UNDERSTANDING THE ROLE OF CONFIDENCE AND SELF-EFFICACY IN THE USE OF MATH EVIDENCE-BASED PRACTICES IN MIDDLE SCHOOL INCLUSIVE CLASSROOMS

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UNDERSTANDING THE ROLE OF CONFIDENCE AND SELF-EFFICACY IN THE USE OF MATH EVIDENCE-BASED PRACTICES IN MIDDLE SCHOOL INCLUSIVE CLASSROOMS

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Table of Contents

List of Tables

List of Figures

Abstract

This study examined the use of six math evidence-based practices (EBPs) for students in middle school with disabilities and sought to understand whether teachers' use of these practices was related to their confidence in implementation of EBPs or math teaching self-efficacy. I also examined differences between general and special education teachers. Math teaching self-efficacy was measured by the Math Teaching Efficacy Beliefs Instrument (MTEBI) and reported as two separate scores from two distinct subscales: Personal Mathematics Teaching Efficacy (PMTE) and Mathematics Teaching Outcome Expectancy (MTOE). The results indicated that both general and special education teachers used EBPs frequently, but that special education teachers had lower confidence in implementing these practices. Self-reported overall math teaching efficacy was low for both groups, but general educators had lower PMTE than special education teachers. Although confidence predicted reported use of EBPs, self-efficacy did not predict the use of EBPs. Years of experience was negatively correlated to the use of math EBPs and was a significant predictor in the regression analysis. Implications for policy, practice, and leadership are discussed.

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CHAPTER 1: INTRODUCTION

In general education middle school math classrooms across the United States, special educators work alongside general educators to provide students with disabilities (SWD) a high-quality education that meets their needs. The "how" of education, and especially of special education, includes the use of instructional strategies shown to be effective in research. These are known as evidence-based practices (EBPs). EBPs are practices that multiple, high-quality, experimental studies have demonstrated effective for a specific population (S. C. Cook et al., 2020). However, teachers struggle to implement EBPs in their work with SWD and SWD demonstrate math achievement that is below expectations (Brownell et al., 2020; Lukins et al., 2023). To improve the performance of these students, it is important to understand which EBPs educators are using and what factors might relate to their use or non-use of these practices. Understanding the current landscape of instructional practice and what elements may influence the use of EBPs is the first step in creating meaningful change in teacher practice, which should result in better outcomes for SWD.

Problem Statement

SWD consistently struggle with mathematics achievement, which can limit participation in post-secondary education, limit career choices, and even put their high school diplomas in jeopardy (Lembke et al., 2012; Powell et al., 2021). For students to be prepared for the rigor of high school math, they need effective instruction during elementary and middle school (American Institutes for Research, 2017; Lembke et al., 2012). For SWD, research has shown math performance predicts success in K-12 education (including earning a high school diploma)

and positive post-secondary outcomes (Lembke et al., 2012; Powell et al., 2021). To promote math achievement and ensure schools place students in the least restrictive environment (IDEA, 2004), special education teachers are charged with providing specially designed math instruction to many SWD in inclusive general education classrooms, where SWD learn alongside their peers without disabilities. However, targeted math instruction and the math achievement of SWD is not the responsibility of special educators alone (Rimpola, 2014). In inclusive classrooms, general and special education teachers work together to deliver curriculum to students and ensure their success.

Federal mandates require the use of EBPs (IDEA, 2004), and researchers have identified six EBPs that increase achievement for middle school math SWD (Powell et al., 2021). However, despite strong research evidence supporting these practices, EBPs continue to be underutilized by special education teachers (Bruno et al., 2021; Kretlow & Blatz, 2011; Lukins et al., 2023) and general education teachers (Dignath & Buttner, 2018; Oleson & Hora, 2014 Rattan et al., 2012). Furthermore, most special education teachers are at a disadvantage in terms of preparation for teaching math content. Most special education teachers do not take significant coursework in mathematics or mathematics pedagogy for secondary students (Marin & Keefe, 2021; Sheppard & Weiman, 2020). Thirty-two states require only testing or training in special education and not in a specific academic content (Vanderbilt University, 2023). However, in secondary math classrooms, special educators are often tasked with teaching content and skills for which they were not well-trained and in which they might not feel confident (Faulkner & Cain, 2013; Floyd & Rice, 2009). Although special education teachers may be less trained and feel less confident in teaching math content, many general education secondary mathematics teachers find themselves under-prepared for teaching SWD (Everett, 2017). Many secondary

content preparation programs feature only a single course in special education (Duchaine et al., 2021). Although general education teachers may be the content experts, they may be less familiar with strategies that are known to be successful in teaching math to SWD (Da Fonte & Barton-Arwood, 2017; Everett, 2017). Each subset of teachers undergoes a different type of training and possesses a different set of skills. This may lead to differences in their instructional practices when teaching math.

Although the research-to-practice gap continues to be problematic and pervasive in education, understanding the elements that influence this phenomenon could help to close this gap. I examined the use of math EBPs by middle school general and special educators, who provide math instruction in inclusive settings, and two variables that might influence teacher use of these practices: confidence in implementing each practice and math teaching self-efficacy. I explored whether educators in inclusive settings consistently engage in best practices, and if they feel confident using these practices and overall effective in teaching mathematics. Also, given the different preparation and distinct roles for general educators and special educators, I compared results from these two groups. Understanding the current practices in mathematics by middle school teachers can inform teacher preparation and training for in-service teachers that supports all teachers in their mission to provide high quality instruction to all students.

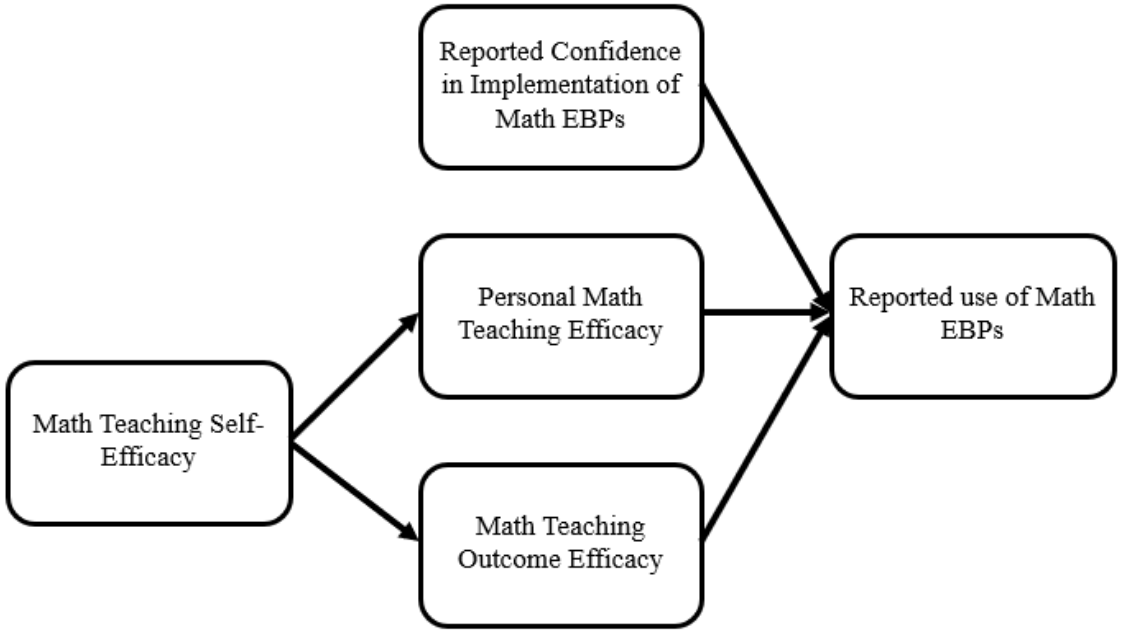
Conceptual Framework

Educating students, especially those with disabilities, is a complex and multi-faceted task, with competing priorities, limited time, and numerous puzzles (Armstrong, 2017). Although many elements may influence student success, high-quality instruction using strategies and practices supported by research is certainly important. In general education, the use of EBPs is currently mandated under the Every Student Succeeds Act (ESSA, 2015), which emphasizes the

use of evidence-based activities, strategies, and interventions. The use of EBPs for SWD is not only a federal mandate but special education organizations and teacher preparation programs, including the Council for Exceptional Children, National Education Association, and the Council for the Accreditation of Educator Preparation promote the use of EBPs. However, research indicates that teachers struggle to select and implement EBPs in their classrooms (B. G. Cook et al., 2013; Guckert et al., 2016; Johnson & McMaster, 2013; Konrad et al., 2019). This current study focused on six math EBPs for middle school and asked teachers to self-report their use of each of these practices. This is a tool to understand how frequently teachers use these practices. To increase the use of EBPs in classrooms, it is important to understand the factors that may promote or influence teacher implementation of these strategies. This study addressed two of those factors: confidence in implementation for each individual practice and math teaching self-efficacy, which consists of two factors: personal math teaching efficacy (PMTE) and math teaching outcome expectancy (MTOE). I theorized that these three factors would have a strong positive relationship to reported use of math EBPs (see Figure 1) as teachers are more likely to use specific instructional practices when they feel effective, confident, or skilled in using them (Hadley & Dorward, 2011).

Figure 1

Conceptual Framework for Current Study



Note. EBP = Evidence-based practice

Teacher Self-Efficacy

Self-efficacy is an individual's belief in his or her ability to carry out a task successfully (Merle, 2021). The concept of self-efficacy comes from Bandura's (1977, 1986) Social Cognitive Theory. Social Cognitive Theory states that the way people learn, act, and behave is based on the influence of a combination of and interaction with personal and environmental factors (Garris, 2019). Bandura was a psychologist attempting to understand and explain human behavior, but his ideas have influenced the field of education. A key component of his theory is the idea of human agency, which states that individuals can impact or cause specific outcomes. Humans can decide what they want to do (Garris, 2019). Bandura (1977) "hypothesized that

expectations of personal efficacy determine whether coping behavior will be initiated, how much effort will be expended, and how long it will be sustained in the face of obstacles and aversive experiences" (p. 191). That is, our self-confidence affects our motivation and actions. If an individual feels more confident and able to affect a situation, they will be more likely to act.

Bandura and Self-Efficacy. Self-efficacy is "the judgement of one's proficiencies to shape and implement actions required to produce desired achievements" (Gulistan et al., 2017, p. 172). If an individual has high self-efficacy, they believe they can be successful. Bandura (1986) explained four ways in which individuals can develop or grow in their self-efficacy—(a) active *mastery experiences*, in which individuals are successful and this success reinforces their concepts of self-efficacy; (b) *vicarious experiences* where models are successful; (c) *verbal persuasion*; and (d) *physiological reactions*, including an individual's physical and emotional perceptions during an event or action. Self-efficacy is cyclical and reciprocal in nature. If an individual has high self-efficacy for a skill, then performs that skill successfully, that in turn further increases their self-efficacy. Of course, the opposite holds true, and a lack of success can decrease feelings of self-efficacy. Self-efficacy is a decades old, thoroughly researched phenomenon, both in psychology and in education. It also matches more "common sense" notions of motivations and actions. If an individual is confident that they perform a task successfully, they will more likely be motivated to perform that task, follow through on their intention with action, and complete the task. Higher self-efficacy is linked to motivation and persistence (Bandura, 1986).

Efficacy Expectations and Outcome Expectations. In Bandura's (1977) early work, he discussed two components of his theory: efficacy expectations and outcome expectations. Self-efficacy is a cognitive process whereby individuals construct beliefs about their ability to

perform a certain task at a certain level of proficiency. Outcome expectancy, separate and distinct from efficacy expectations, is the belief in the likelihood that an individual's actions will produce the desired outcome (Bandura, 1977). Bandura expressed the belief that outcome expectancy was related to efficacy expectancy but placed little importance on the construct in terms of understanding human behavior (Williams, 2010). He believed that efficacy expectancy predicted behavior and that outcome expectancy held little predictive value (Bandura, 1997). Other researchers, informed by the 1966 work of Rotter and early findings of the RAND corporation survey considered both efficacy and outcome expectations part of a larger construct called teacher efficacy (Tschannen-Moran et al., 1998). Gibson and Dembo (1984) developed a survey instrument using this conceptual framework and the teacher efficacy measure used in the current study derives from that survey instrument and, therefore, includes elements of both efficacy and outcome expectancy. For psychologists, the distinctions between these different conceptions of efficacy and the nature of efficacy expectancy and outcome expectancy continue to represent an unresolved contradiction (Williams, 2010). Tschannen-Moran and colleagues (1998) attempted to weave together the construct of teacher efficacy with Bandura's theory of self-efficacy. Thirty years later, multiple instruments assess "teacher efficacy" and "self-efficacy" with little mention of this tension. Self-efficacy continues to be a complex construct that may not have a consistent definition across the research.

Teacher Efficacy. Self-efficacy is both context and task-specific (Hajovsky et al., 2019; Tschannen-Moran & Woolfolk Hoy, 2001). Individuals, including educators, do not have the same level of self-efficacy for all tasks. For teachers, overall self-efficacy comes down to confidence in their ability to do their jobs—to teach students and to have those students learn—to influence student achievement. There are many aspects to overall teacher self-efficacy, as

teaching involves multiple tasks and competencies (Hajovsky et al., 2019). General measures of teacher self-efficacy collect data regarding various facets of teaching and aggregate this into an overall score of self-efficacy (Tschannen-Moran & Woolfolk Hoy, 2001). However, teacher efficacy research has demonstrated that teachers do not consider themselves equally proficient at various aspects of teaching—classroom management, instruction, assessment—or at all subject areas or contents (Gulistan et al., 2017). For the purposes of this study, I focused on self-reported teacher efficacy of mathematics instruction that includes elements of efficacy expectations and outcome expectations.

Confidence in Implementation. I also asked teachers about their confidence in implementation for math EBPs. Teachers rated how confident they felt in using a specific practice. Confidence is sometimes used interchangeably with the term self-efficacy (Feltz & Chase, 1998). However, for the purposes of this research confidence in implementation is a distinct variable from math teaching self-efficacy, as measured by the Math Teaching Efficacy Beliefs Instrument (MTEBI). Confidence in implementation is more closely related to efficacy expectations than outcome expectations, as it focuses simply on how confident the teacher feels in using a practice. Measures of confidence are not focused on how effective or impactful the teacher believes the practice to be. Self-efficacy is an extraordinarily complex construct that is measured indirectly using a survey instrument. In contrast, confidence in implementation is a very narrow concept and is being measured more directly as teachers are asked specifically about their confidence for each specific practice. Confidence in implementation is one element of efficacy expectations but is a more direct, less complex, and narrower construct.

Research Questions

The purpose of this research is to better understand the practices of teachers when teaching mathematics in inclusive classrooms and whether the use of those practices is related to confidence in implementation for those practices or math teaching self-efficacy. General and special education teachers may not feel equally confident or have the same levels of math teaching self-efficacy. Since general education teachers and special education teachers are both responsible for implementation of EBPs in working with SWD, I also compared these two groups. I used the following research questions to guide my study:

1. To what extent do middle school teachers report the use of math EBPs when providing instruction in inclusive settings?
    a. Does the reported use of math EBPs significantly differ between general and special education teachers?
2. To what extent do middle school teachers report confidence in implementing math EBPs when providing instruction in inclusive settings?
    a. Does the reported confidence in implementing math EBPs significantly differ between general and special education teachers?
3. What is the perceived math teaching self-efficacy of middle school teachers?
    a. Does the perceived math teaching self-efficacy significantly differ between general and special education teachers?
4. What is the relationship between self-reported use of math EBPs, reported confidence in implementation, and perceptions of math teaching self-efficacy?

Significance of the Study

As the population of SWD continues to grow in America (Zablotsky et al., 2019), it is incumbent upon the educational systems and individual educators to ensure these students receive a high-quality education. However, SWD have consistently lower math achievement than their peers (National Center for Education Statistics, 2022a); lower high school graduation rates (National Center for Education Statistics, 2023b); and poorer post-secondary outcomes (Bureau of Labor Statistics, 2023; Kearns et al., 2021). One way to improve outcomes for SWD is to improve the quality of instruction they receive.

Despite the extensive research and practitioner friendly publications outlining strong and effective instructional practices, there still exists a disparity between research and practice. This disconnection impacts student achievement. To better understand the divide between research and practice and lack of measurable results, it is important to understand if teachers are using EBPs and to what extent. Understanding the relationship between confidence, self-efficacy, and practice can also help shape next steps in increasing use of EBPs. A strong sense of current pedagogical praxis can guide the next steps in teacher preparation, professional development, and educational research.

Definitions of Terms

Evidence-based Practices (EBP): Evidence-based practices are instructional practices "supported as being effective for increasing an outcome for a population of learners by multiple, high-quality, experimental studies" (S. C. Cook et al., 2020, p. 7).

Free Appropriate Public Education (FAPE): A legal protection for special education students whereby they are entitled to education by public schools that is both free and appropriate, including the opportunity to meet challenging objectives (Osburne & Russo, 2021).

High-leverage Practices: High-leverage practices are a subset of EBP and refer to a specific list of practices for SWD developed by the Council for Exceptional Children and the Collaboration for Effective Educator Development, Accountability and Reform (McCleskey et al., 2017).

Inclusive Classroom/Setting: A general education classroom or setting where special education students are included and receive instruction in the general education curriculum from a general education teacher along with their peers without disabilities (Yakut, 2021). Inclusive classrooms sometimes employ *co-teaching,* where SWD "learn alongside their peers, complete assignments associated with the general education curriculum, and receive instruction from a general education subject-area specialist and a special educator" (Hedin et al., 2020, p. 298).

Individual with Disabilities Act (*IDEA):* A comprehensive federal law, reauthorized in 2004, that makes FAPE available to students with identified disabilities. It assures and outlines the legal requirements of special education.

Least Restrictive Environment: A legal protection for SWD defined in IDEA (2004) as

> Each public agency must ensure that—
>
> (i) To the maximum extent appropriate, children with disabilities, including children in public or private institutions or other care facilities, are educated with children who are nondisabled; and
>
> (ii) Special classes, separate schooling, or other removal of children with disabilities from the regular educational environment occurs only if the nature or severity of the disability is such that education in regular classes with the use of supplementary aids and services cannot be achieved satisfactorily (Sec. 300.114).

Math Difficulty: A designation referring to a category of students with consistent and significant struggles with grade level mathematics content (Powell et al., 2020).

Self-efficacy: “the judgement of one’s proficiencies to shape and implement actions required to produce desired achievements” (Gulistan et al., 2017, p. 172).

Special Education Teacher/Special educator: A qualified individual whose title and job description are to provide specially designed instruction to SWD (Riccomini et al., 2017).

Specially Designed Instruction (SDI): IDEA (2004) defines SDI as

> (3) adapting, as appropriate to the needs of an eligible child under this part, the content, methodology, or delivery of instruction—
>
> (i) To address the unique needs of the child that result from the child’s disability; and
>
> (ii) To ensure access of the child to the general curriculum, so that the child can meet the educational standards within the jurisdiction of the public agency that apply to all children. (Section 300.39)

Student with Disability (SWD): An individual identified under IDEA (2004) as having a disability impacting their ability to access general education curriculum who receives special education services.

CHAPTER 2: REVIEW OF RELATED LITERATURE

The inclusion of students with high incidence disabilities in general education classrooms has increased substantially over the past few decades (Gilmour, 2018; National Center for Education Statistics, 2022b; Zablotsky et al., 2019). These students often make up the largest sub-group when considering student progress under state and federal accountability systems (Crocket et al., 2018), and schools are required to meet their educational needs and increase their achievement levels. Despite decades of reforms to special education, students with high incidence disabilities still struggle to meet the academic standards of their peers without disabilities (Arundel, 2022; National Center for Education Statistics, 2022a). Federal law and court precedent dictate that students with disabilities (SWD) are entitled to an appropriately challenging education (*Endrew F. v. Douglas County School*, 2017; P. W. D. Wright, 2020). Math achievement is an essential piece of this education, as it is vital for high school graduation, as well as for being college and career ready in the global marketplace (Lembke et al., 2012; Minskoff & Allsopp, 2003; Powell et al., 2021). There is overwhelming evidence that many SWD are capable of math achievement at the same level as their peers without disabilities, but they are not reaching these goals (Brownell et al., 2020; King et al., 2016; Powell et al., 2020; Wilburne et al., 2017). The use of evidence-based practices (EBPs) is an essential part of general and special education policy and practice aimed at improving outcomes for SWD. Teacher self-efficacy and teachers' confidence in implementing each practice may influence the use of specific EBPs.

This chapter begins with a brief review of relevant information about special education, because this study focuses on practices for instructing SWD. This section includes key laws and terminology, including laws overseeing general education. I also provided information and data about the math performance of SWD and the research advocating the use of EBPs to improve this performance. The premise of this study is that the reported use of EBPs is related to confidence in implementation and math teaching self-efficacy, so I presented sections on self-efficacy and EBPs. This chapter concludes by presenting the six EBPs for math instruction with middle school SWD I investigated in this study.

Current State of Special Education

I explored the use of EBPs for SWD in middle school mathematics. Although EBPs represent best practices for instruction and a tool to help ensure student achievement and success, they are also a part of federal education policy. EBPs are a type of instructional strategy used in classrooms, but students, teachers, and classrooms are nested in a larger web of local, state, and federal policy and practice. Before I direct my focus to EBPs in classrooms, it is important to understand the laws and policies that inform special education, the essential terms and concepts involved, and the state of special education in America.

History

Special education is a young field, both in terms of practice and research, as SWD were systematically denied access to public education until the Education for All Handicapped Children Act of 1975. *Brown v. Board of Education* (1954) addressed segregation of students by race and began dismantling the separate schools for Black students and White students. This was the beginning of decades of change to education, led by parent advocacy groups, and enacted through federal laws and statutes, as well as court precedent. Soon after the *Brown* decision,

parents and disability advocates argued that denying SWD access to education was no different from denying access based on race and was therefore, not permitted. Several lawsuits brought on behalf of students were successful in arguing this claim (Markelz & Bateman, 2022). Although the Education for All Handicapped Children Act was not the first piece of legislation to address the rights of individuals with disabilities, it specifically addressed K-12 education and was both clear and robust (Markelz & Bateman, 2022). Education for All Handicapped Children Act and its subsequent re-authorization as IDEA in 1990 (as well as further re-authorizations in 2004, 2008, and 2015) established several of the key protections for SWD, including free appropriate public education (FAPE), least restrictive environment, and specially designed instruction (SDI).

