fry, 2009)

4. I believe I can improve student performance in mathematics. (Katz & Stupel, 2016)
5. I believe I have strong content knowledge in mathematics to draw from. (Boaler, 2016)
6. I use student-centered instructional techniques over teacher-centered daily when teaching mathematics. (Swars, 2005)
7. I do not stress about teaching math. (Klassen et al.,2012)
8. I do not have a negative relationship with mathematics. (Swars, 2005)

Mindset

1. I look forward to teaching math each day. (Boaler, 2016)
2. I consistently communicate to my students that math is a subject based on growth. (Boaler, 2016)
3. I give students time to see trends and patterns in math. (Boaler, 2016)
4. I consistently explore students' thoughts about what might work to solve a problem before I ever demonstrate a procedural method aligned to the problem. (Boaler, 2016)
5. I give time for students to demonstrate their creativity and innovate within my math class. (Boaler, 2016)
6. I always respond to student mathematical discourse by focusing on what was correct in the thinking rather than what was wrong in order to create a growth-oriented learning environment. (Boaler, 2016)
7. I do not provide an opportunity for students to opt out of their mathematical thinking. (Boaler, 2016)
8. I excel at providing extended practice time to allow students to develop their understanding in math. (Melville et al., 2013)

Demographics

1. What best classifies your school's geographic location? (Rural, Suburban, or Urban)
2. What grade level area do you teach? (Primary K-2, Intermediate 3-6)
3. Do you teach: (All subjects, specialize in one subject)
4. How many years of teaching experience do you have? (Less than 5, 5-15, More than 15)

APPENDIX C: LETTER OF REQUEST TO IDOE

Dear Dr. Jenner or IDOE designee:

I am contacting you to obtain a list of contact information for elementary teachers in Indiana. I am conducting a research study on *the impact of self-efficacy and mindset of elementary general education teachers' use of best practices in mathematics' instruction.* The study is being conducted by Esther Goodes, a doctoral candidate in the Department of Educational Leadership and Administration at Indiana State University.

I am seeking participation from Indiana educators in order to inform future hiring practices, professional development opportunities and pre-service training for elementary teachers. Because teachers' time is valuable, the survey will only take fifteen minutes to complete. The survey will address the use of best practices in the mathematics classroom.

Participation in the study is completely voluntary and all responses will be kept confidential. There are no costs or risks involved with participation. No one will be able to identify participants based on their answers, nor will anyone know who participated in the survey.

Your cooperation is essential to the launch of this survey and the collection of valuable data.

Your assistance is greatly appreciated, as the research is only valid with the participation of Indiana elementary educators.

If you have additional questions, please contact Esther Goodes at egoodes@sycamores.indstate.edu

Thank you in advance!

Esther Goodes
Doctoral Student
Indiana State University

APPENDIX D: LETTER TO PROSPECTIVE PARTICIPANTS

Dear Indiana Elementary Educator:

I would like to invite you to participate in a research study, entitled *The impact of self-efficacy and mindset of elementary general education teachers' use of best practices in mathematics' instruction.* The study is being conducted by Esther Goodes, a doctoral candidate in the Department of Educational Leadership and Administration at Indiana State University.

Indiana elementary educators have been selected to inform future hiring practices, professional development opportunities and pre-service training for elementary teachers. Your input will be used to inform school districts and teacher preparation programs on strategies that will give the best outcomes for teachers and students.

Because your time is valuable, the survey will only take fifteen minutes to complete. The survey will address the use of best practices in the mathematics classroom at the elementary level.

Your participation in the study is completely voluntary and all responses will be kept confidential. There are no costs or risks involved with participation. No one will be able to identify you or your answers, nor will anyone know you participated in the study.

Your participation is very much appreciated, as this survey can only be deemed credible with your input.

If you have additional questions, please contact Esther Goodes at egoodes@sycamores.indstate.edu

Thank you in advance for your willingness to participate in this study!

Esther Goodes

Doctoral Student

Indiana State University