FAPE. FAPE first appeared in the Education for All Handicapped Children Act in 1975. The intent of this language was to guarantee that students could not be excluded from public education, could not be forced to pay for public education, and that their education was appropriate for their needs (Markelz & Bateman, 2022). Although the term *free* has been easier to interpret, the vague term *appropriate* continues to be a source of disagreement in education. Each year, parents present complaints about their children's special education services, which can take the form of mediation, due process claims, or lawsuits. For many of these, the primary complaint is that their child was denied FAPE, meaning that some aspect of their education was not appropriate (Bateman et al., 2019). As a result of litigation, there is guidance from two separate Supreme Court decisions surrounding the meaning of FAPE. In *Board of Education of the Hendrick Hudson Central School District v. Rowley* (1982), judges described an appropriate education as one that is "sufficient to confer some educational benefit" (p. 458). This has come to be known as the "some educational benefit" standard and established a minimum standard for FAPE (Osburne & Russo, 2021). The Supreme Court ruled on a more recent case, *Endrew F. v.*

Douglas County School District, in 2017 and went beyond the minimum expectation from *Rowley* (Osburne & Russo, 2021). The ruling stated that "a school must offer an IEP [Individualized Education Program] reasonably calculated to enable a child to make progress appropriate in light of the child's circumstances" (Endrew F. v. Douglas County, 2017, p. 2) The Supreme Court interpreted IDEA to mean that all SWD should have the opportunity to meet challenging objectives and that IEP should provide these opportunities as a part of FAPE (Osburne & Russo, 2021).

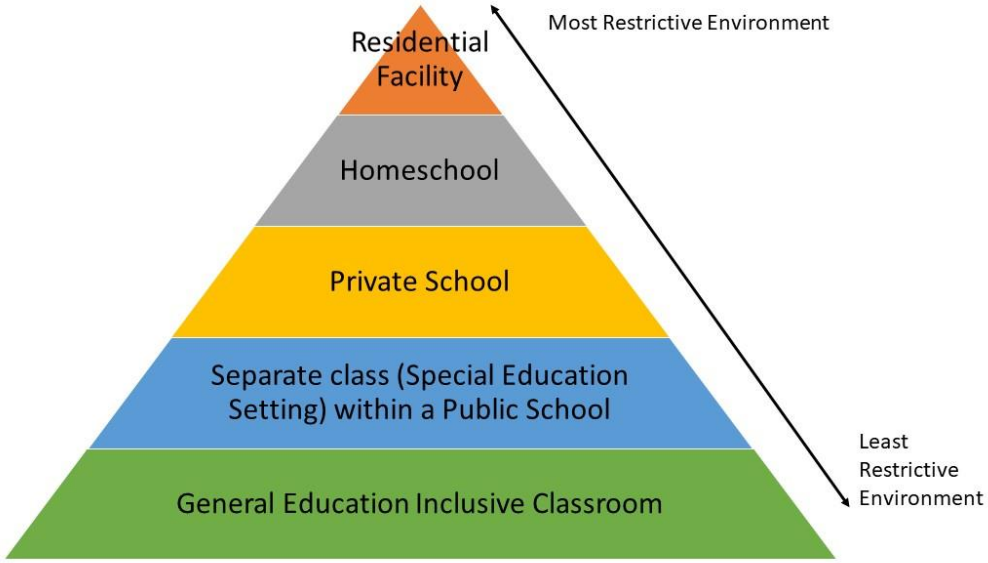
Least Restrictive Environment. Least restrictive environment is another key idea first introduced in the Education for All Handicapped Children Act in 1975 and expanded in subsequent versions of IDEA. The term was a last-minute addition to the final version of the Education for All Handicapped Children Act in 1975 after parent and disability advocate groups argued that SWD might still be segregated within public education—in separate schools and classrooms (Markelz & Bateman, 2022). IDEA (2004) defined least restrictive environment this way:

> Each public agency must ensure that—
>
> (i) To the maximum extent appropriate, children with disabilities, including children in public or private institutions or other care facilities, are educated with children who are nondisabled; and
>
> (ii) Special classes, separate schooling, or other removal of children with disabilities from the regular educational environment occurs only if the nature or severity of the disability is such that education in regular classes with the use of supplementary aids and services cannot be achieved satisfactorily. (Sec. 300.114)

Based on most understandings of least restrictive environment, the general education classroom is considered the least restrictive environment as it allows for maximum communication and interaction with peers without disabilities in the general educational environment (Markelz & Bateman, 2022). IDEA established the idea of a continuum of services, from less restrictive to more restrictive (see Figure 2). Although the law might seem clear and straightforward, implementation of this policy is messy for several reasons. First, least restrictive environment is highly individualized and must consider a wide range of factors related to each student. Second, the least restrictive environment mandate can be seen to conflict with the FAPE mandate, and they must be considered together. Schools must consider what is the least restrictive environment in which the student can receive an appropriate education. The least restrictive environment provision means that "schools must strive to educate students with disabilities in less restrictive settings; However, the appropriateness of that setting can only be determined by whether the student can make appropriate educational progress in light of their circumstances" (Markelz & Bateman, 2022, p. 85). Weighing those factors can be exceedingly difficult. Third, different states, localities, and schools receive different levels of funding and resources, and structure their continuum of options differently. The freedom and flexibility that states have means that the educational environments available might differ significantly between schools. Although states are required to offer a continuum of placement options, the number and nature of those options vary (Sterman et al., 2022).

Figure 2

Continuum of Services



Complaints about least restrictive environment are also a significant contributor to case precedent, which informs policy implementation and ultimately, practice. Although the Supreme Court has never heard an least restrictive environment case, four separate circuit court rulings have established their own "tests" for determining least restrictive environment. These court rulings differ from each other in their definitions of least restrictive environment and the importance of considerations for least restrictive environment, but they all agree that the general education classroom is the preferred educational setting (Markelz & Bateman, 2022). Court rulings have also emphasized the need to consider individual student needs and circumstances in making least restrictive environment decisions and not making decisions based on diagnosis or disability status (Bateman et al., 2019). Because of the least restrictive environment protection,

many SWD receive instruction in general education classrooms, which is why this current study addresses instruction in these inclusive environments.

SDI. By definition, students in special education require SDI. IDEA (2004) defined SDI as

> 3) adapting, as appropriate to the needs of an eligible child under this part, the content, methodology, or delivery of instruction—
>
> (i) To address the unique needs of the child that result from the child's disability; and
>
> (ii) To ensure access of the child to the general curriculum, so that the child can meet the educational standards within the jurisdiction of the public agency that apply to all children. (Sec. 300.39(b)(3))

Simply put, SDI is instruction tailored to the students' needs that arise from their disability. SDI involves changing the content, methods, or delivery of instruction to meet the unique needs of the student (Riccomini et al., 2017). For example, if a math class is learning about solving one step equations, the SDI for SWD might involve changing the content (e.g., focusing on just one type of problem at a time); changing the methods (e.g., teaching a different strategy for solving problems); or changing the delivery (e.g., teaching in short sessions with opportunities for practice throughout the lesson). Unfortunately, SDI is often misunderstood or absent from general education teaching environments, even when a special education teacher is present (Hedin et al., 2020; Rodgers et al., 2021). In the translation of federal policy to state policy to actual classroom practice, if and how SDI is implemented may vary significantly. The role of a special education co-teacher involves providing SDI to students in the co-taught, general education classroom. However, researchers have seen a lack of differentiation and SDI in co-taught classes (Hedin et al., 2020). This is an example of how federal policy may be clear and

unequivocal in what it expects of teachers, but the implementation of that policy in the classroom does not match the intent.

Other Legislation Impacting Students With and Without Disabilities

No Child Left Behind (NCLB, 2001) and the Every Students Succeeds Act (ESSA, 2015) are important pieces of federal legislation related to education. Although their content includes topics outside of special education, these laws have significant ramifications for all students in K-12 schools, including those with disabilities. One of the largest effects of these laws was the shift toward accountability for schools. For the first time, schools were held accountable for the achievement of all students, including SWD, and federal monies were linked this success (Markelz & Bateman, 2022). This change meant that not only did public schools need to include SWD; SWD also needed to achieve at the same level as their peers without disabilities. Although ESSA shifted more authority (and therefore, discretion and freedom) back to the states themselves, state and federal accountability for the academic achievement of SWD still remains a major factor in K-12 education (Markelz & Bateman, 2022). NCLB also included the requirement that scientifically based research must be used to educate SWD (Markelz & Bateman, 2022). ESSA echoed this requirement that SWD be educated using EBPs.

EBPs. EBPs are as practices demonstrated effective using multiple high-quality, experimental studies (S. C. Cook et al., 2020). The term evidence-based is often used interchangeably with researched-based, scientifically based, and scientifically validated, although exactly what criteria are used as "evidence" differs across fields of education (B. G. Cook et al., 2013; Hightower, 2018; Nelson et al., 2022). In 2002, the federal legislation NCLB used the term "scientifically-based practices" more than 100 times (van Ingen, 2013). NCLB specified that these strategies would rely on research that was systematic, valid, and reliable,

using appropriate methods, and drawing appropriate conclusions (Hightower, 2018). IDEA (2004) continued this language, usually using *scientifically validated, scientifically based,* or *research based* (Nelson et al, 2022). The law was clear that special education services must rely on research-based methodologies (Nelson et al., 2022). In 2015, ESSA specified that an evidence-based practice is one that in research had a statistically significant effect and called for special education teachers to identify and use EBPs (Nishanian, 2022). Through policy, this legal emphasis on connecting research to practice has continued and strengthened over the past 2 decades. To achieve this aim, the federal government established the What Works Clearinghouse (https://ies.ed.gov/ncee/wwc/), a resource for practitioners maintained by the Institute for Education Sciences (Strong, 2014).

Identifying and implementing this legal requirement to use EBPs is far from straightforward. The definitions and requirements in these laws lead to numerous questions. What type of research is needed to call a practice research-based? What does statistically significant mean? ESSA (2015) provided guidelines for selecting EBPs using the language well-designed and well-implemented. What constitutes well-designed and well-implemented? Determining which practices meet this bar is not easy and has led to confusion amongst educators (Konrad et al., 2019). The use of various terms like EBP, research-based practice, best practice, scientifically validated practice, and so forth, make it difficult for teachers to know which practices are truly supported by research and will likely be effective with their students (B. G. Cook & Cook, 2011). This can make implementation of EBPs even more difficult, as teachers may experience initiative fatigue and may be unwilling to invest time and energy into learning and using a new set of practices (B. G. Cook & Cook, 2011).

Organizations such as the Best Evidence Encyclopedia (https://bestevidence.org) and What Works Clearinghouse (https://ies.ed.gov/ncee/wwc/), as well as authors such as Gersten et al. (2005) have created and applied criteria for distinguishing which practices are evidence-based. Although these criteria and others like them are used to judge individual studies and to review multiple studies as a part of a review or meta-analysis, there are still differences in how different organizations and professionals determine if a practice is evidence-based (Bone et al., 2021). B. G. Cook and Cook (2011) stated that these approaches may vary in terms of details, but they do use a similar framework focused on four issues: research design, quality of research, quantity of research, and effect sizes for the practice.

In the field of special education, the Council for Exceptional Children (2014) has developed quality-indicators to categorize the evidence base of specific practices. Quality indicators exist for different types of research designs and relate to the level of detail and information included in the research article, the fidelity of implementation for the practice, internal validity, and appropriate data sources and data analysis (Council for Exceptional Children, 2014). The Council for Exceptional Children has created its own definition of EBP, which many in the special education field use (B. G Cook et al., 2015). The associated criteria narrow the type of research that can be used to support a practice to high-quality experimental group comparison designs or single-subject experimental designs (Hughes et al., 2016).

Although in other parts of the field of education, there might be a wider use of the term EBP, or it may be used interchangeably with terms like research-based, the field of special education has differentiated between EBP and research-based. Research-based is a broader and less stringent term, as it does not speak to the quality or quantity of research supporting an instructional practice (B. G. Cook & Cook, 2011). EBP is an umbrella term for different types of

instructional practices, strategies, or interventions (Hughes et al., 2016). However, EBPs have a strong and rigorous research base of high-quality studies that show a specific positive outcome for a specific group of students (B. G. Cook & Cook, 2011).

State law and Policy

Another complicated factor in special education law is the existence of state laws and mandates in addition to federal legislation. Although state legislation must be consistent with federal laws, there are still differences across states, with some states adopting laws that exceed federal requirements and standards (Osburne & Russo, 2021). For example, West Virginia law specifies that no state law may exceed the requirements of federal law, but North Carolina, New Jersey, Michigan, and California all have standards that exceed federal laws (Osburne & Russo, 2021). Many aspects of the federal laws are vague, forcing states to be more precise and definitive and when states interpret and enact law, significant differences emerge (Ysseldyke & Algozzine, 2006). One example of this is how students qualify for special education as a student with a specific learning disability. Although IDEA outlined categories for eligibility in special education, including specific learning disability, it did not outline the procedures or criteria that should be used to determine the presence of a specific learning disability. Therefore, there are wild disparities between states about how students meet these criteria (U.S. Government Accountability Office, 2019).

When implementing special education law and policy, there are many levels between federal legislation and the actual student. At each stage, policy is interpreted and can be twisted from its original intention (Crocket et al., 2018). EBPs are a good example of this policy-to-practice phenomenon. Given the intense emphasis on EBPs in federal legislation, one might expect to find this emphasis in classrooms. In addition to the What Works Clearinghouse,

disability advocacy agencies like the Council for Exceptional Children and the National Education Association have published their own lists of EBPs for specific disability areas. Some states have generated lists of EBPs for teachers to choose from, and others simply offer guidance about EBPs in general (Office of Elementary and Secondary Education, 2020). However, the emphasis on EBPs and actual EBPs used in classrooms varies significantly across the U.S. (Bruno et al., 2021; Kretlow & Blatz, 2011; Lukins et al., 2023).

Increased Inclusion

Since the introduction of federal law ensuring rights and protections for SWD, the number of students qualifying for special education has steadily risen. During the 1977-1978 school year, only 1.8% of the school population received special education services. By the 2020-2021 school year, 15% of the school age population received special education services (National Center for Education Statistics, 2022a). Not only has the number and percentage of students served in special education increased, but where they receive those services has also shifted. The least restrictive environment mandate, as well as the accountability aspects of NCLB and ESSA, have led to an increased number of SWD in general education settings. As of 2020, 66% of SWD spent 80% or more of their school day in general education classrooms (National Center for Education Statistics, 2022b). Federal data shows a steady increase in this percentage, beginning when data were first collected in 1989, when only 32% of SWD remained in the general education classroom for 80% of more of their school day (National Center for Education Statistics, 2022b). These classrooms are often referred to as inclusive classrooms, because special education students are included in the same setting as their general education peers. Inclusive math classes, especially at the secondary level, are sometimes co-taught, where a general education teacher and special education teacher work together to provide instruction to

all students (Hedin et al., 2020; Jones et al., 2008). In practice, this rise in rates of inclusion means that teachers are facing classrooms full of increasingly diverse students with a wide variety of needs (Crocket et al., 2018).

Co-Teaching in the Secondary Math Classroom

Co-teaching is a strategy often employed in inclusive settings (Rodgers & Weiss, 2019). Co-teaching consists of a general education teacher and a special education teacher who work together to plan and deliver instruction and to support students. In secondary math classrooms, students must learn advanced mathematical concepts, develop deeper mathematical understandings, and master complex curriculum (Rimpola, 2014). When teachers collaborate and share responsibility, they can deliver effective math instruction to support all learners in diverse classrooms (Livers et al., 2017). Co-teaching in inclusive settings can increase effectiveness of mathematics instruction and interventions for SWD (Bottge et al., 2018). Pairing the content knowledge of general education teachers with the expertise of special education teachers can support mathematics learning (Magiera et al., 2005; van Ingen et al., 2016).

Co-teaching in middle school mathematics classrooms can represent a challenge in terms of content for special educators. Special education teachers are often not specifically trained in secondary mathematics content, which some argue puts them at a disadvantage and might affect their ability to provide high-quality instruction (Rimpola, 2014; Rosas & Campbell, 2010). Content knowledge has a direct link on effective instruction (Bray, 2011; Griffin, 2009). However, special education teachers are specifically trained in instructional strategies to meet the individual needs of learners and may be in the best position to implement EBPs (Magiera et al., 2005; Rodgers & Weiss, 2019).

For general education mathematics teachers, who are trained specifically in math content, teaching in inclusive settings comes with its own set of challenges. First, current trends in math education focus on more student-centered, inquiry-based, constructivist styles of teaching (Boyd & Bargerhuff, 2009). These methods are in a direct contrast to instructional practices for SWD, which focus on direct, systematic, and explicit instruction (R. Lambert & Tan, 2016). General education math teachers must make instructional decisions blending research from the fields of math instruction and special education (Boyd & Bargerhuff, 2009). Middle school math teachers may feel underprepared for the daily realities of working with SWD in inclusive settings (DeSimone & Parmer, 2006). Despite their levels of mathematical knowledge, general education teachers may be less likely to use specific instructional practices that benefit SWD in mathematics than their special education colleagues (Maccini & Gagnon, 2006).

High-Incidence Disabilities

This study targets teachers working in general education math classrooms. Most of the students they will serve have what are typically referred to as high-incidence disabilities, which include those disabilities that occur more commonly in the school population and are milder in nature (Hott et al., 2018). This includes students with specific learning disabilities, autism spectrum disorder, communication disorders, mild intellectual disability, and emotional and behavioral disorders (Gage et al., 2012). Students with these high-incidence disabilities are more often included in general education settings, more often being taught and held accountable for general education curriculum, and more likely working towards a standard diploma (National Center for Education Statistics, 2022a). National data shows that students with these high-incidence disabilities are more likely to spend most of their day in a general education setting. Eighty-eight percent of students with speech or language impairments, 75% of students with

specific learning disabilities, and 69% of students with other health impairments receive instruction in the general education setting for 80% or more of their school day (National Center for Education Statistics, 2022a). This increased inclusion of SWD in general education settings results from the least restrictive environment mandate included in federal law. As schools more consistently place students in their least restrictive environment, students with high incidence disabilities are more often served in the general education classroom.

SWD and Mathematics Performance

In general, scores in mathematics tend to decline as students progress from elementary to secondary math content (Gersten, Beckmann et al., 2009). SWD often demonstrate difficulties with math and consistently underachieve in mathematics (Hughes et al., 2014). Difficulties can start for these students as early as preschool and kindergarten and often persist through secondary school (Powell et al., 2020). Nationwide data on math performance for SWD is troubling. The National Assessment of Educational Progress consists of reading and mathematics tests given every 2 years to a nationally representative sample of students in fourth and eighth grades (The Advocacy Institute, 2022). In 2022, on the fourth-grade assessment, 57% of SWD performed at the below basic level. On the eighth-grade assessment, results were even more startling, with 78% of SWD performing below basic (National Center for Education Statistics, 2022a). These results are consistent with results over the last decade, where SWD fail to meet the expected level of achievement in math (Arundel, 2022). On the fourth-grade math assessment, the percentage of SWD who show proficiency on this exam has hovered between 12% and 20% over the last 2 decades. The eighth-grade results are even less promising, with between 6% and 9% of SWD demonstrating proficiency on the mathematics test. (National Center for Education

Statistics, 2022a). SWD are falling behind, and—despite special education services—their performance shows consistent achievement gaps in mathematics.

Mathematics achievement for SWD compared to their general education peers has also been evaluated using tools other than the National Assessment of Educational Progress. The National Longitudinal Transition Study-2 collected and analyzed a plethora of data to determine outcomes for SWD (National Center for Learning Disabilities, 2014). In one report, the research team compared scores on the Math Computation subtest of the *Woodcock Johnson Tests of Achievement* (3rd ed.). This assessment was individually administered and required students to complete math calculations ranging from simple (e.g., single digit addition) to complex (e.g., solving log functions). Among students without disabilities, 50% scored in the *below average* or *very below average* range, compared to 74–85% of SWD. The average standard score for SWD was 85, but the average standard score for the general population is 100, indicating a significant gap in the performance of SWD (National Center for Learning Disabilities, 2014). Across disability categories, grade levels, and assessment types, SWD struggled to achieve in mathematics.

The Importance of K-8 Mathematics

This trend of underperformance by SWD in mathematics matters, both in terms of implementation of policy and outcomes for individual students. IDEA (2004) specifies that all students should leave high school with the knowledge skills to be successful in post-secondary education, employment, and independent living. ESSA (2015) also requires that SWD have meaningful access to the general education curriculum and outlines how SWD participate in state accountability assessments. In line with these mandates, math achievement is an important part of this success (Leddy, 2010). These laws are interpreted and implemented at the state and local

levels and if SWD are to have meaningful access and demonstrate achievement in mathematics, "deep changes in how teachers conduct themselves and relate to their students in the classroom" must occur (Crocket et al., 2018, p. 285). In looking at middle school mathematics, it is essential that students, including those with disabilities, leave eighth grade with a key set of math skills to pass high school coursework and be career and life ready (Lembke et al., 2012; Powell et al., 2021). Without a firm foundation in math knowledge and skills, students are more likely to struggle in high school math courses and are at risk to drop out (American Institutes for Research, 2017; Booth & Newton, 2012).

There are four main reasons why mathematics achievement matters to SWD. First, math skills are necessary to perform important life skills after high school (Lembke et al., 2012). Second, mathematics achievement is related to job success (Geary, 2011). Third, math achievement is essential to passing high school math courses and obtaining a high school diploma (Matthews & Farmer, 2008). Finally, strong math skills are needed for students headed to college or other post-secondary educational opportunities (Althauser, 2015).

Life readiness includes being able to solve problems and complete the math required in everyday activities like shopping, cooking, budgeting, and so forth (Lembke et al., 2012). Functional mathematical skills allow adults with disabilities to maximize their independence (Bouck & Joshi, 2012). This includes specific skills like making change (Bouck et al., 2017); understanding and making decisions related to salary (Geary, 2011); telling time; and taking basic measurements (Webster, 2019).

The overall outlook for employment for SWD is poor (Kearns et al., 2021). Individuals with disabilities are still employed at a much lower rate than those without and are more likely to be jobless or participate only in part time employment (Bureau of Labor Statistics, 2023. One

element affecting this outcome is math achievement. Without foundational math knowledge, SWD are less likely to be employed (Shapka et al., 2006); more likely to earn lower wages (Morris et al., 2022); and have lower overall quality of life (Nelson et al., 2022). Math literacy has become increasingly important for successful employment (Geary, 2011). Lack of math achievement is one factor continuing to hold back SWD from post-secondary employment.

For SWD, math performance can serve as an early indicator of success in K-12 education and beyond (Shapka et al., 2006). Math achievement is necessary to graduate high school. Standard high school math courses required for a standard diploma, like Algebra 1, are often viewed as gatekeeper courses because failing this class blocks students from receiving a high school diploma (Booth & Newton, 2012; Laughbaum, 2021; Matthews & Farmer, 2008). The National Mathematics Advisory Panel (2008) stated that algebra serves as a gateway to postsecondary education and employment. Currently, 33 states require students to pass Algebra 1 or higher to graduate (Achieve.org, 2020). As of 2019, 13 states required passing scores on high stakes assessments in math coursework to earn high school diplomas and graduate (National Center for Education Statistics, 2021). Without foundational skills from K-8 mathematics courses, students are not ready for the rigors of high school mathematics courses (American Institutes for Research, 2017). Students who do not pass Algebra 1 as ninth-graders (when the course is typically offered) are significantly more likely to not finish high school or receive a standard diploma (American Institutes for Research, 2017). Lack of mathematics proficiency can also hinder students in other high school coursework including the sciences and economics (Booth & Newton, 2012; Laughbaum, 2021; Lembke et al., 2012). For SWD, lack of achievement in high school mathematics can have a variety of consequences.

Finally, lack of a math achievement can limit post-secondary education opportunities and outcomes for SWD (Shapka et al., 2006). The deficits from K-8 math education persist into college. “Middle-school mathematics scores predict high-school graduation, postsecondary college readiness, and college completion” (Powell et al., 2021, p. 296). Math achievement in high school can limit acceptance into more selective colleges and certain majors (Douglas & Attewell, 2017). When students do pass high school mathematics requirements, receive a diploma, and attend college, gaps in their mathematical learning could still become a major hurdle. Recent research indicates an increase in the percentage of students entering college with significant math deficits (Althauser, 2015; Laughbaum, 2021). These students are often assigned to remedial math courses, which may limit or stunt their progress in college (Douglas & Attewell, 2017). Between 21% and 44% of SWD attending 2- or 4-year colleges enroll in remedial math courses (National Center for Education Statistics, 2022a). However, college math courses are often unable to bridge the gap between the students’ deficits and the rigors of college level work. Too often, students do not pass these remedial courses and do not finish their college degree (Logue et al., 2016). Lack of math achievement can limit the future success of SWD and instruction using EBPs can help prepare students and improve these outcomes.

Increasing Mathematics Achievement Through EBPs

To meet the diverse needs of SWD and ensure that special education laws and policies are appropriately implemented, instruction must shift to EBPs. Although some educators may believe that SWD cannot meet the rigorous demands of current math curriculum (Moscardini, 2015; Root et al., 2022), the National Council for Teachers of Mathematics (2022) stated that all children can and should become proficient in K-8 mathematics skills and can learn mathematics concepts with understanding and depth (Wilburne et al., 2017). Federal accountability measures

require that SWD achieve at the same level as their peers without disabilities (ESSA, 2015). Even among educators, the fallacy that math is an innate talent (i.e., some people are math people, and some are not) persists and may limit the efforts of educators to address the needs of struggling learners (Douglas & Attewell, 2017; Shifrer, 2016). Traditionally, special education programs have emphasized lower-level computational skills and test preparation over high-level mathematical thinking skills (Blank & Smithson, 2014). Instructional practices such as these create educational inequity, as SWDs are denied the opportunity to learn mathematics at the same level of depth as their peers (Tan & Kastberg, 2017). However, researchers have shown that with appropriate, targeted instruction and appropriate accommodations, SWD can demonstrate growth in math skills and mastery of grade level content (Brownell et al., 2020). Quality instruction in the math classroom must be paired with SDI and EBPs to address weaknesses in mathematics (Powell et al., 2020). For example, interventions that address functional and computational skill deficits have been shown to be effective in improving performance for students with autism spectrum disorders (King et al., 2016). Interventions including data-based instruction with progress monitoring (Powell & Stecker, 2014); teacher-created interventions (Capizzi & Fuchs, 2005); and commercially available programs (Bottge et al., 2007) have all been shown effective in improving a variety of math skills for students with math difficulties, including computation, fluency, and problem solving (Lembke et al., 2012). Despite the research that shows SWD can achieve mathematics proficiency and the importance of doing so, SWD are consistently underperforming in math. Consistent use of EBPs by educators in inclusive settings may be essential in correcting this and ensuring that SWD are provided FAPE and set up for future success.

Although there are innumerable factors that influence student achievement, instructional practices used by teachers certainly play a key role. Quality instruction using EBPs is an important factor in student learning, especially for SWD (McCleskey et al., 2017). Despite the legal mandates and research advancing EBPs, teachers do not always use EBPs (Hedin et al., 2020; Moscardini, 2015). But what drives this lack of implementation and what causes this disconnect between research and practice? The theoretical framework for this study outlined in Chapter 1 indicates two key factors that may influence teacher use of specific instructional practices: their confidence in implementing the practice and their math teaching self-efficacy.

Teacher Self-Efficacy

In 1986, Bandura defined self-efficacy as "people's judgements of their capabilities to organize and execute courses of action required to attain designated types of performances" (p. 391). Self-efficacy is a belief or confidence in one's own ability. Self-efficacy research in education is extensive. Decades of research has focused on the role of self-efficacy and its influence on teacher practice and student achievement.

Self-Efficacy and Outcomes

Researchers have studied the correlation between teacher self-efficacy and student achievement, because student achievement is the main goal of education. Studies of the relationship between teacher self-efficacy and secondary student achievement in mathematics have mixed results. Although some show a strong positive correlation (Gulistan et al., 2017; Shahzad & Naureen, 2017), others show no correlation (Prewett & Whitney, 2021). Studies of self-efficacy and student achievement across different contexts and contents indicate that the relationship may be indirect, complex, or influenced heavily by context. The relationship between teacher self-efficacy and student achievement may be mediated by and related to other

factors, which in turn, have been linked to student achievement. For example, higher teacher self-efficacy is associated with teacher affect and warmth toward students (Prewett & Whitney, 2021; Strong, 2014); better classroom management (Brown, 2012); increased student engagement (Tschannen-Moran et al., 1998); student self-efficacy (Chang, 2015); and student motivation (Thoonen, Sleegers, Oort, et al., 2011), all of which may be related to student achievement. Any of these might serve as mediating factors between teacher self-efficacy and student achievement.

Self-Efficacy and Instructional Practice

Although the effects of teacher self-efficacy on student achievement are complex, and therefore unclear, its effects on instructional practices is not (Tschannen-Moran & Woolfolk Hoy, 2001). First, teacher self-efficacy is linked to teacher's knowledge of instructional strategies (Forston, 2018). Second, teacher self-efficacy directly and strongly influences the use of instructional practices (Rubie-Davies et al., 2012; Shoulders & Krei, 2015) and teachers' willingness to try more innovative instructional practices in general (Rubie-Davies et al., 2012; Tschannen-Moran & Woolfolk Hoy, 2001). Higher self-efficacy has also been associated with the use of differentiated instruction, co-teaching, and flexible assessment practices (Elkstam et al., 2017). Low teacher self-efficacy is related to the use of more traditional techniques, like lecture and worksheets (Etheridge, 2016; Hinton et al., 2015). Teacher use of specific strategies has been linked to their feelings of self-efficacy and confidence in using the strategies (Herron, 2017). When teachers have higher self-efficacy for particular effective teaching strategies, they are more likely to use them, are more likely to persist in the face of obstacles, and to give more help to students (Brownell & Pajares, 1999; Schaller, 2020).

Research has specifically documented the connection between self-efficacy and motivation to implement EBPs (Burchard et al., 2017). That is, teachers who experience higher degrees of self-efficacy are more motivated to implement EBPs. Self-efficacy has a strong influence on behavioral intentions (Merle, 2021). When individuals have strong self-efficacy about a task, they are more likely to be energetic and to demonstrate determination in the face of obstacles (Gulistan et al., 2017). Teachers with high self-efficacy are more likely to demonstrate effective and novel instructional techniques (Shoulders & Krei, 2015; Thurlings et al., 2015). Use of EBPs, and specifically high-leverage practices for special education, has also been linked to teacher self-efficacy (Schaller, 2020). There is a strong relationship between instructional practices and student learning (Connor et al., 2005), meaning that self-efficacy can influence instructional practices, which can ultimately lead to student achievement. Research on how special education teachers' self-efficacy affects their instructional practices is mixed. For special education teachers, self-efficacy has been linked to implementation of reading practices (Forston, 2018; Tatum, 2016) and data collection (Ruble et al., 2018). However, one study found that even when special education teachers were aware of EBPs and felt confident in implementing these EBPs in their classroom, they still might not implement EBPs in their classrooms (Guckert et al., 2016).

Self-Efficacy in Mathematics Instruction

As in other content areas, teacher self-efficacy has been established as an important factor in mathematics classrooms. For teachers, there is a significant relationship among mathematics teaching self-efficacy, math content efficacy, and mathematical beliefs (Briley, 2012). In mathematics, teacher-self efficacy is linked to the use of strategies that help students develop conceptual understandings, like hands-on activities and the use of mathematics manipulatives

(Althauser, 2015; Bandura, 1993; Battista, 1999). Likewise, the use of high-quality instructional techniques has been shown to have a positive effect on teacher self-efficacy, showing the reciprocal relationship between self-efficacy and actions (Holzberger et al., 2013). Teacher self-efficacy may also have a positive relationship on student motivation in math (Midgley et al., 1989). Several researchers have shown positive relationships between teacher self-efficacy and student performance (Zee & Koomen, 2016). Quite recently, Perera and John (2020) conducted a large-scale study positively linking teacher self-efficacy with the quality of interactions in the classroom, student levels of math self-concept, and student achievement.

Math Teaching Efficacy Beliefs Instrument

Scholarship in the field of teacher self-efficacy has resulted in numerous surveys to detect and measure this complex construct. Since self-efficacy is a domain- and task-specific skill, assessing math teaching efficacy may have better predictive power than measuring overall teaching self-efficacy (Thommen et al., 2022; Ward & Johnston, 2014). I used the Math Teaching Efficacy Beliefs Instrument (MTEBI; Enochs et al., 2000). The MTEBI includes two subscales: Personal Mathematics Teaching Efficacy (PMTE) and Mathematics Teaching Outcome Expectancy (MTOE). These two subscales represent two separate elements of self-efficacy. PMTE examines the teacher's personal ability to teach mathematics, and MTOE looks at outcome expectancy, which is the belief that specific behaviors will result in desirable outcomes (Enochs et al., 2000). These correlate closely with Bandura's original conception of self-efficacy as made up of two components: efficacy expectations and outcome expectations (Bandura, 1977).

Much of the research using the MTEBI has been conducted on preservice teachers (Bates et al., 2011; Hinton et al., 2015; Koutsianou & Emvalotis, 2019; Rimpola, 2014). PMTE has

been positively correlated with self-report of mathematics content efficacy (Bates et al., 2011). This would seem to indicate a relationship between math skills and math teaching. Hinton and colleagues (2015) found links between higher scores on the MTEBI and effective teaching methods. Other research has shown that math teaching efficacy may differ based on the amount of education an individual has completed and may be positively linked to science teaching efficacy (Brown, 2012; Bursal & Paznokas, 2010). Alsawaie (2009) demonstrated that video modeling and discussions helped increase the math teaching self-efficacy of preservice teachers. In preservice elementary teachers, research has sought to understand the relationship between math teaching self-efficacy and math anxiety (Briley, 2012). Math anxiety seems to be negatively correlated with math teaching self-efficacy, perhaps inferring that decreasing anxiety around math can increase self-efficacy for teaching it (Bursal & Paznokas, 2010).

Although the MTEBI was originally developed using pre-service teachers as the target population, researchers studying in-service teachers have also used this scale. Evans (2014) used MTEBI to examine if traditional and alternative teachers differed in their math teaching, which they did not. Other research has used the MTEBI as a pre- and post-test during professional development or training to determine if specific training has impacted self-efficacy (Christie et al., 2001; Good, 2009 as cited in Tassell et al., 2019). Tassell et al. (2019) found that participation in a 3-year long leadership academy positively affected scores on the PMTE section of the scale, but not MTOE. This further supports these two sub-scales as independent from each other, but also shows that outcome expectancy may be more difficult to influence through professional development. Despite the extensive research using the MTEBI, there is no research exploring math teaching self-efficacy and its use of specific instructional practices.

Self-Efficacy and Years of Experience

Because self-efficacy is largely informed by experience, changes to teacher self-efficacy can occur over the course of a teaching career. However, research surrounding the relationship between years of experience and self-efficacy shows mixed results. Some research shows that self-efficacy increases with overall years of experience, with a strong linear relationship (Penrose et al., 2007). For special education teachers, other research indicates that overall years of experience may not be as strongly correlated to self-efficacy as years of experience related to working with a specific population (Dimopoulou, 2014). Other research indicates there may be a curvilinear relationship between self-efficacy and years of experience, with self-efficacy increasing from early-career to mid-career and then declining afterwards (Klassen & Chui, 2010).

In looking at math teaching self-efficacy, Bjerke and Xenofontos (2023) found that math teaching self-efficacy was higher among in-service teachers compared to preservice teachers and that experienced teachers (more than 5 years) had higher self-efficacy than novice teachers (5 or fewer years). However, they found that even among experienced math teachers, there were extremely low scores in some areas of math teaching self-efficacy, specifically related to teaching conceptually and explaining math concepts to students. A study using the MTEBI compared pre-service to novice to experienced teachers (Segarra & Julià, 2020). For PMTE, experienced teachers had the highest scores, followed by novice, and then preservice teachers. The results were statistically significant and showed that PMTE increased over teachers' years of experience. However, the results were not the same on the MTOE subscale, which showed that novice teachers had lower scores than either preservice or experienced teachers. This shows that teachers experience a dip in their outcome efficacy during their early teaching careers.

Self-Efficacy of Special Educators in Mathematics

Special education teachers are trained as experts in meeting the needs of SWD. It is, therefore, not surprising, that special education teachers often have high levels of self-efficacy in teaching students with various disabilities (Garris, 2019; Pearson, 2021). However, many special education teachers are not experts in any specific academic content, despite the fact that almost all special education teachers will teach academic content to students (Vizenor & Matuska, 2018; Willard, 2019). Because most special education teaching licenses cover multiple grade levels and academic content areas, most special education teacher preparation programs do not include significant coursework in mathematics or mathematics pedagogy, especially for secondary mathematics content (Duchaine et al., 2021; Floyd & Rice, 2009). Therefore, special education teachers co-teaching secondary mathematics may be teaching courses with a higher level of content than for which they were trained (Faulkner & Cain, 2013). This lack of preparation can lead to a lack of content knowledge (Smith-Moyler, 2020). Content knowledge in mathematics is a key component in developing the self-efficacy of teachers for providing instruction to students in mathematics (Martin, 2018; Swackhamer et al., 2009).

Special educators' level of competence and confidence in teaching mathematics is a question of concern and a topic of research (Cantimer, 2020; Garderen et al., 2009). Often, special education teachers take minimal coursework in mathematics as a part of their teacher preparation program (Greenberg et al., 2013). In many programs, special education teachers may take only a single course in math pedagogy and exposure to middle and high school math content may be limited (Billingsley & Bettini, 2019). They may be overly reliant on procedural understandings of math from their own school experiences (Hinton et al., 2015). Middle school math teaching certification programs across the United States vary significantly in their

coursework requirements, secondary math teacher education programs put more emphasis on content than others teacher education programs (Ingersoll et al., 2014). This may put special education teachers at a disadvantage related to math content.

There has been minimal research on the math content knowledge of special education teachers, but Flores and colleagues (2010) found no significant differences in math ability between elementary and middle school general education and special education teachers. However, when a lack of content knowledge does exist, teachers are overly reliant on teaching practices that are not evidence-based (Griffin et al., 2009). The final report for the National Mathematics Advisory Panel in 2008 recommended that middle school special education teachers complete coursework in foundational algebra, highlighting the importance of content knowledge. In addition to content knowledge, pedagogical knowledge in mathematics has also been linked to successful instructional approaches (Maccini & Gagnon, 2006). Both content and pedagogical knowledge are necessary to deliver middle school math content to a diverse group of students (Smith-Moyler, 2020). Powell and colleagues (2015) argued that special education teacher preparation programs need to emphasize understanding legislative requirements, national standards, math content, math pedagogy, math assessments, and why students struggle with math to build the pedagogical content knowledge to be successful as a teacher.

For aspiring special education teachers, lower math self-efficacy has been correlated with lower math skills and the use of less-effective teaching methodologies, such as focusing on computational skills rather than conceptual understandings of mathematics (Hinton et al., 2015). However, this research merely shows correlations and not causal relationships. Teachers who struggle with mathematics skills and mathematics teaching are likely to report lower math self-efficacy. Math teaching self-efficacy has also been positively correlated with education level,

indicating that continued professional development and education can increase special education teachers' self-efficacy in teaching mathematics (Cantimer et al., 2020). For special educators, the level of support and mentorship they receive as early career teachers can also positively affect their self-efficacy (Y. Lee et al., 2011). Support, professional development, and mentorship can all positively affect self-efficacy but unfortunately, several studies have shown special educators to have lower self-efficacy for teaching math than their general education teacher peers (Floyd & Rice, 2009). This effect is more prominent in secondary math classrooms as compared to elementary math classrooms (Flores et al., 2010). This lower self-efficacy for teaching mathematics is associated with less effective teaching strategies (Hinton et al., 2015).

For special educators to use specific EBPs, they must feel confident in their ability to understand and implement the practice in their classrooms and with their students. Without strong confidence in implementing a practice, teachers may feel uncertain and be unlikely to use the practice, regardless of what evidence exists to support the use of that practice (Herron, 2017). The research on the role of self-efficacy on teacher instructional practices and student achievement is promising, but there is no specific research examining self-efficacy and use of evidence-based math instructional practices for SWDs of teachers in middle school math.

Confidence in Implementation

In the conceptual framework for this study, confidence in implementation is listed as a separate variable that may be related to and predict the use of math EBPs in middle school inclusive classrooms. The term *confidence* is found frequently in educational literature related to self-efficacy and is even sometimes used as a synonym for self-efficacy (e.g., Morony et al., 2012; Pfitzner-Eden, 2016). However, in this study, confidence in implementing each specific math evidence-based practice is a separate concept and construct from overall math teaching

self-efficacy. Self-efficacy is an extremely broad and complex concept, but confidence is narrower and more specific.

Although confidence might be a less well known and less studied element of teacher practice, confidence has been studied as a predictive element in the performance of students. Confidence can be difficult to define. Previous researchers have noted that confidence has elements of both a cognitive ability and a personality trait (Stankov et al., 2012). Competence is also a metacognitive trait, as it requires individuals to know what they do and do not know (Krebs & Roebers, 2010). For students, self-confidence has been shown to predict academic achievement (Rezaei, 2012), so there may be similar parallels between teacher confidence and performance.

Other studies have measured teacher confidence, and unlike self-efficacy, these measures have been extremely task specific. For example, Lloyd and colleagues (2012) measured teacher confidence in implementing a specific set of classroom management strategies. Similarly, Pancsofar and Petroff (2013) asked teachers about their confidence in defining and engaging in different aspects of co-teaching. In 2020, Capp surveyed teachers about their confidence in using different components of Universal Design for Learning. In these studies, and others where confidence is used as a variable, it is measured directly often through a Likert-style question asking teachers to rate their confidence. Also, confidence in implementation specifically looks at teacher's feelings of confidence in using a specific strategy, practice, and so forth. In each of these examples and in this current research, confidence was used as a very task-specific and directly measured concept. In this way, it is distinct from self-efficacy.

EBPs

Federal mandate requires general education teachers to use evidence-based strategies and interventions, especially for students who may be struggling to achieve (ESSA, 2015). By definition, special education students require SDI to ensure access to the general education curriculum. SDI "is created by changing instructional content, methods, or delivery to meet the student's unique needs as a result of a disability" (Riccomini et al., 2017, p. 21). SDI is specifically defined in IDEA (2004) and states that the goal of SDI is "so that the child can meet the educational standards" (Section 300.39). Later legal precedent has added that this instruction must meet the unique needs of the student and "provide for meaningful academic and/or functional advancement" (P. W. D. Wright, 2020, para. 2). IDEA (2004) also states that this instruction for SWD should be evidence-based. EBPs are an essential element of pedagogy for both general education and special education teachers and should be used in inclusive classroom settings.

Implementation of EBPs

Despite the legal mandate to use EBPs and the extensive literature on EBPs for a variety of content areas and populations, there is still a significant research-to-practice gap. That is, EBPs are not consistently used in schools, either in general or special education (B. G. Cook & Odom, 2013). Although teachers have been tasked with using EBPs, teachers struggle with three elements of using EBPs: identifying appropriate EBPs, selecting appropriate EBPs, and implementing EBPs in the classroom (Konrad et al., 2019; Nishanian, 2022). Identifying which strategies and interventions have a strong evidence base can be difficult for practicing educators (Brownell et al., 2020). Teachers often state they do not have the time to read research (Accardo & Finnegan, 2019). Research articles may also not feel relevant or meaningful to special

education teachers (B. G. Cook & Cook, 2016). To make the identification of EBPs easier, many organizations have developed criteria for EBPs and published lists or created databases, like the federally funded What Works Clearinghouse (https://ies.ed.gov/ncee/wwc/). Other examples include the Best Evidence Encyclopedia (http://bestevidence.org), John Hattie's visible learning (https://visible-learning.org), and Center for Exceptional Children's high leverage practices (www.highleveragepractices.org). Each of these uses systematic standards to prioritize EBPs (B. G. Cook et al., 2013).

Even when teachers are aware of EBPs, they may not have the tools to determine which EBP is best for their situation or may lack the time and motivation to learn about and implement EBPs (Guckert et al., 2016). No EBP is effective in all situations for all students. Although a general guideline states that teachers should choose EBPs that most closely match their content and population, it can be hard to decipher if an EBP will work in a particular situation (B. G. Cook et al., 2013). When teachers do identify practices, translating research-based instructional practices into daily classroom instruction can be challenging (Jones, 2009 as cited in Schaller, 2020). One strategy to assist with this process is for practitioner-friendly journals to publish articles that specifically link research and give specific information on how to implement it into a classroom. However, a recent systematic review found that only 30% of practitioner articles were aimed at translating research to practice (Hott et al., 2018). When implementing EBPs, teachers often struggle between maintaining high standards for fidelity and practical considerations for flexibility and modification (Johnson & McMaster, 2013). Teachers often need to modify EBPs to meet the needs of their specific learners and their specific context (Johnson & McMaster, 2013), but if an EBP is modified too severely, it might no longer be effective (Merle, 2021).

Implementation of new practices is a complex process, influenced by a variety of factors (B. G. Cook & Odom, 2013). Implementation science is a particular field of study attempting to understand these factors and determine how to get EBPs successfully implemented in schools (B. G. Cook & Odom, 2013). To this end, Konrad and colleagues (2019) developed a checklist to help practitioners evaluate, select, and implement EBPs into classroom practice. Their article also included lists of online databases and resources for locating, evaluating, and implementing EBPs. Tools like this provide teachers with a series of steps to follow in this process, but the usefulness of this tool has not been evaluated. Hughes and colleagues (2016) have also attempted to provide an easy to navigate list of resources for teachers to locate math EBPs. There continues to be a gap between research and practice and teachers, especially those with less experience, require coaching and support to consistently implement EBPs with their students (Sawyer, 2015). Teachers also do not always feel confident enacting EBPs for students with certain disability categories, like autism spectrum disorders (Brock et al., 2014) and specially designed instruction is often misunderstood or absent in inclusive classrooms (Hedin et al., 2020; Rodgers et al., 2021). Teachers face many challenges in implementing EBPs in classrooms and understanding factors that influence the use of EBPs is important to expanding the use of these practices.

Years of Experience and Instructional Practice. A teacher's years of experience can also influence their overall instructional practice and their use of EBPs. There is often an assumption that experienced teachers are more proficient than beginning teachers (Gore et al., 2023). However, some research demonstrates no significant relationship between years of experience and instructional practices or quality (Gagnon & Maccini, 2007; Gore et al., 2023). Other research suggests that teaching quality may increase initially, and then decline (L. J. Graham et al., 2020). A 2020 report looked more closely at the math teaching practices and

beliefs of middle school teachers with different years of experience (Craven & Trygstad, 2020). Novice teachers were significantly more likely to hold reform-oriented beliefs as opposed to traditional beliefs about math instruction. Although there was no significant difference in the use of many math EBPs, novice teachers were more likely to use math representations and certain problem-solving strategies. However, veteran teachers were more likely to incorporate reading and writing into mathematics instruction. This shows that the use of certain instructional strategies may differ based on years of experience.

High Leverage Practices for Special Education

The Council for Exceptional Children, in partnership with the Collaboration for Effective Educator Development, Accountability and Reform developed and published a set of high-leverage practices for special education. This comprehensive and broad list identifies EBPs for use across contents and disability categories. The goal of these practices was not only to provide practicing educators with a set of useful tools, but also to guide teacher education in special education. These practices are high leverage in that they occur frequently, can be used by novice teachers, represent high-quality instruction, and have been linked to positive student outcomes when successfully implemented in classrooms (Nelson, 2022). Although these practices do not incorporate every research-based strategy that could ever work with any student with a disability, they offer an essential list of effective strategies that work across grade levels, content, and disability category.

High-leverage practices encompass best practices for educators in four areas: collaboration, assessment, social/emotional/behavioral, and instruction (McCleskey et al., 2017). Because the focus of this current study is instructional practices in grades 5-8 inclusive math classrooms serving students with high incidence disabilities, I focused on the practices for

instruction (Numbers 11-22). Although this does not diminish the importance or relevance of the other practices, this study was focused on EBPs for instruction. These practices are listed on Table 1.

Table 1

High Leverage Practices (HLPs) for Instruction

No.	Description
HLP 11	Identify and prioritize long- and short-term goals.
HLP 12	Systematically design instruction towards a specific learning goal.
HLP 13	Adapt curriculum tasks and materials for specific learning goals.
HLP 14	Teach cognitive and metacognitive strategies to support learning and independence.
HLP 15	Provide scaffolded supports.
HLP 16	Use explicit instruction.
HLP 17	Use flexible grouping.
HLP 18	Use strategies to promote active student engagement.
HLP 19	Use assistive and instructional technologies.
HLP 20	Provide intensive instruction.
HLP 21	Teach students to maintain and generalize new learning across time and settings.
HLP 22	Provide positive and constructive feedback to guide students' learning and behavior.

Note. Adapted from McCleskey, J., Barringer, M-D., Billingsley, B., Brownell, M., Jackson, D., Kennedy, M., Lewis, T., Maheady, L., Rodriguez, J., Scheeler, M. C., Winn, J., & Ziegler, D. (2017). *High-leverage practices in special education.* Council for Exceptional Children and CEEDAR Center

Although high-leverage practices are strongly supported by research in special education, they are not content or grade level specific (Sayeski, 2018). Also, some of these practices are not designed for primary use in the general education co-taught classroom. For some, it is easy to translate that practice into a middle school math classroom. For other strategies, this may be more difficult and impractical. For these reasons, high-leverage practices were not selected for this research study due to their lack of specificity for the population and setting. However, several overlap with the instructional strategies that were selected for this study.

Students With Math Difficulty

In mathematics intervention literature, researchers often target students with math difficulty. Students with math difficulty do not necessarily receive special education services, but many SWD demonstrate math difficulty. In the literature, there are variations in how math difficulty is defined. However, there is consensus about many aspects of math difficulty. First, math difficulty can manifest as early as preschool and can be persistent through a child's school career (Powell et al., 2020). Second, students with math difficulty often struggle with foundational math skills, including number sense and representations used with numbers. They also tend to perform lower on both math computation and math problem-solving (Powell et al., 2020). Because of the various categorizations and terminology used when SWD qualify for services, SWD who receive services in mathematics may not be identified as having math difficulty or a math learning disability. However, students who received SDI in mathematics must, by definition, have a weakness in mathematics, which can be equated with math difficulty.

Other Meta-Analyses and Systematic Reviews

To study the use of EBPs for a particular group of students (SWD) in a particular context (middle school math general education classroom), a list of EBPs must be compiled. Although there are numerous individual studies of EBPs for SWD and for mathematics, one way to compare these results and identify practices with consistent and strong research evidence is through systematic review or meta-analysis. Systematic reviews consist of reviews of research literature focused on a specific topic. Their goal is to include all studies that meet their criteria for inclusion (Talbott et al., 2018). A meta-analysis is a type of systematic review and is focused on a single topic, but also focuses on a single type of research design (Talbott et al., 2018). In a meta-analysis, the results of individual studies are not simply reported, but are statistically

analyzed and combined. Meta-analysis is a widely accepted research tool and an effective way to examine practices for a larger number and greater diversity of participants (Schaller, 2020). The results of meta-analyses are often considered more powerful because conclusions are drawn from a wider research base. Numerous systematic reviews and meta-analyses have been completed for specific math strategies (e.g., Friedt, 2012; Lein et al., 2020); for struggling algebra learners (Bone et al., 2021; Hughes et al., 2014); for professional development for best practices for SWD (Brock & Carter, 2017); for high leverage practices for SWD (Nelson et al., 2022); and for teaching math to students with learning disabilities (Gersten, Chartd, et al., 2009).

Gersten, Chartd, and colleagues completed a meta-analysis, published in 2009, specifically aimed at instructional components of math intervention for K-12 students with learning disabilities. After synthesizing the findings from 42 studies using regression analysis, the authors found the use of heuristics (problem-solving strategies) and explicit instruction to provide significant and unique contributions to effect size. However, student verbalizations, the use of visuals, and teacher feedback also demonstrated strong pooled effect sizes across studies.

In 2015, Myers and colleagues at The University of Florida conducted a thorough review of literature related to mathematics interventions for secondary students with learning disabilities. This was an extension on an existing review from 2007 published by Maccini, Mulcahy, and Wilson. The 2015 review by Myers et al. revealed a total of 15 studies published between June 2006 and October 2014 with results which showed improvement in student achievement in mathematics. Each article targeted students with learning disabilities (not other high incidence disabilities or math difficulty) in Grades 6-12 receiving intervention in the areas of mathematics. The three main instructional practices used in these studies were (a) cognitive

and metacognitive strategies for solving word problems, (b), visual representations, and (c) Enhanced Anchor Instruction.

In 2022, Nelson and colleagues conducted a systematic review of meta-analyses, targeting research syntheses with effect sizes included, rather than individual studies. Their findings summarize and further synthesize research related to students with learning disabilities, math learning disabilities and mathematics difficulty K-12. These authors identified six strategies explored in the articles they reviewed: (a) explicit instruction, (b) visual and pictorial representations, (c) strategy instruction, (d), schema instruction or schema broadening instruction, (e) peer-assisted learning, and (f) computer-assisted learning. Each of these had a positive effect, but effect sizes varied significantly across each of these strategies and across various research studies.

Given that middle school math generally includes significant content related to algebraic thinking (National Council for Teachers of Mathematics, n.d.), I also examined a meta-analysis conducted by Hughes and colleagues (2014) related to algebra interventions. This meta-analysis included studies of SWD and those at-risk for a mathematics disability (also referred to as struggling learners in the article). These studies included students at the elementary, middle, and high school levels. Ultimately, the authors examined and analyzed 12 articles from 1986 to 2012. The results of this meta-analysis specifically identified cognitive and model-based interventions, as well as concrete-representational-abstract instructional sequences. Some evidence was also presented for technology-based interventions.

A more recent systematic review for algebra interventions was conducted by Bone and colleagues (2021). This review included studies examining algebra interventions for secondary students with learning disabilities. After reviewing 17 articles published between 1999 and 2019,

the authors identified five instructional practices that met Council for Exceptional Children's criteria as potentially evidence-based: (a) Peer-assisted learning, (b), schema-based instruction, (c) Enhanced Anchor Instruction, (d), concrete-representational-abstract instructional sequence, and (e) the use of manipulatives were all identified as promising strategies for secondary students with learning disabilities for learning algebra content.

EBPs for This Research Study

Each of these reviews resulted in a list of strategies for practice. However, each of these reviews was not deemed the most appropriate for this research project. Both the 2009 meta-analysis by Gersten, Chartd, et al. and the 2014 systematic review by Hughes et al. were completed too long ago and might not include the most current information about best practices. When determining appropriate EBPs, the population is important, and the characteristics of the populations should match. Bone et al. and Myers et al. were both more recent, but both limited their research to students with learning disabilities, which is only one of the high-incidence disabilities represented in inclusive classrooms. This focus on one specific disability limits the scope and generalizability of this research to the current study. Finally, Nelson et al.'s (2022) sound review widens the student population to more closely match this study, including students K-12 represented too broad a sample. This current study looks at math learners in middle school who have disabilities. An exact review for this population was not located, but one systematic review had a remarkably similar population that most closely matches this research study. A comparison of the reviews is located in Table 2.

Table 2

Summary of Recent Syntheses

Elements	**Recent Syntheses**					
Authors	Gersten, Chardt et al.	Hughes et al.	Myers et al.	Powell et al.	Bone et al.	Nelson et al.
Year	2009	2014	2015	2021	2021	2022
Type	Meta-Analysis	Meta-Analysis	Literature Review	Systematic Review	Systematic Review	Systematic Review
Grade level	K-12	K-12	Secondary	Middle School	Secondary	K-12
Student Focus	Learning Disabilities	Learning Disabilities and Struggling Learners	Learning Disabilities	Math Difficulty	Learning Disabilities	Learning Disabilities and Math Difficulty

Sarah Powell is a well-respected researcher whose focus areas include EBPs and mathematics teaching practices. In her 2 decades of work, Powell has published 54 peer-reviewed articles and has been cited over 5,000 times. In 2021, Powell and colleagues conducted a systematic review of the literature relating to effective instructional practices for students with math difficulties in middle school. They reviewed articles from 1990 to 2020 where the focus was math interventions at the middle school level and located a total of 72 studies meeting their inclusion criteria. Many meta-analyses and systematic reviews use the quality standards outlined by the Council for Exceptional Children (B. G. Cook et al., 2015). Powell and colleagues also reported study quality calculated mathematically from these quality standards. In all, 88% (63 out of 72) of the studies scored high on this measure, indicating an overall high quality for the studies in this review. Of the 72 studies that met their criteria, only 59 produced positive and significant effects. After exploring the results of these 59 studies, this review provided a list of

six instructional components that were used regularly within studies where the instruction was effective. I used this list of EBPs in this study.

I selected this list for three reasons. First, this review most closely matches the population of this study—middle school math SWD. The review targets students with math difficulties, but it does include SWD (Powell et al., 2021). Although students with math difficulty is a broader category than SWD, students receiving special education services in a mathematics classroom likely have math difficulty; in the research I reviewed, there is no claim that strategies for students with math difficulty are distinct from SWD. Hughes and colleagues (2014) asserted that "students who struggle with mathematics, but are not identified with a disability, often manifest similar difficulty with mathematics as those identified with a disability" (p. 37). In their meta-analysis, they did not differentiate between SWD and students with math difficulty, arguing that these students had similar deficits and would benefit from similar interventions. Other researchers have conflated the use of the terms math difficulty with math disability, arguing that they are both defined by poor performance in mathematics (Mazzocco et al., 2008; Seethaler & Fuchs, 2010). Therefore, it seems reasonable that the strategies Powell and colleagues identify for students with math difficulty would be appropriate for SWD. Also, this review specifically looks at strategies for middle school students and is one of the only systematic reviews or meta-analyses to target this school level specifically. Therefore, the strategies are likely to be a better match to the instructional needs and curriculum of this population of students. Second, this review of the research included studies from 1990-2020, meaning that only the last 3 years of publications would be not included in this review. Completing an updated systematic review at this point would likely show very few new studies. Finally, this review was thorough, well-carried out, and its conclusions are sound. The EBPs included in this review all have strong

research bases on their own, overlap with other similar meta-analyses and systematic reviews (Table 3) as well as with recommendations from the What Works Clearinghouse.

This review concluded that there are six intervention or instructional strategies with significant evidence of effectiveness for middle school students with math difficulty: explicit instruction, multiple representations, problem-solving instruction, mathematical language, mnemonics, and graphic organizers (Powell et al., 2021). Each of these instructional strategies represents an evidence-based practice and are explored here.

Table 3

Powell's Identified Strategies in Other Syntheses

	Syntheses					
Instructional Strategy	Gersten, Chartd, et al., 2009	Hughes et al., 2014	Myers et al., 2015	McCleskey et al., 2017	Bone et al., 2021	Nelson et al., 2022
Explicit Instruction	X			X		X
Multiple Representations	X	X	X		X	X
Mathematical Language	X					
Mnemonics	X					
Graphic Organizers				X		
Problem-Solving Instruction	X	X	X	X	X	X

Explicit Instruction. Powell and colleagues (2021) found that of the 59 studies that had significant results, 45 (76%) involved explicit instruction. Explicit instruction is a method of instruction that is direct and systematic and tends to move from teacher modeling to independent practice of skills. Explicit instruction involves a "series of teaching behaviors that facilitate

students' active engagement in mathematical tasks and has a long history as an effective teaching strategy in special education" (Strickland & Maccini, 2012, p. 144). Explicit instruction includes making the learning visible—by telling students what to do or think when solving problems, by modeling, scaffolding, and enacting strategies (Powell et al., 2021). Explicit instruction is more than simple lecture or notes, but involves the strategic selection of strategies, models, examples, non-examples, think-alouds, guided practice, and independent practice (Doabler et al., 2016; McCleskey et al., 2017). It is appropriate when students are learning new material, complex concepts, and difficult skills.

Explicit instruction begins with an advanced organizer, which involves assessing student's prerequisite skills, connecting current learning to prior learning, explicitly stating the objective of the lesson and explaining the important of the lesson (Strickland & Maccini, 2012). In explicit instruction, a teacher will model how to solve mathematical problems, using demonstrations, examples, and thinking aloud (Bouck et al., 2017). During a think aloud, teachers provide step-by step demonstrations of how to solve the problems and provide organization of knowledge (e.g., Doabler et al., 2016; Riccomini et al., 2017). The lesson then moves on to guided practice, where the teacher offers prompts and cues to students as they solve problems together. Then, students work independently to solve problems (Doabler & Fien, 2013). Timely and specific feedback to the students is the final imperative step in explicit instruction (Halpern et al., 2007).

In an intervention developed by for teaching middle school students fraction operations, explicit instruction was used by using this lesson format: Warming Up, Learning to Solve, Practicing Together, Trying it on your Own, and Wrapping It Up (J. Lee et al., 2023). In

Warming Up, the teacher would state the purpose of the lesson, connect it to prior knowledge, and give the purpose for learning the skill. For example,

> Today, you are going to learn to add fractions with unlike denominators. already know how to add fractions with like denominators and how to multiply, so today, we will combine those skills. Adding fractions with unlike denominators is going to be important when you are solving word problems and solving equations.

While the teacher demonstrates and models how to solve these types of problems, the teacher reveals his or her thinking. “I know that I have to make the denominators the same, so I am going to use the strategy of multiplying them together to find the common denominator.” The teacher provides explicit steps and procedures for solving the problem. During Practicing Together, students might do some guided practice problems with the teacher, where they are encouraged to think aloud while they solve just like the teacher did. Alternately, students might practice together with a partner. During this time, the teacher provides specific academic feedback on student performance and prompts thinking. During Trying on Your Own, the students solve a few problems independently. The teacher immediately checks these and lets students know where they have been successful and where their errors are.

In the research and practitioner literature, explicit instruction has varied definitions, components, and applications. However, at its core, explicit instruction relies on instructional design principles (Doabler et al., 2021) and includes active student engagement, deliberate and scaffolded instruction, and purposeful practice with explicit feedback (Archer & Hughes, 2011). Explicit instruction increases learning time and has been shown effective across contents, grade levels, settings, and students (Stockard et al., 2018).

Explicit instruction is one of the high-leverage practices identified for SWD by The Council for Exceptional Children. In a review of meta-analyses exploring the evidence base of high-leverage practices for SWD across content areas, explicit instruction has one of the largest amounts of evidence (Nelson et al., 2022). Explicit instruction is well-designed to meet the needs of struggling learners and SWD because it reduces the cognitive load on students by making the instruction clear and helps keeps students engaged in learning (Riccomini et al., 2017).

The National Mathematics Advisory Panel (2008) recommended explicit instruction for students with learning disabilities and low achieving students, specifically in the areas of word problems and computation. Research also demonstrates the effectiveness of explicit instruction during math interventions for students at risk for mathematical learning disabilities (Doabler et al., 2021; Gersten, Beckmann, et al., 2009). Explicit instruction is the most frequently researched EBP in mathematics and is effective for a variety of math content and skills and with a variety of populations (Doabler & Fien, 2013; Powell et al., 2021). Explicit instruction is effective for students with mild developmental disabilities (Spooner et al., 2019); learning disabilities (Gersten, Beckmann, et al., 2009; Leach, 2016; Strickland & Maccini, 2012); mathematics disabilities (Agrawal & Morin, 2016); and autism spectrum disorders and math difficulty (Root et al., 2018). In terms of math content, there is research support for explicit instruction in basic math facts (Leach, 2016); number sense (Gerzel-Short & Hedin, 2022); fraction operations (J. Lee et al., 2023); algebra content (including computation with integers and linear equations; Stickland & Maccini, 2012); algebra problem solving (Root et al., 2018); and solving multi-step linear equations (Satsangi et al., 2018). Overall, this strategy is effective for students with learning disabilities, other disabilities, and math difficulty in keeping students actively engaged;

teaching math skills, content, and problem-solving; and promoting the ability to generalize math skills across problem types (National Mathematics Advisory Panel, 2008).

Multiple Representations. Overall, 73% (43 out of 59) of studies with significant results in Powell and colleagues' (2021) systematic review included the use of multiple representations. Myers and colleagues' (2015) earlier systematic review of effective strategies for secondary students with learning disabilities also found physical and visual representations to be a powerful strategy. Representations in mathematics can be visual (e.g., graphs or pictures); physical (e.g., three dimensional shapes or hand movements); symbolic (e.g., "the language of math"—like the symbols for add +, subtract, -, multiply, x); verbal (e.g., spoken or written words, mnemonics); and contextual (giving real life meaning to math problems). It is important that students be exposed to all the forms of mathematics representation and that they can move back and forth between various forms. For example, does a student understand that "three-fourths," ¾, and a picture of a pizza with 3 out of 4 slices colored in all represent the same concept? Visual representations and physical manipulatives are popular math tools for teachers and when used correctly, can increase student understanding of the content, and allow them to solve problems from different approaches (Leinwand et al., 2014). Mathematical representations also include speaking and writing about math. However, the use of mathematical language is listed as its own instructional practice, as are mnemonics and graphic organizers. Therefore, this section focuses on physical, visual, and symbolic representations of mathematics. Powell and colleagues (2021) specifically mention hands-on tools, drawings, and manipulatives in this section of her research. Physical representations would be the use of concrete math manipulatives and tools. Visual representations would include pictures, and symbolic representations include more typical abstract math problems.

The use of physical math manipulatives, like base-10 blocks, fraction bars, two colored counters, and snap cubes have a long history in mathematics classrooms, and in interventions and instruction for SWD (Bouck & Park, 2018; Morin, 2014; Peltier, Morin, et al., 2020; Satsangi & Miller, 2017). Manipulatives are "concrete objects students can manipulate to support their learning" (Peltier, Morin, et al., 2020, p. 3). Mathematical manipulatives allow students to represent the abstract concepts in mathematics explicitly and concretely, which can aid in comprehending these concepts more completely (Uribe-Flórez & Wilkins, 2017). Manipulatives have proven benefit for increasing procedural fluency across grade levels and content for students with and without disabilities (Bouck & Park, 2018; Myers et al., 2015; Peltier, Morin, et al., 2020). Although there is research supporting the use of manipulatives on their own, there is a larger research base supporting their use as a part of the Concrete-Representational-Abstract instructional approach (Bouck et al., 2020).

Concrete and visual representations are both more powerful when used in this sequence and incorporated as a part of explicit instruction (Peltier, Morin, et al., 2020). In the Concrete-Representational-Abstract graduated sequence of instruction, students move from solving problems using concrete manipulatives, to using representations like drawings to solve problems abstractly with no visual supports (Agrawal & Morin, 2016). For example, students might solve two-digit subtraction problems with base 10 blocks, which allow students to physically perform actions like regrouping and taking away. They would then move to using visual representations, like drawing pictures of the base 10 blocks. Finally, they would be able to solve the problem using subtraction procedures without the visual supports when the problem is represented symbolically, 43 - 27 = ___.

The use of visual mathematical representations in interventions for SWD and students with math difficulty has been shown to be effective (Powell et al., 2021). In a meta-analysis of math interventions for SWD and students with math difficulty, Concrete-Representational-Abstract had one of the largest effect sizes (Hughes et al., 2014). Specifically, this approach is evidence-based for students with developmental disabilities (Spooner et al., 2019); moderate intellectual disabilities (Rivera & Baker, 2013); and learning disabilities (Bouck et al., 2018). When compared to traditional direct instruction, Concrete-Representational-Abstract was shown to be more effective in teaching fraction operations to upper elementary students (Flores et al., 2020). Using concrete and visual representations has been shown effective across various math contents and skills, as well, including computational skills (Flores et al., 2014; Stroizer et al., 2015); functional skills like counting money (Rivera & Baker, 2013); and algebra skills (Bouck et al., 2019; Satsangi et al., 2018; Strickland & Maccini, 2012).

More recently, the use of virtual manipulatives has led to the use of the Virtual-Representational-Abstract approach, where concrete manipulatives are replaced with virtual manipulatives (Bouck et al., 2020). Virtual manipulatives do not have the extensive research base that concrete manipulatives have, but are a promising tool for SWD, both on their own and as a part of a Virtual-Representational-Abstract approach (Peltier, Morin, et al., 2020). Middle and high school students using physical manipulatives may feel singled-out or stigmatized, as their peers in the general education classroom may not be using these tools (Bouck et al., 2019). Virtual manipulatives may serve as a good alternative tool that is less obvious and stigmatizing. Some students prefer virtual manipulatives and can achieve a higher level of independence with these tools (Bouck, et al., 2020). They have other advantages, like requiring fewer materials and offering more flexibility (Root et al., 2017). The Virtual-Representational-Abstract sequence of

instruction has been shown effective for students with autism spectrum disorders (Root et al., 2017); students with learning disabilities (Satsangi et al., 2018); and specifically for middle school students with a variety of disabilities (Bouck et al., 2019; Bouck et al., 2018). Initially promising studies of Virtual-Representational-Abstract have addressed skills like word problem solving (Bouck et al., 2017) and basic algebra concepts like solving equations (Bouck et al., 2019; Santsangi et al., 2018). Both Concrete-Representational-Abstract and Virtual-Representational-Abstract are instructional approaches that combine explicit instruction and multiple representations to benefit diverse learners and would be effective approaches for middle school math SWD.

Mathematical Language. Powell and colleagues (2021) found that in 32% of the studies with positive results, there was a language component to the instructional strategy. Several of the common representations of mathematics include language, including verbal and written representations. The idea of mathematical language involves understanding representations, using appropriate vocabulary, engaging in "math talk," and interpreting word problems.

Math vocabulary has been most extensively studied in early elementary grades (Peng & Lin, 2019). Math vocabulary is essential to skills like measurement and geometry and word problems (Peng & Lin, 2019). Strong math vocabulary has also been linked to calculation skills and to later success in mathematics (Peng & Lin, 2019). Explicit instruction in math vocabulary is essential for secondary students who may struggle with reading skills (Paulsen, 2013). For SWD, math vocabulary can be particularly challenging, and it is important that this vocabulary is explicitly taught and consistently used in the inclusive math classroom (Powell et al., 2018). Precise definitions using consistent and appropriate vocabulary can prevent later misunderstandings (Wu, 2009). Vocabulary instruction is generally not an instructional strategy

used or studied in isolation. However, math interventions that include a vocabulary component have been shown to be effective for teaching fraction operations (J. Lee et al., 2023); word problems (Bae et al., 2015); and one-step algebraic equations (Rivera & Baker, 2013). Populations for these studies have included students with moderate intellectual disabilities (Rivera & Baker, 2013); students with learning disabilities (J. Lee et al., 2023); and students with autism spectrum disorders (Bae et al., 2015). Vocabulary instruction allows students to make connections between visual and verbal mathematics concepts (Rivera & Baker, 2013) and increases their ability to engage in "math talk," or math discourse in their learning spaces.

Discourse in the mathematics classroom advances the learning of the entire class of students (Leinwand et al., 2014). When students share ideas, discuss ideas, question each other, explain, and argue, they come to better understand the content. In meaningful mathematics discourse, students explain and justify their own ideas, processes, and answers in math (Jang, 2010; Manouchehri & St. John, 2006). This allows them to clarify their own understanding, but also benefits when other students learn from that discourse (Leinwand et al., 2014). This communication is an important goal in mathematics and is a powerful tool for student learning (National Council for Teachers of Mathematics, 2000). Mathematical discourse involves more than simply students sharing out their correct answers, but deeper discussion of how they arrived at their answers, what their misconceptions or mistakes were, and the various strategies they might use to solve a problem. Mathematical discourse makes visible mathematical thinking, which can also help teachers guide instruction (Baron, 2016; Leung & Mohan, 2004). Engaging in math discourse can also help students improve their understanding of math and math achievement (Yok et al., 2022). How teachers construct and conduct math discourse can increase the intellectual work students complete in class (Bishop, 2021). The engagement and

participation of students during math discourse can predict their math achievement (Ing et al., 2015).

Math language also involves the use of writing in math. Math journaling allows students to write, rather than speak, their answers, thoughts, and thinking processes in mathematics (Kostos & Shin, 2010). However, especially in secondary settings, opportunities to write in math are minimal (Applebee & Langer, 2011). Math journals allow students to express their understandings of math and in addition to being an excellent assessment tool for teachers, can help students grow in their mathematical understandings, computational skills, application of taught strategies, and to make real life math connections (Benson-O'Conner et al., 2019). Frequent and interactive math journaling focused on problem solving can increase student understanding of math (Baxter et al., 2005).

For students with a wide variety of disabilities, the use of academic language, including math vocabulary and discourse, can present a challenge (Tucker-Whitaker, 2019). Teacher modeling, opportunities for practice, and feedback are important instructional tools in overcoming this challenge (Tucker-Whitaker, 2019). Too often, students' difficulties with math vocabulary and math discourse stem from poor instruction. Many special education teachers, who are not math content experts, struggle to teach and use math vocabulary in their instruction (Harris et al., 2014). Too often, teachers attempt to simplify instruction by using informal math language. However, this can hinder students' ability to understand and solve math problems (Powell et al., 2018). By using formal language and being precise with math vocabulary, teachers can model and use math discourse appropriately to support students with learning needs (Powell et al., 2018).

Mnemonics. Another language-related instructional strategy is the use of mnemonics. Powell and colleagues (2021) found that mnemonics were used successfully for middle school students with math difficulty in 19% of the studies they reviewed in their systematic review. Mnemonics are patterns of letters, words, or ideas that assist in memory retention. They connect visual or phonetic clues to information that needs to be remembered (Friedt, 2012). Many mnemonics in mathematics are acronyms, where the first letter of each step or piece of information is pulled out and arranged to form a word. For example, *RUNS* is an evidence-based mnemonic for a problem-solving strategy: Read the problem, Underline key information, Name the problem type, Solve (Root et al., 2018). Mnemonics can also come in song form, which researchers have studied to teach math facts (Cade & Gunter, 2002). Mnemonics in math can be classified as fact mnemonics, which may address discrete computational skills (like multiplication facts) or process mnemonics, which often address problem solving strategies, steps, or rules (J. Lee et al., 2023). Mnemonics are one tool to draw attention to material, organize material, and promote student retention of material (McCleskey et al., 2017).

Mnemonics are often used in combination with other EBPs, including explicit instruction, Concrete-Representational-Abstract, and graphic organizers. Mnemonics have been shown effective in helping students master computational skills (Flores, 2009); fraction operations (Ennis & Losinksi, 2019); and word problems (Peltier, Sinclair, et al., 2020). Researchers have specifically studied the effectiveness of this strategy for upper elementary students (Ennis & Losinski, 2019); students with math difficulty (Flores, 2009; Powell et al., 2021); and students with learning disabilities (Peltier, Sinclair, et al., 2020).

Quality instruction using mnemonics includes a specific focus on teaching, practicing, and assessing student memorization of the mnemonic while also applying it to math problems

(Agrawal & Morin, 2016). Ennis and Losinski (2019) outline instructional stages for providing mnemonic instruction to students at risk for math learning disabilities—develop background knowledge, discuss the strategy, model the strategy, memorize the strategy, support the strategy, and independent performance. This sequence is much more detailed than simply showing students a mnemonic and expecting them to use it. It is imperative that students accurately memorize the strategy before applying it in supported or guided practice (Ennis & Losinski, 2019).

Graphic Organizers. Graphic organizers were used in a relatively small, but still significant percentage (15%) of studies with effective strategies in Powell et al.'s (2021) systematic review. Graphic organizers "are a research-based instructional tool that can organize complex information and display that information in a way that assists comprehension and understanding" (Rivera & Baker, 2013, p. 16). They are visual displays to help students see and understand the relationships between concepts (Dexter & Hughes, 2011). In mathematics instruction, graphic organizers are rarely used as a stand-alone intervention, but are often used with multiple representations (including Concrete-Representational-Abstract) and problem-solving strategies (Powell et al., 2021). Much like mnemonics, graphic organizers help students remember information and apply procedures to math problems. Also, similar to mnemonics, students must receive explicit instruction including feedback on graphic organizers (Paulsen, 2013). The use of graphic organizers to support student learning have large effect sizes across grade levels and populations (Dexter & Hughes, 2011; Ives, 2007; McCleskey et al., 2017).

Graphic organizers are used in a variety of content areas (Rivera & Baker, 2013); they have been shown effective in teaching math to students with developmental disabilities (Spooner et al., 2019); students with math difficulty (Benz & Powell, 2021); students with learning

disabilities and emotional and behavioral disorders (Paulsen, 2013); and students with autism spectrum disorders (Root et al., 2018). Although graphic organizers can be used in a variety of application in the math classroom, research has focused on solving word problems (Benz & Powell, 2021; Root et al., 2018); teaching vocabulary (Harris et al., 2014; Paulsen, 2013); and teaching math computational processes (Rivera & Baker, 2013). Graphic organizers are most effective when explicitly taught (Barton-Arwood & Little, 2013). Graphic organizers may be particularly useful in the math classroom to assist students with reading difficulties to learn vocabulary, access and process written information, and apply strategies to mathematical calculations (Paulsen, 2013).

Graphic organizers can be especially powerful for students with learning disabilities in their study of algebra concepts (Root et al., 2018; Strickland & Maccini, 2012). Students with learning disabilities often struggle or organize and sequence multiple steps in solving an algebraic problem (Strickland & Maccini, 2012), and graphic organizers can support these steps and become more proficient problem solvers (Barton-Arwood & Little, 2013; Shin & Bryant, 2015). By using a graphic organizer to support the use of a series of steps to solve a problem, students are more likely to remember and use the strategy (Maccini & Hughes, 2000).

Problem-Solving Instruction. In Powell's (2021) systematic review, problem-solving instruction, including the use of cognitive and metacognitive strategies was found in 36% of the studies with significant results. This echoes earlier reviews. A systematic review in 2015 for secondary students with learning disabilities found that cognitive and metacognitive strategies for word-problem solving was an effective EBP for this population (Myers et al., 2015).

Mathematics instruction includes more than simple computations. Current Common Core State Standards place an emphasis on problem-solving and the skills necessary to solve problems

are an essential and integral part of the middle school math classroom (Cole & Wasburn-Moses, 2010). Solving complex math problems requires students to use higher-level thinking and often involves application of skills, real world scenarios, opportunities to collaborate, and the ability to use different strategies to solve a problem (Foster, 2018).

Definitions of problem-solving vary throughout the special education and math instructional literature, but it is generally linked to students' ability to solve word problems, also known as story problems (Peltier et al., 2018). "Performance on story problems serves as a proxy to measuring a student's ability to analyze a real-world situation and apply mathematical knowledge to identify and interpret a solution" (Peltier et al., 2018, p. 89). Problem-solving involves a novel problem, where a student must determine appropriate steps and implement that strategy to solve the problem (Alter, 2012). Mastering the problem-solving skills in mathematics can increase student's overall problem-solving abilities, including real-life challenges, like grocery shopping (Bouck et al., 2019; Lein et al., 2020).

Despite the importance and relevance of math problem-solving, SWD and students with math difficulty consistently struggle with this skill (Bae et al., 2015; Peltier, Sinclair, et al., 2020; Powell et al., 2020). Solving word problems can be more challenging than performing simple calculations for several reasons. Solving word problems involves two distinct phases—problem representation/comprehension and problem solution (Alghamdi et al., 2020). Problem solution involves carrying out the computations necessary to solve the problem. However, even when able to complete math calculations, students with math difficulty struggle with word problems (Alghamdi et al., 2020). The difficulties for most students, including those with math difficulty and SWD, is in the problem representation/comprehension.

Deficits in working memory are often seen in SWD and students with MD who struggle with these types of problems (S. C. Cook et al., 2020). Working memory involves the ability to process and store information in the brain efficiently and concurrently (Morin, 2014). When solving a word problem, students must identify important information and ignore extraneous information, which can be a difficult skill for students with working memory deficits (Dexter & Hughes, 2011). Working memory deficits also negatively impact the ability of students to plan tasks, process verbal information, and regulate attention (Morin, 2014). Word problems can overload the processing capabilities of students with math difficulty and are best taught in systematic ways, in manageable pieces (Doabler et al., 2016; Wilson, 2013).

Working memory is frequently cited in the research as a factor leading to difficulty with problem-solving; word problems present other challenges as well. Some students simply struggle with reading comprehension, mathematical language, or math vocabulary (Lein et al., 2020). Others may have difficulty with the abstract thinking required to contextualize and solve a word problem (Lein et al., 2020). Working memory, problem representation, abstract thinking and reading comprehension have all been cited as possible explanations for the poor performance of SWD and math difficulty on problem-solving tasks, but it should be noted that problem-solving is a historically weak area for all K-12 math students (Klein, 2022). Teachers often struggle to teach the complexities of problem solving and word problems (English & Gainsburg, 2015; Peter, 2012). Therefore, lack of strong prior instruction may also be a factor for secondary students who struggle with problem solving (Peter, 2012). Because of both the complexities involved and the difficulties encountered, problem-solving strategies are one of the more frequently researched EBPs for math. Powell and colleagues (2021) found that 61% of studies in

their review addressed problem-solving strategies, which comprises a large variety of different strategies to assist students with problem representation and comprehension.

Problem-solving strategies consist of cognitive and meta-cognitive strategies and are particularly useful for SWD when solving word problems (Hightower, 2018; Powell et al., 2020). Cognitive strategies often involve teaching students a process to use, aided by a graphic organizer or mnemonic (Özkubat & Özmen, 2021). Cognitive strategies teach students how to think about a problem rather than simply how to do it and include skills like paraphrasing, visualizing, drawing pictures, and checking their work (Morin, 2014). For example, STAR is a cognitive process strategy for solving word problems with four steps: Search the problem, Translate the words into an equation in picture form, Answer the problem, Review the solution (Maccini & Hughes, 2000). It has been shown to be effective for students with learning disabilities and mild intellectual impairment (Maccini & Hughes, 2000; Özkubat & Özmen, 2021). The Math Frame is another research-based cognitive strategy for solving word problems (Wilson, 2013). This strategy uses a series of steps, taught through systematic instruction, and laid out in a graphic organizer, to help secondary students solve complex problems. Cognitive strategy instruction has been demonstrated effective for students with mathematics disabilities (Zhu, 2015).

Metacognitive strategies work to teach students how to engage in metacognition, which is often weaker in students with math difficulty (Desoete, 2009). Metacognition involves thinking about thinking or having knowledge of one's own cognition. Although students without disabilities often develop metacognitive skills on their own, many SWD require explicit instruction in these skills and strategies (L. Graham & Berman, 2012). In math, metacognition includes skills like noticing errors in problem-solving, re-reading a word problem to increase

understanding, or evaluating if an answer is reasonable (Morin, 2014). Lack of metacognitive strategies has a negative impact on student's problem-solving ability in math, but also affects their overall conceptual understanding of math in general and may contribute to doubt in their own math abilities (Morin, 2014).

Solve it! is a strongly researched problem-solving strategy that incorporates cognitive and metacognitive elements. It was first pioneered by Montague in 1992. It teaches students a process for solving word problems that consists of seven steps—read, paraphrase, visualize, hypothesize, predict, calculate, and check (Özkubat & Özmen., 2021). Along with these seven cognitive processes, each step includes the metacognitive steps: ask, say, and check. A systematic review of studies using this strategy found it was effective for SWD (Özkubat & Özmen, 2021). In addition to Solve it!, there are other cognitive and metacognitive strategies for math problem solving. The two most frequently studied are enhanced anchor instruction and schema instruction.

Enhanced Anchor Instruction. Enhanced anchor instruction grew out of the idea of Anchor Instruction, where students solve problems situated in a real-world context or story (Cognition and Technology Group at Vanderbilt, 1990). These anchor problems represent rich mathematical tasks, where students must collaborate to solve complex real word problems (Bottge et al., 2015; Maccini et al., 2013). Enhanced anchor instruction includes the use of technology and emphasizes hands-on application of skills. In enhanced anchor instruction, students are presented with a real-world problem (like building a skateboard ramp) through a multimedia format (like a video). They must solve the problem while working as a team and then enact their solution through building or construction (e.g., building models of skateboard ramps; Bottge et al., 2007). Multiple studies led by researcher Brian Bottge have demonstrated the

effectiveness of this instructional strategy for middle school students with and without learning disabilities, as well as the ability of students to maintain and generalize this knowledge (Bottge et al., 2004; Bottge et al., 2007; Bottge et al., 2015). By situating a word problem in an authentic context and including both hands-on and collaborative elements, enhanced anchor instruction increased student engagement and application of problem-solving skills.

Schema Instruction. Although research on enhanced anchor instruction is promising, research on schema instruction is much more extensive (Powell, 2011). Schemas are knowledge or structures that are organized and stored in long term memory. They can be applied to newly received information. Each time a new experience is encountered, it is compared to the existing schema, which can be used to address the novel situation, but which can also grow and change as individuals encounter new information (S. C. Cook et al., 2020). In math, students use schema (existing knowledge) to comprehend and solve problems (S. C. Cook et al., 2020). For math word problems, schemas refer to different types or patterns of word problems. "Word problems can be differentiated into types of problems. The problem type is determined by what is happening in the word problem narrative" (Powell, 2011, p. 94). For example, in multiplication and division word problems, one type is ratios/proportions, which involve finding the relationships between numbers. For example, a pet store is donating a portion of each sale to a local animal shelter. For each $10.00 that someone spends, $1.00 is donated to the animal shelter. What proportion of their sales is the pet store donating? Students can use "schemas to organize information from a word problem in a way that represents the underlying structure of a problem type" (Powell, 2011, p. 94). Students are explicitly taught how to recognize these schemas and then how to apply their problem-solving techniques to each type. SWD and

students with math difficulty may require explicit instruction on schemas (S. C. Cook et al., 2020).

Schema instruction is generally divided into two separate types: schema broadening instruction and schema-based instruction (Peltier et al., 2018). Both methods have a strong research base and involve applying an understanding of the underlying structure of a word problem to solve word problems (S. C. Cook et al., 2020; Peltier et al., 2018; Peltier, Sinclair, et al., 2020).

> Schema-based instruction
>
> emphasizes the underlying mathematical problem structure, uses visual-schematic diagrams to show how the quantities in a problem are related, focuses on problem solving procedures grounded in reasoning, and highlights metacognitive strategy knowledge to monitor and reflect on the problem-solving process. (Alghamdi et al., 2020, p. 125)

In a meta-analysis of algebra interventions for SWD and students with math difficulty, schema-based interventions had one of the largest effect sizes (Hughes et al., 2014). Schema-based instruction is generally delivered through explicit instruction (S. C. Cook et al., 2020) and often incorporates the use of mnemonics (Alter, 2012; Peltier et al., 2018) and graphic organizers (S. C. Cook et al., 2020).

Much of the schema-based instruction has been completed by Jitendra and colleagues (Jitendra et al., 1998; Jitendra et al., 2002; Jitendra et al., 2009). Although most of the research has focused on elementary students at risk for math disabilities, some of the research focuses on middle school students (Jitendra & Xin, 1997; Jitendra et al., 2002). Jitendra's work relies on teaching schemas and using diagrams or graphical representations to assist in solving the problem. Results of multiple studies have shown this type of cognitive instruction to be very

effective in increasing the achievement of students Grades 3-8 for math word problems. More recent work has shown schema-based instruction used effectively with SWD in the middle school setting (Witzel & Myers, 2023).

Schema-broadening instruction is very similar to schema-based instruction. Fuchs and colleagues have spearheaded this work. There are two primary differences. First, Fuchs used algebraic representations as opposed to visual representations of the schema (Powell, 2011). Fuchs believes this helps develop algebraic thinking (Fuchs et al., 2006). Second, after teaching the students the schemas, or problem types, the teacher provides explicit instruction in transferring their knowledge between different types of problems.

> Teachers explained how problem features, such as format or vocabulary, can make problems seem unfamiliar without modifying the problem type or the required solution rules; they discussed examples, emphasizing that they had the same problem types as superficial features, such as format or vocabulary, changed; they provided practice in sorting novel problems in terms of changes in superficial problem features and in terms of solving those problems; and they prompted students to search novel problems for familiar problem types (Fuchs et al., 2006).

This additional element allows students to see how problems that might seem superficially different are the same type of problem and can be solved the same way (Fuchs et al., 2008).

As opposed to the other EBPs outlined in Powell's work, schema instruction is used for one type of math problem—word problems, but the specific content may include addition, subtraction, multiplication, division, ratios, proportions, percentages, and so forth. Schema instruction has been demonstrated effective for students with learning disabilities (Jitendra et al., 2002; Peltier et al., 2018); math difficulty (Peltier et al., 2018); mild intellectual disabilities

(Chung & Tam, 2005; Kot & Yikmis, 2018); ADHD (Iseman & Naglieri, 2011); emotional and behavioral disorders (Alter et al., 2012; Jitendra et al., 2010; Peltier & Vannest, 2018); and autism spectrum disorders (Cox & Root, 2020). Schema instruction can easily be modified and used in concert with other strategies to meet the needs of SWD who may require more intensive instruction (Root et al., 2017).

Conclusion

Federal laws, court precedence, state accountability systems, and professional education organizations all agree that EBPs for SWD are essential to providing them with a high quality, appropriately challenging education. Student achievement in mathematics is an important part of this education and one that can affect students' futures. Understanding which EBPs are being used in providing middle school math instruction in inclusive settings is a first step in closing the research to practice gap in this area. Knowing if self-efficacy or confidence in implementation influence the use of these practices provides further insights and may inform preservice and in-service teacher training designed to increase the use of these practices in classrooms. Finally, a sense of any differences between general and special educators may help to target efforts to increase use of math EBPs.

CHAPTER 3: METHODS

Most special education students spend most of their instructional time in general education classrooms (National Center for Education Statistics, 2022b). Within these inclusive environments, SWDs should receive specially designed instruction using EBPs from a special educator and a general educator. The literature has identified and thoroughly explored math EBPs, but it is unclear which of these practices are used in classrooms and what factors may influence the use of these practices. I explored use of EBPs by general and special educators in middle school (i.e., Grades 5-8) inclusive general education mathematics classrooms, their confidence in implementing math EBPs, and their math teaching self-efficacy.

Research Questions

The purpose of this research was to better understand the practices of general and special education teachers when teaching mathematics in inclusive classrooms and whether the use of those practices was related to confidence in implementation for EBPs or math teaching self-efficacy. This study also explored differences in these measures for general education vs. special education teachers. I used the following research questions to guide my study:

1. To what extent do middle school teachers report the use of math EBPs when providing instruction in inclusive settings?
    a. Does the reported use of math EBPs significantly differ between general and special education teachers?
2. To what extent do middle school teachers report confidence in implementing math EBPs when providing instruction in inclusive settings?

a. Does the reported confidence in implementing math EBPs significantly differ between general and special education teachers?

3. What is the perceived math teaching self-efficacy of middle school teachers?
    a. Does the perceived math teaching self-efficacy significantly differ between general and special education teachers?
4. What is the relationship between self-reported use of math EBPs, reported confidence in implementation, and perceptions of math teaching self-efficacy?

Methods

I used a quantitative survey instrument to gather data, including demographic information, teacher self-reported use of math EBPs, and teacher confidence in implementation of math EBPs. I also used an existing survey of math teaching self-efficacy, the MTEBI, in this study. Survey instruments are appropriate research tools when asking for facts or opinions (Hazel et al., 2016). I investigated usage of instructional practice, as well as the relationships between variables, for which survey design is uniquely suited (Creswell, 2012; Hazel et al., 2016). Surveys, or questionnaires are a popular method in educational research as they allow researchers to collect a large amount of information from many participants in a short period of time (Fowler, 2014; M. Lambert, 2019). Using a cross-sectional survey design (Creswell, 2012), I administered the survey at one point in time to a group of participants selected from the overall population of middle school math teachers. Participants accessed the online survey through a link or QR code. Researchers commonly use online surveys due to their ease and ability to access participants over a wide geographical area (Costa & Condie, 2018).

Reported Use and Confidence in Implementation

The first two sets of variables assessed through this survey were (a) reported use of each math EBP and (b) confidence in implementation of each EBP. The survey asked six questions about each, one related to each practice. Because no prior research has examined implementation and confidence of this specific set of math EBPs, there are no existing scales or set of questions designed to assess these variables. The purpose of this research was not to develop and validate such a scale, as this is unnecessary for constructs as simple and straightforward as reported use and confidence in implementation (Enders & Kostewicz, 2023).

In special education research, surveys or questionnaires often include questions assessing reported use of instructional practices to better understand the landscape of practice in schools. Answers to these questions are often examined in relationship to other variables, such as factors contributing to the use of these strategies (e.g., elements of student population such as grade level or disability type); training on the strategies; or demographic information. For example, Gagnon and Maccini (2007) surveyed teachers of SWD about their use of specific effective instructional strategies, including graphing calculators, self-monitoring strategies, graduated instructional sequences, and working in groups. Enders and Kostewicz (2023) asked secondary teachers working with SWD about instructional practices during remote learning. Knight and colleagues (2019) surveyed teachers working with students with autism spectrum disorders and intellectual disability about their use of established EBPs for those populations. All these studies reported descriptive statistics (e.g., mean, standard deviation, frequencies) for the reported use of each practice and in several studies, this was statistically analyzed for correlations or differences between groups. Using a similar question style and answer format (Likert-scale), I asked teachers about their reported use of each practice.

Like questions about teacher's self-reported use of an instructional practice, special education research often employs survey questions regarding confidence in implementation of each strategy. Confidence in implementation is seen as a straightforward question, and although it may be related to or a part of the larger and more complex construct of self-efficacy, they are not identical. Often, confidence is used as a synonym for self-efficacy, but in this research, they are viewed separately. Confidence in implementation seeks to understand how confident, or assured, a teacher feels in using a specific strategy in a specific context. It does not address other elements of self-efficacy or overall confidence in their teaching or even teaching mathematics. The question was limited in scope to the specific strategy discussed.

Many of the studies discussed previously asking teachers about their use of a practice also assessed confidence in implementation, including Gagnon and Maccini (2007) and Knight et al. (2019). Brock et al. (2014) surveyed special education teachers and administrators in Tennessee about their use of best practices for students with autism spectrum disorder to develop targeted professional development. Layden and colleagues (2022) asked about confidence in implementation and reported use of EBPs for students with autism spectrum disorder, but targeted school administrators rather than teachers. Other studies ask about confidence in performing specific skills or teaching strategies to understand if confidence can change over time or as the result of professional development. For example, Shriner and colleagues (2010) surveyed teachers about their confidence in specific tasks related to the use of technology in social studies classrooms. Additionally, Kretlow and colleagues (2012) examined changes in confidence about research-based strategies for mathematics before, during, and after coaching. Bjerke and Xenofontos (2023) used a four-point Likert scale to assess confidence in distinct skills used in math instruction. The survey developed for the current study uses similar wording

for the questions and the same 5-point Likert scale as used in Brock et al. (2014; see Appendix A).

Mathematics Teaching Efficacy Belief Instrument

The Mathematics Teaching Efficacy Belief Instrument (MTEBI) was developed from an existing instrument, the Science Teaching Efficacy Beliefs Instrument and has a total of 21 items (McGee & Wang, 2014). Participants answer each of the 21 statements using on a 5-point Likert-style scale (1 = *strongly disagree* to 5 = *strongly agree*). This is an inverse scale, meaning that lower scores would represent higher levels of self-reported efficacy. The MTEBI includes two subscales: Personal Mathematics Teaching Efficacy (PMTE) and Mathematics Outcome Expectancy (MTOE). PMTE refers to a teacher's efficacy expectations for teaching mathematics (e.g., "I know how to teach mathematics concepts effectively"). MTOE examines outcome expectancy or to what degree a teacher believes their teaching can influence student understanding and outcomes (e.g., "The inadequacy of a student's mathematics background can be overcome by good teaching"). Enochs et al. (2000) conducted a confirmatory factor analysis and confirmed the presence of two factors and indicated that these two separate subscales are independent from each other. Enochs and colleagues (2000) also established reliability for each subscale, with an alpha coefficient of .88 for the PMTE scale and .75 for the MTOE scale.

Researchers originally developed the MTEBI for use with preservice elementary teachers and it has been used extensively to study this population (Bursal & Paznokas, 2006; Cakiroglu, 2008; Thomson et al., 2017; Utley et al., 2005). However, reliability and validity of this scale was established with high school teachers (Jansen, 2008). Jansen's (2008) confirmatory factor analysis confirmed the existence and independence of the two subscales, and their analysis included an overall alpha coefficient of .88 for the MTEBI. They also compared results of this

scale to several other scales of teacher efficacy and found strong correlations between scores of in-service teachers on all three measures. After an extensive statistical analysis, Jansen (2008) concluded that the MTEBI was both valid and reliable for use with in-service secondary teachers. Consequently, other researchers have used this instrument to study in-service teacher populations (Evans, 2014; Rimpola, 2014; Tassell et al., 2019). In using this tool with in-service middle school mathematics teachers, I made some relevant wording changes. Several statements were worded in the future tense, "I will generally teach mathematics ineffectively." I changed these questions to the present tense to reflect that the respondents are current teachers. Also, Question 11 asks about teaching elementary mathematics; I removed the word "elementary." These changes were not substantive and should not affect the validity or reliability of this measure.

Participants

Participants for this study included general and special education teachers in the U.S. who currently teach mathematics in an inclusive setting in middle school (Grades 5-8). Since I limited my participants to those who meet these inclusion criteria, I used purposeful, criterion sampling. Purposeful sampling indicates that the individuals chosen must have specific knowledge and life experience and can provide rich and relevant data for study (Gentles et al., 2015). Purposeful sampling allows for the generation of information-rich cases, which allow for in depth understanding and generalizable results (Patton, 2015). Criterion sampling simply indicates that the individuals chosen must meet the criteria stated above (Patton, 2015).

I recruited teachers through several outlets. First, I disseminated the survey link through Facebook groups aimed at special education teachers and middle school mathematics teachers. As a practicing teacher, I am a member of 12 groups that are likely to include individuals who

meet the target sample for this study. These groups are private or closed. An individual must request permission to join, usually by answering filtering questions. Moderators also monitor these groups and approve posts. In all these groups, the published set of rules allows for distribution of surveys. I also used convenience and snowball sampling to recruit participants. I reached out to my professional teaching network via email or messaging through social media (e.g., Facebook, Twitter, LinkedIn). I requested they forward the survey to others with similar teaching roles. Despite the fact that researchers have expressed concerns about the generalizability related to such sampling methods, this type of internet survey sampling method has become common, including by worldwide statistical agencies (Dillman et al., 2014). Sampling in this way runs the risk of creating a non-representative sample, which would limit the generalizability of results. Using a variety of methods for distributing access to this survey helped to ensure I reached a wider and more diverse audience. Table 4 compares my sample to the overall population of secondary teachers in America (National Center for Education Statistics, 2023a).

Table 4

Teachers by Degree Type and Sex

Demographic Information	Secondary Teachers	Participants
Degree Type		
Bachelor's Degree	35%	28%
Master's Degree	53%	68%
Professional Teaching License	90%	98%
Sex		
Female	64%	96%
Male	36%	4%

Sample Size

In survey research, it is essential to determine an appropriate sample size to complete the planned statistical analysis and answer the research questions. Calculating the number of respondents needed for statistical power ensures that the analysis can continue as planned (Cohen, 1992). I used GPower 3.1.9.7 (Faul et al., 2007) to calculate some sample sizes for this study. GPower is a free, downloadable program that calculates statistical power and related information using algorithms. GPower analyses indicated that to perform a linear multiple regression with three predictors, a power value of .80, and a *p*-value of less than .05, the sample must include at least 38 participants. To conduct an independent samples t-test of two groups with a power value of .80 and a *p*-value of less than .05, each group would require 64 participants, for a total of 128 respondents.

My data analysis plan also included a Confirmatory Factor Analysis (CFA) on the MTEBI. Larger sample sizes are often required in factor analysis. Several rules-of-thumb used by researchers include a minimum sample size of 100-200 or at least 10 cases per variable (Bentler, 1995; Wolf et al., 2013). Using these guidelines, since the MTEBI has 21 variables, an estimated sample size of at least 210 participants was required to run this analysis appropriately. However, more nuanced and recent research indicates that these rules-of-thumb may not always be accurate, and the number of participants should be increased when the number of factors increases (Wolf et al., 2013). However, since I investigated a two-factor design, a sample size less than 210 may have been acceptable. Wolf and colleagues (2013) also discussed that missing data could increase the number of participants required, but this was not a concern due to the limited missing data in the final dataset for this survey.

Data Sources

For this study, I developed a survey comprised of items from the existing MTEBI and researcher-developed questions to assess demographic information, reported use of math EBPs, and confidence in implementation of each EBP (see Appendix A). Self-report surveys are uniquely appropriate to gain information about a teacher's practices and attitudes (Dillman et al., 2014). Surveys allow for generalization of results, are efficient, and cost-effective. They allow researchers to access many responses over a short period of time (Dillman et al., 2014). Despite concerns about web-based survey research, this method offers a way to reach a large portion of the intended audience of possible respondents to answer the research questions.

Instrument Development

I examined the validity and reliability of this survey tool to decrease the opportunities for measurement error (Creswell & Creswell, 2018). Validity refers to the degree to which the survey measures what it is intended to measure, in this case, teacher instructional practices and attitudes. Reliability in survey research references the consistency of the survey instrument (Creswell & Creswell, 2018). In survey research, survey design is the most common place where errors occur, and steps taken prior to administration of the survey are essential to minimize this error (Fowler & Cosenza, 2008). The validity and reliability of the MTEBI have already been established, but I took additional steps to establish validity for the survey questions I designed. I also conducted a reliability measure on the research data to investigate reliability.

I took three steps to ensure this tool was as reliable and valid as possible. First, I invited a panel of experts to review the content and design of the survey. Second, I conducted cognitive interviews. By listening to participants think aloud while they fill out the survey, I collected more information about the face validity of the survey and the time needed to fill it out. Finally, I

conducted a pilot test with a small number of individuals to better understand how the survey instrument worked for participants.

Expert Review. Systematic question review by experts can assist in determining content validity and scrutinize survey design and wording. Content validity refers to the degree to which the survey measures the constructs it intends to measure (Creswell, 2012). To determine the content validity of the survey I created, I asked a group of experts to judge the content of this survey. They scrutinized the instrument to ensure the questions were clear and that the survey items properly explored each construct. I recruited experts in three areas—special education, middle school math instruction, and survey design—to gain insight regarding the content, as well as a wider variety of features, including wording, question order, readability of font, and visual organization (Dillman et al., 2014). As a result of this expert review, I made small changes to the survey instrument. First, the middle school math expert suggested several changes in the description of each math EBP to increase clarity for teachers taking the survey. The expert in survey design suggested changes to the visual format and answer entry type in Qualtrics and made suggestions for coding the questions in Qualtrics. The special education expert suggested changes to the demographic questions, including eliminating questions, adding questions, changing the answer choices on questions and re-ordering questions. For example, she suggested moving demographics that were not related to inclusion criteria to the end of the study in case participants experienced survey fatigue.

Cognitive Interviews. The second step to determine the validity of the survey was to gather a panel of three individuals to take the survey and provide feedback through cognitive interviewing. These individuals were all former general and special education middle school math teachers, who had been in that role in the last two years but were currently serving in a

different role. These individuals took the survey individually while sharing their screens through video conferencing. Cognitive interviewing allows the participants to share their thoughts and questions while completing the survey (Dillman et al., 2014). This "think-aloud" process helps to "investigate respondents' cognitive behaviors" and is used in assessment validation (Bostic, 2021, p. 1). Cognitive interviewing has become a popular and accepted method of testing questions and questionnaires and many federal and academic organizations, including the U.S. Census Bureau utilize this tool (Fowler & Cosenza, 2008). Cognitive interviewing can consist of simply asking participants to "think-aloud" while completing the survey or asking probing questions during the survey (Willis, 1999). I chose to combine these two methods. At the start of the interviews, I asked individuals to share their thoughts as they were taking the survey, particularly if they were confused or experienced an emotional response. I also asked a set of probing questions at certain points to understand how individuals were interpreting the questions. For example, I asked how individuals defined explicit instruction and asked them to provide me with an example from their own teaching. At the end, I also asked how difficult the survey seemed. I also timed each interview to determine how long survey completion was taking.

Through this process, participants noted several minor typos, which I corrected for the pilot study. There were several demographic questions where participants could select more than one answer, so I added additional directions to those questions to clarify that direction. One participant skipped a question, so I added a warning screen to the survey to alert participants if they made the same error. Another participant consistently failed to read the directions at the top of the screen, so I increased and bolded the font size to make directions more visibly salient. Cognitive interview participants took 10–15 minutes to complete the survey and made comments at the end like, "That was easy" or "Not too painful."

Pilot Test. I tested the survey with a small number of participants who met participant criteria for this study. Pilot or field testing can assist the researcher in determining how the survey instrument works under realistic conditions (Fowler, 2014). This allowed me to collect information about three primary elements: the amount of time to complete the survey, issues related to survey completion, and issues related to data collection. According to Qualtrics, the estimated the time for the survey completion was 8.7 minutes, pilot testing refined this projection, with an average completion time of 10.5 minutes. One participant, whose survey was open for more than 90 minutes, was an outlier and excluded. Furthermore, surveys that are incomplete are a consistent issue in survey research (Fowler, 2014). A pilot test can also show what percentage of individuals fail to complete the survey. In this case, all the participants that started the survey finished it and completed all the questions. Finally, the pilot test can help identify any concerns regarding how data are coded and stored for analysis. In the case of this pilot study, the survey had two additional typos. The words “teacher” and “teach” were misspelled. It is unclear how these typos might have affected data collection. I did not use data from the pilot test in the final analysis. Table 5 presents a summary of the final instrument, showing which individual questions correspond to each practice, and each section of the survey.

Table 5

Instrumentation Summary

Section	Items
1: Inclusion Criteria	1-3
2: Reported Use of Practices	4-9
3. Confidence in Implementation of Practices	10-15
4. MTEBI	16-36
5. Demographics	37-44

Note. MTEBI = Math Teaching Efficacy Beliefs Instrument

Data Collection

Participants accessed the survey through a web-link, or QR code. I designed email and social media posts to increase response rates for the survey. One strategy to increase response rates is to be clear about who is conducting the survey, the purpose of the survey and the time anticipated for completion (Dillman et al., 2014; Fowler, 2014). In this case, I designed the cover email and social media posts to be brief, informational, attention-getting, but non-coercive in their message (see Appendices B and C). Researchers can also increase survey participation through financial incentives (Fowler, 2014). The email and social media post included information about the opportunity to enter their email for a chance to win a $25 gift card to Target. There were ten gift cards available. After completing the questionnaire, the survey provided participants a link to a separate survey where they could enter their email address to participate in the drawing. The wording in the questionnaire clarified that this was optional. Collecting identifying information for the gift card drawing as separate survey allowed the original survey responses to be anonymous. From those email addresses, 10 participants were selected at random to receive the incentive. Repeated contacts are another strategy for recruiting respondents (Fowler, 2014). After 1 week, I sent follow-up emails to my professional contacts

and repeated social media posts. I planned to leave the survey open to collect responses for approximately 3 weeks. However, after 11 days, the survey had over 700 responses, which far exceeded minimum estimates for my sample size, so I decided to close the survey.

Data Analysis

I used quantitative data analysis to answer each research question. I reported relevant descriptive statistics. I conducted an Exploratory Factor Analysis (EFA) of the two sets of questions related to reported use of practices and confidence in implementation to determine if these presented as single constructs or not. I also calculated Cronbach's alpha to evaluate the reliability of these two scales. These two steps helped determine the validity of the constructs being measured. In addition, I conducted a CFA, including reliability analyses, on the MTEBI to confirm the validity and reliability of that instrument and to determine if it should be treated as a single construct or factor or if the two sub-scales should be treated as separate constructs. I used scores from the factor analysis to run t-tests comparing general and special education teachers on each of the measures. I also ran t-tests comparing the two teacher roles on individual items from the Reported use of Practices and Confidence in Implementation scales. Then I used the factor scores as variables in a regression analysis to determine the relationship between self-reported use of math EBPs, reported confidence in implementation, and perceptions of math teaching self-efficacy. I also ran correlations to explore these relationships.

Descriptive Statistics

For Research Question 1, I used descriptive statistics to summarize teachers' ratings of how often they use each practice. For each individual practice, I conducted an item-by-item analysis, providing frequencies for each point on the 5-point scale, the mean score, and standard deviation. I analyzed Research Question 2 in a similar fashion for confidence in implementation

of each of the six math EBPs. I summarized teacher ratings of confidence using descriptive statistics (i.e., frequencies, mean, standard deviation). To describe math teaching self-efficacy as measured by the MTEBI for Research Question 3, I reported descriptive statistics, including the mean and standard deviation for each of the subscales, as well as the overall score.

Understanding Reported use of Practices and Confidence in Implementation

The next step in the analysis was to understand and interpret the data from the two researcher-created scales by performing factor analyses and reliability analyses. I ran an EFA on the six items of reported use of math EBPs and another EFA on the six items of confidence in implementation of math EBPs. To run the EFA, I first completed Horn's parallel analysis, which calculates mean eigenvalues based on random data sets (Horn, 1965). Factors are retained based on the factors for which the sample eigenvalue no longer exceeds its respective random eigenvalue. I also used the Kaiser-Meyer-Olkin measure to verify the sampling adequacy for the analysis. The measure indicates what proportion of variance might be accounted for by latent factors. Scores closer to 1.0 (and generally above .50) show that factor analysis may be useful in understanding data (Li et al., 2020). I also ran Bartlett's test of sphericity to show if the correlational structure was sufficient to run a factor analysis.

I then used maximum likelihood factor analysis to calculate factor loadings. These analyses allowed me to determine the dimensionality of each scale, that is, whether items should be considered as a single construct of "reported use of math EBPs" or "confidence in implementation of math EBPs" or if items should be analyzed separately. Given the exploratory nature of this study, it was unclear whether teacher reports regarding the six practices would coalesce into a single factor or if I would need to consider each practice individually. I obtained factor scores for each of the two scales that I used later in the regression analysis. Since I created

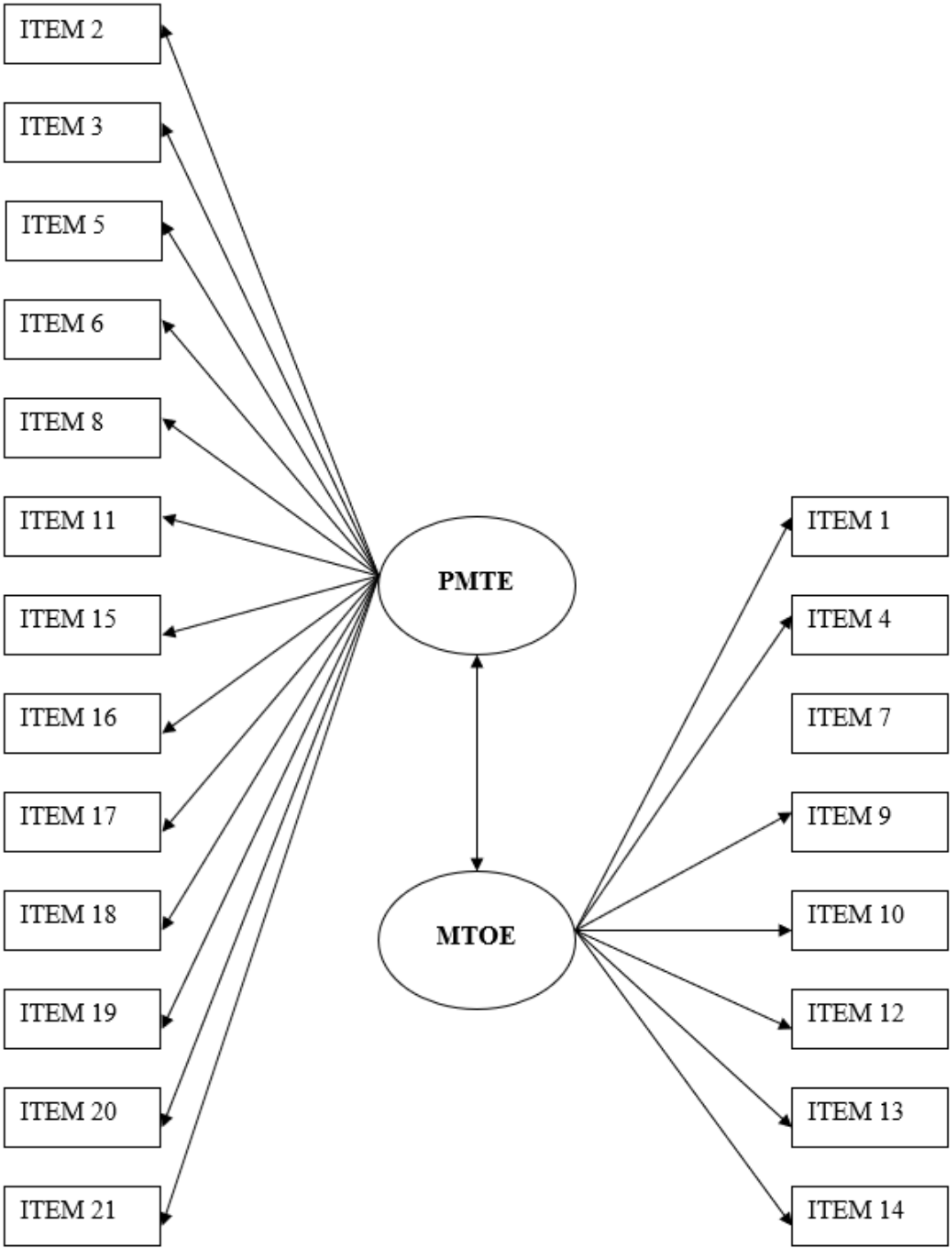
the questions about reported use of practices and confidence in implementation, I ran reliability measure—Cronbach's alpha—to determine if the scales had strong reliability.

CFA—MTEBI

Although previous research presented considerable evidence regarding the reliability and validity of the MTEBI, it was not originally designed for use with practicing teachers or middle school teachers. I ran a confirmatory factor analysis to determine if the two-factor design of this survey instrument is present in the sample population used for this study. I obtained factor scores for each of the two factors to use later in the regression analysis. The two-factor structure showed PMTE and MTOE as separate, but related latent factors, with questions from the survey as observed variables. The basic two-factor structure of this scale is presented in Figure 3.

Figure 3

Hypothesized Two-Factor Model MTEBI



Note. MTEBI = Math Teaching Efficacy Beliefs Instrument; PMTE = Personal Math Teaching Efficacy; MTOE = Math Teaching Outcome Efficacy

The CFA uses various fit indices to determine how well the proposed model fits the data. In the original publication, the authors ran an original and then modified model (Enochs et al., 2000). They reported three fit statistics: Akaike's Information Criterion (AIC; modified = 2.23), Comparative Fit Index (CFI; modified = .919), and average standard residuals (modified = .445). However, they relied heavily on the CFI, and this was the only fit statistic that the authors discussed in their results section. The field of structural equation modeling, including CFA, has advanced since this publication. In my CFA, I examined six different fit indices. The fitness of any model cannot be judged by a single statistic, and a more thorough investigation provided more information about the fit of the model (Lai & Green, 2016).

I used chi square divided by the degrees of freedom (CMIN/DF), goodness of fit index (GFI), comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean squared residual (SRMR) to explore the model fit. CMIN/DF is the chi square divided by the degrees of freedom. The chi square value determines if the observed variables (in this case, the answers to survey questions) and expected results from the model are statistically significant. It assesses the basic fit between the data and the model. It is easily interpreted when divided by the degrees of freedom. A CMIN/DF value of three or less indicates an acceptable fit between the data and the model (Kline, 1998). The GFI, or goodness of fit index, is the proportion of variance accounted for by the estimated population covariance. It shows how well the proposed model fits with the observed covariance. Scores are between zero and one, with one representing a perfect fit (Baumgartner & Hombur, 1996). A GFI of equal to or greater than .90 indicates a reasonable fit (Hu & Bentler, 1998). The CFI is the comparative fit index and examines the discrepancy between the data and the model (Gatignon, 2010. A CFI of greater than .90 was deemed an acceptable fit for the original model (Enochs et

al., 2000). Although .90 was considered acceptable at time of the original publication (Hu & Bentler, 1999), .95 or greater is currently considered the norm for appropriate fit (West et al., 2012). Similar to CFI, the Tucker-Lewis Index (TLI) is another fit index that compares the fit between the hypothesized model and the data. Scores closer to one indicate a better fit, with scores equal to or greater than .95 showing an acceptable level of fit (Kline, 2005). RMSEA, root mean square error of approximation, is another commonly reported fit statistic and measures differences between the expected and actual covariance matrix. Values between .05 and .08 are considered acceptable and values under .05 are considered excellent (MacCallum et al., 1996). Finally, SRMR is the standardized root mean squared residual looks at the discrepancy between the sample covariance matrix and the model covariance matrix (Hooper et al., 2008). Values less than .08 are considered acceptable on this measure (Hu & Bentler, 1999). I calculated factor scores for each of the subscales for use in later analyses.

Comparing Teacher Roles

Research Questions 1a, 2a, and 3a, all compare the data obtained based on teacher role—general education or special education. For each of these questions, I conducted an independent-samples t-test (two tailed) to determine the difference in means between the two groups (i.e., special education teachers and general education teachers). I used the factor scores obtained earlier using EFA and CFA to answer the research questions.

Regression Analysis

To answer Research Question 4, which looks at the relationships between the variables measured in this study, I used a multiple regression analysis such that the outcome variable (reported use of EBPs) was regressed on three predictor variables (confidence in implementation, PMTE subscale of the MTEBI, and the MTOE subscale of the MTEBI). Because of the complex

possible relationships present between these variables, teacher role (Cantimer et al., 2020), and years of experience (Klassen & Chui, 2010), I used each of these as a control variable.

Table 6

Data Analysis Plan

Research Question	Survey Question	Data Analysis
1. To what extent do middle school teachers report the use of math EBPs when providing instruction in inclusive settings?	4-9	Descriptive Statistics: *f, M, SD*
a. Does the reported use of math EBPs significantly differ between general and special education teachers?	1, 4-9	Independent samples t-test
2. To what extent do middle school teachers report confidence in implementing math EBPs when providing instruction in inclusive settings?	10-15	Descriptive Statistics: *f, M, SD*
a. Does the reported confidence in implementing math EBPs significantly differ between general and special education teachers?	1, 10-15	Independent samples t-test
3. What is the perceived math teaching self-efficacy of middle school teachers when providing instruction in inclusive settings?	16-36	Descriptive statistics: *M, SD* (overall and for each of the two subgroups)
a. Does the perceived math teaching self-efficacy significantly differ between general and special education teachers?	1, 16-36	Independent samples t-test
4. What is the relationship between self-reported use of math EBPs, reported confidence in implementation, and perceptions of math teaching self-efficacy?	1, 4-36	Multiple Regression Analysis; *r*

Note. EBP=Evidence-based practice

Delimitations

As a researcher exploring these specific research questions, I have made decisions and set boundaries, which represent delimitations for my study (Theofanidis & Fountouki, 2018).

Overall, the goal of this research was to use quantitative methods to learn about teacher practices in a way that may generalize to the overall teacher population, Therefore, the limitations placed upon the sample were to create a group of fairly homogenous participants who might have something in common. These participants were limited in two ways. First, I limited my sample to teachers in the U.S., a decision made for convenience of sampling, but also because the practices and details of educational systems outside the U.S. might vary significantly from those within the U.S. Data from outside the U.S. might muddle results from the study.

Second, I chose to limit the study to middle school instructors, excluding preschool, elementary and high school educators. Although states and divisions may rely on different standards Grades 5-8, there are many similarities to how schooling takes place and the types of content and processes students learn in mathematics (Dingman et al., 2013). However, preschool and elementary classrooms vary significantly across the United States in terms of location, hours per day on instruction, and curriculum content (Sanchez & Nadworthy, 2017). On the other end of the educational system, high school instruction mathematics instruction is often based on particular end-goals (passing a course, passing an end of course assessment, graduation, diploma type) that may change instructional practices and priorities (Duan-Barnett & St. John, 2012). High school math instruction differs too significantly from elementary and middle school instructional practices to be included in the study.

In addition to limiting the participants for this study, I chose to conduct quantitative survey design research, rather than another type of quantitative or qualitative research. Given the paucity of research on the use of practices by special education teachers in mathematics, I determined that a survey design would be a most appropriate exploratory study and answer the research questions most efficiently and clearly (Hazel et al., 2016).

Limitations

Limitations include any potential weaknesses in the study design, methodology, and execution (Theofanidis & Fountouki, 2018). There are several sources of potential bias involved in this sort of survey research that can affect the results. Response bias represents a limitation for survey research (Creswell & Creswell, 2018). Response bias occurs when the responses from the sample do not represent the responses of the overall population. This can occur because only certain individuals respond to the survey. These individuals may have a particular reason for responding to the survey that is not common to the population and their responses can skew the results. The sample for this study mainly consisted of teachers who found the survey through social media. Teachers who join social media groups may be different than the overall population of teachers. Because of the sampling methods used, there is no firm guarantee against this type of bias or error. However, sampling methods are designed to reach a wide variety of participants, which is one safeguard against this type of error. Response bias also occurs when respondents become bored or fatigued by the survey and begin repeating answers. Limiting the length of the survey is one tool to limit this type of response bias. I took careful consideration with this survey instrument to make it as short as possible to answer the research questions. Some responses were incomplete, and I removed these from the sample.

Social Desirability Bias

Another bias that may be present is social desirability bias, where respondents misrepresent their practices to what they believe the researcher is looking for or what they believe are better answers. Social desirability bias occurs due to individuals' desire to manage the impression they make on others based on their own understanding of their identity (Larson, 2018). Social desirability bias is a legitimate concern, especially in special education research,

where teachers use clues about the context and origin of the survey to influence their answers (Luke & Grosche, 2018).

There are several research-based methods for reducing social desirability bias. The first is to give the survey online, not face to face, which was already a part of the design of this study. Ensuring anonymity or confidentiality can help ensure that respondents are more honest (Gordon, 1987). The survey directions and information in the cover letter can also be vitally important to decreasing social desirability bias. The survey introduction should include a statement about the purpose and importance of the research and therefore, the purpose and importance of honest and accurate answer (Bergen & Labonte, 2019). Making sure that the respondent feels like a contributor of valuable information can also help reduce bias in responses (Gordon, 1987). I took All of these into account when designing the cover letter and survey introduction.

Assumptions

Inherent in this research study are several assumptions. The first is that the responses received are honest and are representative of 5^{th}-8^{th} grade teachers in math classrooms nationwide. The second is that the practices examined are best practices in teaching and that they link positively to student achievement in mathematics.

Researcher as Instrument

As an educator, I have professional connections with the subject matter of this research study. I have served as a special educator in a middle school general education math classroom. I am a firm believer in the power of inclusion and co-teaching and often experience frustration at the lack of research-based practices used in classrooms that I have experienced. This experience and frustration gave rise to this study and provided motivation to seek answers.

As this is a survey research design, risk of my own bias occurs not in analyzing and interpreting the results, but in the development of the survey. My firsthand experiences and bias are always present as I select and re-word questions. To counteract this bias, I first always try to rely on the research rather than my own opinion when selecting which aspect or element of a practice to include. Furthermore, the content validity steps I have taken in the creation of the survey have served to counter any bias that might have been present in the survey itself.

Ethical Considerations

When conducting any research with human participants, it is essential to ensure that a study is approached ethically to decrease the risk of harm to those participants (Seiber, 2008). Since this survey is anonymous, this research protects the identity of the participants. There are no sensitive items in this survey. Before data collection, I submitted this proposal to William & Mary's Educational Institutional Review Board (EDIRC) to obtain permission to proceed.

The consent form served to introduce the study to participants, including the purpose of the research, the importance of honest answers, and the confidentiality of the responses. I specified that participants could quit at any time. The consent form was located at the beginning of the survey in Qualtrics, and participants selected if they consent or do not consent before survey questions appeared.

CHAPTER 4: FINDINGS

This research examined the use of math EBPs in middle school inclusive classrooms, how confidence and self-efficacy may influence these practices, and whether there are differences between general and special education teachers. This chapter includes the results of descriptive and inferential statistics that I used to answer the research questions. This chapter starts with describing the participants through demographic information. Next, I presented descriptive and inferential statistics looking at Research Questions 1, 2, and 3 to understand and interpret the raw scores for the measures participants completed. Next, I obtained factor scores to use later in the t-tests and regression. I look at the scales for Reported use of Practices and Confidence in Implementation to determine if they are unidimensional and reliable. I also shared the results of a CFA on the MTEBI to determine its factor structure and factor scores. With these initial analyses completed, I presented the results of t-tests to compare results based on teacher role and end with a regression analysis to determine if Confidence in Implementation and self-efficacy can predict Reported use of Practices.

Research Questions

This analysis answered the following research questions.

1. To what extent do middle school teachers report the use of math EBPs when providing instruction in inclusive settings?
    a. Does the reported use of math EBPs significantly differ between general and special education teachers?

2. To what extent do middle school teachers report confidence in implementing math EBPs when providing instruction in inclusive settings?
    a. Does the reported confidence in implementing math EBPs significantly differ between general and special education teachers?
3. What is the perceived math teaching self-efficacy of middle school teachers?
    a. Does the perceived math teaching self-efficacy significantly differ between general and special education teachers?
4. What is the relationship between self-reported use of math EBPs, reported confidence in implementation, and perceptions of math teaching self-efficacy?

Participant Demographics

The survey was available for a total of 11 days in January 2024. Once data was screened for inclusion criteria and completeness, 587 survey responses remained. There were 718 survey responses. I excluded any responses less than 50% complete from the study, resulting in 621 responses. I also removed survey responses that did not meet the inclusion criteria (taught middle school Grades 5-8, general or special education teacher, teaching in the U.S.), resulting in a total sample size of 587. There was very little missing data within these responses, perhaps because the survey was designed to prompt participants to see if they missed a question before they moved to the next screen. On the Reported use of Practices scale, two respondents each missed a single question. Other than this, the responses for all three scales—Reported use of Practices, Confidence in Implementation, and the MTEBI—were complete. Given that the only missing data was on that scale, only the descriptive statistics and t-tests were affected, and cases were excluded pairwise so that each of the two missing cases were not entirely excluded (Pigott,

2009). Factor scores for Reported use of Practices were calculated for those two participants using only five out of the six questions.

To better understand the sample population, I examined personal demographic variables. For gender, 94.5% identified as female; 4.3% identified as male; and 0.3% identified as non-binary or a third gender. This is quite different from the national population of secondary teachers, which is reported as 36% male and 64% female (National Center for Educational Statistics, 2023a). However, the available national data includes all secondary teachers, but the sample for this study was limited to participants teaching SWD in middle school math classrooms. Participants also answered a question about in which state they taught. The drop-down menu for states included Washington, D.C., and Puerto Rico. Participants represented 50 out of the 52 choices for state. There were no participants from Washington, D.C., or Vermont.

Teaching Information

Participants provided information about their teaching role, grade level, license type, and school type (Table 7). More than two-thirds (71.4%) of the respondents were general education teachers, and 28.6% were special education teachers. Teachers reported which middle school grade(s) they taught and could select more than one response. Grades 6-8 were fairly equally represented, with some responses for fifth grade. A very small percentage (3.7%) indicated that they also taught another grade outside of this grade range.

Table 7

Participant Demographics: Teaching Information

Demographic Information	General Education	Special Education	No.	%
	n/%	*n*/%		
Teacher Role				
General Education	419	--	419	71.4
Special Education	--	168	168	28.6
Grade Taught				
5th	38 (9.1%)	32 (19.1%)	70	11.9
6th	171 (40.8%)	98 (58.3%)	269	45.8
7th	202 (43.8%)	106 (63.1%)	308	52.5
8th	189 (45.1%)	95 (56.6%)	284	48.4
Other	9 (2.2%)	13 (7.7%)	22	3.7
School Type				
Public	396 (95.4%)	163 (97.0%)	559	95.2
Private	23 (5.5%)	4 (2.4%)	27	4.6
Licensure				
Special Education K-6	7 (1.7%)	17 (10.1%)	24	4.1
Special Education 6-12	3 (0.7%)	27 (16.1%)	30	5.1
Special Education K-12	45 (10.7%)	131 (78.0%)	176	30.0
General Education Generalist	168 (40.0%)	44 (26.2%)	212	36.1
General Education Content Specific	310 (74.0%)	32 (19.1%)	342	58.3
Emergency/Provisional	7 (1.7%)	4 (2.4%)	11	1.9
No Teaching License	3(0.7%)	1 (0.1%)	4	0.7

General Education Teachers. For grade level taught, sixth, seventh, and eighth grade had a similar number of responses, with 40.8% teaching sixth grade, 43.8% teaching seventh grade, and 45.1% teaching eighth grade. A small percentage (9.1%) reported teaching fifth grade. A very small percentage (2.2%) indicated they taught a grade outside of the Grade 5–8 range in addition to their middle school teaching responsibilities. Most of the teachers (95.4%) taught at a public school.

General education licenses can be content specific (e.g., math, science, physical education) or can be generalist licenses (K-6, 5-8) that qualify a teacher to teach any subject in

that grade range. Participants could select more than one license option. Many respondents selected more than one type of license. Of those responding as general education teachers, 74% reported having a content specific license, and 40% reported having a generalist license. A very small percentage reported having a provisional license (1.7%) or no teaching license (0.7%). The results indicated that over 13% of general education teachers also had a special education teaching license.

Special Education Teachers. Special education teachers also responded to questions about which grade level(s) they taught. Like the general education teacher population, Grades 6-8 were similarly represented (sixth: 58.3%; seventh: 63.1%; eighth: 56.5%). The higher percentages reveal that the special education teachers in this sample were more likely to teach more than one grade level or multiple grade levels than their general education teacher counterparts. Compared to general education teachers, a much larger percentage (19.1%) taught fifth grade and other grades (7.7%). As with general education teachers, most of the sample (97.1%) reported teaching at a public school.

Special education licenses are often divided by grade levels. Most of the special education teachers in this sample (78%) had a K-12 Special Education teaching license, with 10.1% having a license for K-6 and 16.1% having a secondary 6-12 license. Many special education teachers also had a general education license as well, with 26.2% having a generalist license and 19.0% having a content specific general education license. The percentage of those with provisional (2.4%) or no teaching license (0.1%) was also very small.

Teacher Preparation and Experience

To better understand the background of participants, the survey included questions about their teacher preparation and years of experience (Table 8). For general education teachers,

32.7% of respondents had a bachelor's degree, 65.6% had a master's degree, and 1.7% had a doctoral degree. The college math coursework reported by general education math teachers demonstrated 26.7% of the sample held a degree in mathematics, 16.7% minored in mathematics, and the largest group (43.7%) completed some coursework in mathematics. Also, 11.5% of general education teachers completed minimal math coursework in college and 1.7% completed no math coursework in college.

The special education teachers in the sample had an overall higher level of education, with 17.9% having bachelor's degrees, 75.6% having master's degrees and 6.0% having doctoral degrees. Despite their higher degree of education, special education teachers reported less math coursework in college than their general education teaching colleagues. Most (51.8%) reported completing some coursework in math, with only 7.1% reporting having a degree in mathematics and 8.9% reporting a minor in mathematics. Compared to general education teachers, a much larger percentage had minimal (28.0%) or no coursework (3.6%) in mathematics.

Table 8

Participant Demographics: Teacher Preparation

Demographic Information	General Education	Special Education	No.	%
	n/%	*n*/%		
Highest Level of Education				
Bachelor's	137 (32.7%)	30 (17.9%)	167	28.4
Master's	275 (65.6%)	127 (75.6%)	402	68.5
Doctoral	7 (1.7%)	10 (6.0%)	17	2.9
College Coursework in Mathematics				
Degree in mathematics	112 (26.7%)	12 (7.1%)	124	21.1
Minor in mathematics	69 (16.5%)	15 (8.9%)	84	14.3
Some coursework in mathematics	183 (43.7%)	87 (51.8%)	270	46
Minimal coursework in mathematics	48 (11.5%)	47 (28.0%)	95	16.2
No coursework in mathematics	7 (1.7%)	6 (3.6%)	13	2.2

I also collected data about the years of experience, specifically how many years participants had been teaching middle school mathematics. One participant did not answer this question, so there were 586 responses (Table 9). The descriptive statistics indicate a wide range of experience. In this sample, general education teachers had more years of experience than special education teachers.

Table 9

Participant Demographics: Years of Experience

Teachers	*n*	*M*	*SD*
General Education	419	10.26	7.83
Special Education	167	7.18	5.38
Total	**586**	**9.39**	**7.35**

Reported Use of Practices

The first research question asked to what extent do middle school teachers report the use of math EBPs when providing instruction in inclusive settings? Teachers were asked to rate their use of six math EBPs on a scale from 0 for *never* to 4 for *daily/almost daily*. Frequency data for each practice is presented in Table 10. Descriptive statistics (Table 11) demonstrated that the overall mean scores for four of the six practices fell over 3, which means teachers in the study used these practices *weekly* or *more than weekly*. Explicit instruction was the most highly used practice with 73% indicating *daily/almost daily* use. However, mnemonics and graphic organizers were each used daily/almost daily by only 19% of survey respondents, meaning that they are used less frequently.

To further explore this data, I put the practices in order from most frequently used to least frequently used and found that Explicit Instruction was reported most frequently (M = 3.64). Mathematical Language was the second most-used practice of (M = 3.46), with Mathematical Representations as the third most used practice (M = 3.18), Problem-Solving as the fourth most used practice (M = 3.06), Mnemonics as the fifth most used practice (M = 2.63), and Graphic Organizers as the least used practice (M = 2.44). This order was true for both general and special education teachers. General education teachers used four out of the six practices more frequently than special education teachers (Table 11). In contrast, special education teachers used graphic organizers and mnemonics more frequently than general education teachers.

Table 10

Frequencies by Math Evidence-Based Practice

Evidence-based Practice	0 Never		1 A few times in a school year		2 One to three times in a month		3 Weekly		4 Daily/Almost Daily	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Explicit Instruction	5	0.9	10	1.7	21	3.6	121	20.6	430	73.3
Mathematical Representations	4	0.7	16	2.7	79	13.5	258	44.0	230	39.2
Mathematical Language	3	0.5	9	1.5	44	7.5	187	31.9	343	58.4
Mnemonics	4	0.7	82	14.0	153	26.1	235	40.0	112	19.1
Graphic Organizers	27	4.6	22	15.0	181	30.8	180	30.7	111	18.9
Problem-solving	5	0.9	29	4.9	89	15.2	265	45.1	199	33.9

Table 11

Descriptive Statistics: Reported Use of Practices

Evidence-based Practice	General Education Teachers		Special Education Teachers		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*
Explicit Instruction	3.66	.65	3.57	.85	3.64	.72
Mathematical Representations	3.21	.74	3.11	.97	3.18	.82
Mathematical Language	3.53	.69	3.29	.85	3.46	.74
Mnemonics	2.61	.98	2.69	.94	2.63	.97
Graphic Organizers	2.38	1.1	2.59	1.2	2.44	1.10
Problem-solving	3.07	.87	3.04	.90	3.06	.87

Confidence in Implementation

The second research question asks to what extent middle school teachers report confidence in implementing math EBPs when providing instruction in inclusive settings. Teachers rated their confidence in using each of the six math EBPs on a scale from 0 for *not at all confident* to 4 for *extremely confident*. Frequency data for this research question is presented in Table 12. Descriptive statistics (Table 13) indicated that the means for all six questions fell between 2.85 and 3.49, hovering around *Quite Confident*, with the highest confidence being associated with using explicit instruction (M = 3.49) and the lowest confidence with using graphic organizers (M = 2.80).

Table 12

Frequencies for Confidence in Implementation

Evidence-based Practice	0 Not at all confident		1 A little confident		2 Somewhat confident		3 Quite Confident		4 Extremely Confident	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Explicit Instruction	2	0.3	6	1.0	35	6.0	206	35.1	338	57.6
Mathematical Representations	2	0.3	12	2.0	113	19.3	278	47.4	182	31.0
Mathematical Language	3	0.5	11	1.9	114	19.4	254	43.3	205	34.9
Mnemonics	3	0.5	31	5.3	122	20.8	255	43.4	176	30.0
Graphic Organizers	7	1.2	45	7.7	157	26.7	230	39.2	148	25.2
Problem-solving	5	0.9	28	4.8	157	26.7	257	43.8	140	23.9

Table 13

Descriptive Statistics: Confidence in Implementation

Evidence-based Practice	General Education Teachers		Special Education Teachers		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*
Explicit Instruction	3.54	.65	3.35	.75	3.49	.69
Mathematical Representations	3.11	.76	2.96	.83	3.07	.78
Mathematical Language	3.17	.78	2.93	.85	3.10	.81
Mnemonics	2.99	.89	2.92	.83	2.97	.88
Graphic Organizers	2.77	.96	2.87	.91	2.80	.95
Problem-solving	2.87	.88	2.81	.85	2.85	.87

Math Teaching Self Efficacy

The MTEBI was used to examine teacher self-efficacy. Each question is answered on a 5-point scale, with 1 being used for strongly agree and 5 being used for strongly disagree. Scores are reported in Table 14 for the entire 21-question measure. However, the MTEBI consists of two distinct subscales—PMTE and MTOE. PMTE refers to a teacher's belief in their ability to teach effectively and MTOE is a teacher's belief that effective teaching can influence the outcome, or student learning (Enochs et al., 2000). To examine teaching self-efficacy among survey respondents, an average score for each respondent was calculated for the PMTE subscale, the MTOE subscale, and the overall measure. These subscale scores were used to run descriptive statistics, including mean and standard deviation (Table 14). Results showed that teachers' overall math teaching self-efficacy is poor. These findings also showed that teachers have a higher sense of their ability to affect student learning than their personal teaching efficacy.

Table 14

Descriptive Statistics: MTEBI

Section	General Education Teachers		Special Education Teachers		Total Sample	
	M	*SD*	*M*	*SD*	*M*	*SD*
PMTE subscale	4.34	.39	4.05	.53	4.25	.45
MTOE subscale	3.39	.53	3.41	.51	3.39	.52
MTEBI	3.98	.34	3.81	.38	3.93	.36

Note. PMTE = Personal Mathematics Teaching Efficacy; MTOE = Math Teaching Outcome Efficacy. MTEBI = Math Teaching Efficacy Beliefs Instrument

Exploratory Factor Analyses

As the Reported use of Practices scale and Confidence in Implementation scale were both created by the researcher, the first step in understanding the data was to understand if these were unidimensional constructs. That is, can I discuss Reported use of Practices as one factor or construct? Similarly, is Confidence in Implementation of math EBPs a single factor or is confidence for each individual practice a distinct variable? Exploratory factor analysis (EFA) was used to answer these questions. Both sets of data met basic assumptions for EFA, including having a sufficient sample size and level of measurement. This data was also within acceptable limits in terms of normality and distribution (Kline, 2023). I also examined the factorability of the data.

Using SPSS (v29), I first ran Horn's Parallel Analysis, which is a well-known and well-respected method for determining how many factors to retain when completing a factor analysis (Dinno, 2009). Because the second sample eigenvalue does not exceed the second random eigenvalue, I only retained one factor. Random eigenvalues (λ) from this analysis are included in Table 14. SPSS does not complete rotations on factor analyses with single factors, so a non-rotated solution was used. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for

the analysis, KMO = .750. The measure indicates what proportion of variance might be accounted for by latent factors. Scores closer to 1.0 (and generally above .50) show that factor analysis may be useful in understanding data (Li et al., 2020). Bartlett's test of sphericity showed that the correlational structure was sufficient to run a factor analysis, $\chi^2(15)=418.596$, $p<.001$.

The maximum likelihood factor analysis with the Kaiser's criterion of eigenvalues greater than one yielded a single factor that explained 37.5% of the variance (Table 15 and Table 16). I repeated this using Principal Components Analysis and Principal Axis Factoring, which both confirmed the existence of a single factor. I also examined the reliability of this six-question scale using Cronbach's alpha ($\alpha = .66$). This indicates that the scale shows questionable reliability (Sarmento & Costa, 2017).

Explicit instruction had a factor loading of .292, which is slightly lower than the .30 threshold that is often used in factor analysis (Field, 2013). However, I retained this factor for two primary reasons. First, there is no theoretical justification for removing this factor from the model. Explicit instruction does not differ from the other practices in any way that would indicate it should not be included in the single factor of Reported use of Practices. Second, explicit instruction did load higher on the Confidence scale and since I used the factor scores from Reported use of Practices and Confidence in later analyses, it made sense that they include the same six instructional practices.

Table 15

Reported use of Practices Factor Analysis Results

Factor	Random λ from Parallel Analysis	λ	% of Variance Explained	Cumulative % of Variance
1	1.188	2.250	37.501	37.501
2	1.109	.939	15.652	53.153
3	1.050	.909	15.084	68.238
4	1.002	.689	11.489	79.726
5	.965	.636	10.606	90.332
6	.910	.580	9.668	100.000

Table 16

Reported use of Practices Factor Loadings and Communalities

Instructional Practice	Factor Loading	Extraction Communalities
Explicit Instruction	.292	.085
Mathematical Representations	.560	.314
Mathematical Language	.472	.222
Mnemonics	.562	.316
Graphic Organizers	.536	.287
Problem-Solving	.552	.305

Because the second eigenvalue was close to one, I also ran an EFA using a two-factor model to determine if this better explained the data. Results of this maximum likelihood factor analyses were not promising, as communalities greater than one indicated that the results should be interpreted with caution. Also, the factor loadings on the two factors did not align with any theoretical rationale and created problems with interpretability (see Appendix D). Although factor analyses are a mathematical process with statistical logic, the role of EFA is to help interpret the findings and the two-factor analysis did not result in strong interpretability. Therefore, I rejected the two-factor model for Reported Use of Practices.

I carried out similar steps and analysis on the Confidence in Implementation scale as well. In this case, the Horn's Parallel Analysis showed that a single factor should be retained. The KMO for this scale was .849, with Bartlett's test of sphericity showing a significant result as well, $\chi^2(15) = 910.914$, $p < .001$. Factor analysis using maximum likelihood extraction showed a single variable accounting for 50.4% of the variance (Table 17 and Table 18). Cronbach's alpha for reliability on the six-question scale was $\alpha = .799$, showing higher reliability than the reported use of practices scale. The Confidence in Implementation scale demonstrated acceptable reliability (Sarmento & Costa, 2017).

Table 17

Confidence in Implementation Factor Analysis Results

Factor	λ	% of Variance Explained	Cumulative % of Variance
1	3.023	50.389	50.389
2	.748	12.469	62.858
3	.663	11.045	73.903
4	.660	10.001	83.904
5	.486	8.100	92.004
6	.480	7.996	100.000

Table 18

Confidence in Implementation Factor Loadings and Communalities

Instructional Practice	Factor Loading	Extraction Communalities
Explicit Instruction	.593	.352
Mathematical Representations	.726	.526
Mathematical Language	.634	.402
Mnemonics	.609	.371
Graphic Organizers	.584	.342
Problem-Solving	.668	.447

CFA

To determine factors for further analyses and to examine if the factor structure of the MTEBI remained true for this sample, I completed a CFA using the MTEBI data. This data set met the assumptions of the CFA, including random sampling, multivariate normality, and appropriate sample size (Suhr, 2006). CFA is appropriate for testing a hypothesis related to the relationship between observed and latent variables (Suhr, 2006). The original hypothesized factor structure of the MTEBI (Enochs et al., 2000) is located in Figure 3.

In the initial 2000 paper by Enochs and colleagues, researchers ran two separate CFAs on the MTEBI, both using the two-factor model. The original CFA for the MTEBI showed two related, but independent factors, PMTE and MTOE, which matched the hypothesized model. This model was a poor fit, CFI = .869. However, the authors used the misfit analysis from within the CFA itself to modify the model as they explain below.

> The results of the LM tests revealed a highly significant model misfit associated with the error components of Items 12 and 5 and modest misfit associated with the three error covariances associated with Items 3, 6, and 8. Since all of these items were on the self-efficacy scale, and correlated errors among items on the same scale was not an uncommon occurrence, the model was modified by setting these four parameters free to vary from their previously fixed values of zero (Enochs et al., 2000, p. 197).

In this explanation, the authors relied primarily on statistical justification for the modifications they made to the original model, using misfit analyses to determine which changes to make to the model. However, they did offer a general theoretical justification for changes to the model and noted that errors on the same subscale often correlate. With these changes made, they then ran a corrected model and achieved better results with a CFI of .919. This newer model was a

better fit, with lower AIC and average standard residuals. The authors stated that a CFI of .90 or better is considered a good fit and when taking all the fit indices together, determined that the model fit was "reasonably good" (Enochs et al., 2000, p. 197).

My analysis followed a similar process to the original authors. However, given the advancement in factor analyses and the existence of updated guidelines for model fit, the statistics reported are more thorough. A CFA was run using maximum likelihood extraction on the data from the MTEBI using SPSS AMOS (v. 29). Using a two-factor model with no corrections, a CFI of .874 was achieved. Other misfit statistics also indicated that this model was a poor fit (Table 19). The poor fit mirrored the first results of the initial researchers (Enochs et al., 2000). Following the same process, I then also used the misfit statistics to determine which items may have correlated errors. In the case of my sample data, on the PMTE scale, errors from items 11 and 16, 16 and 20, and 19 and 21 showed correlation leading to model misfit. Similarly, on the MTOE scale, AMOS reported errors from items 12 and 13, as well as 1 and 10 were correlated, leading to model misfit. I adjusted the model based on this statistical justification. There is not a strong theoretical rationale for these adjustments, but these items are on the same subscales, and I wanted to follow the process proposed by the original authors of this scale. Although I did not exactly replicate their analysis, I did use a similar set of steps and logic to adjust the factor model for the scale.

Once I adjusted these five pairs of items to correlate in the model, the model fit increased significantly. Fit statistics for the original and adjusted model are reported in Table 19, with detailed information in Appendix E For example, the CFI increased to .922. A CFI of greater than or equal to .95 is considered an excellent fit and therefore, this model may be characterized as an adequate, but not excellent fit based on this statistic (West et al., 2012). However, it is very

similar to the results in the initial publication. Unlike the initial publication, I calculated additional fit statistics, which indicated this model had a good or adequate fit. A GFI of greater than .90 is considered reasonable and the GFI for the adjusted model was .937 (Hu & Bentler, 1998). The RMSEA was .046, where less than .05 is considered excellent (MacCallum et al., 1996). A TLI of .95 or better demonstrates good fit (Kline, 2015). The TLI for this model was .910. Therefore, both CFI and TLI may not meet current standards of fit but were near acceptable levels. Finally, the SRMR was .053 and values less than .08 are considered acceptable (Hu & Bentler, 1999). Therefore, despite the lower CFI and TLI, the other fit statistics of the CFA of the MTEBI for this sample of participants showed adequate fit with an adjusted two factor model. The adjusted model is presented in Figure 4. Factor scores were also calculated for PMTE and MTOE to be used in later analyses and are presented in Table 22.

Table 19

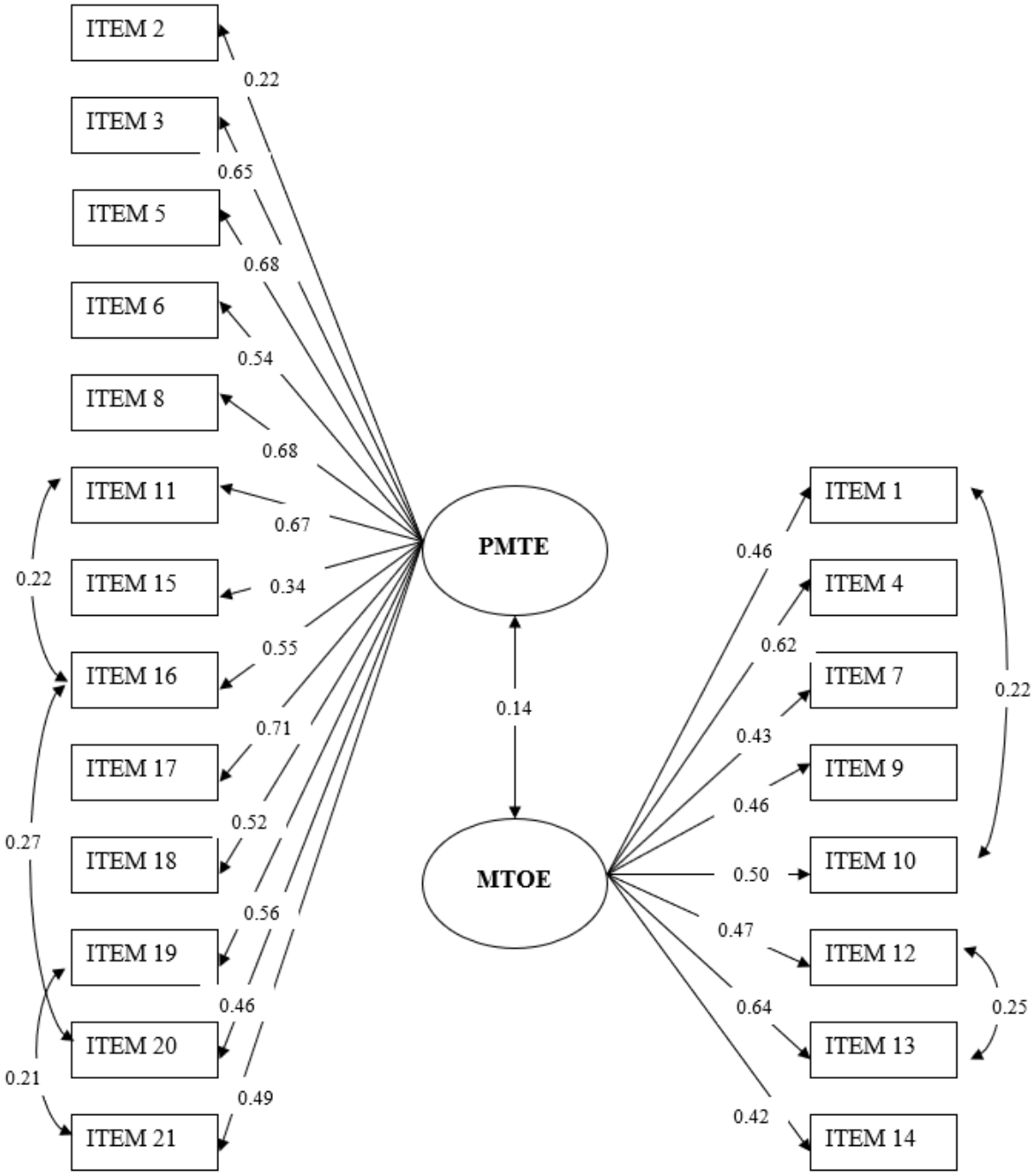
Goodness-of-Fit Indicators of Original and Adjusted Models of MTEBI (n=587)

Model	CMIN	*df*	CMIN/df	CFI	GFI	RMSEA	TLI	SRMR
Original	553.240	188	2.943**	.874	.915	.058	.860	.058
Adjusted	410.607	183	2.244**	.922	.937	.046	.910	.053

Note. CMIN = chi square, CMIN/df = chi square divided by degrees of freedom, CFI = comparative fit index, GFI = goodness of fit index, RMSEA = root mean square error of approximation, TLI = Tucker-Lewis index, SRMR = standardized root mean squared residual.
** $p < .001$

Figure 4

Adjusted Model MTEBI



Note. MTEBI = Math Teaching Efficacy Beliefs Instrument; PMTE = Personal Math Teaching Efficacy; MTOE = Math Teaching Outcome Efficacy

Reliability for MTEBI

I also explored reliability for the entire MTEBI and its two factors. Using SPSS, I generated Cronbach's alpha. For the entire 21-item MTEBI, Cronbach's alpha was α = .797. The PMTE subscale consisted of 13 items (α = .839) and the MTOE subscale consisted of eight items (α = .737). Values between .70 and .79 are considered acceptable and values between .80 and .89 are considered good (Sarmento & Costa, 2017). Therefore, the overall scale and MTOE subscale demonstrated acceptable reliability and the PMTE subscale demonstrated good reliability.

Comparing General and Special Educators

To determine if there were differences between general and special education teachers in the areas of Reported use of Practices, Confidence in Implementation, MTOE, and PMTE, I conducted a series of independent sample t-tests. This data met assumptions for the t-test in terms of the scale, sample size, and distribution. I assessed each measure for violations related to homogeneity of variance. The t-test is generally considered robust to violations of normality and homogeneity of variance (Posten, 1984), and I used the t-test results that took this violation into account when necessary. For Reported use of Practices, I used a factor score for the t-test. I ran additional t-tests for each EBP to determine for which EBPs the two groups differed (Table 20). For overall Reported use of Practices, there was no significant difference between general and special education teachers, $t(583)=.529$, $p=.597$. In terms of each individual EBP, the means for Reported Use differed slightly between the two groups (Table 10). The groups ranked the frequency of use of these practices in the same way from most to least used: Explicit Instruction, Mathematical Language, Mathematical Representations, Problem-Solving, Mnemonics, and Graphic Organizers. When examining differences between the two groups for each EBP individually, there were no significant differences for Explicit Instruction, Mathematical

Representation, Mnemonics, or Problem-Solving. General education teachers did use Mathematical Language more frequently than special education teachers, $t(584) = 3.228$, $p < .001$. However, special education teachers used Graphic Organizers more frequently, $t(585) = -2.053$, $p = .041$.

Table 20

Differences for Reported Use of Practices

Instructional Practice	*t*	*p*
Explicit Instruction *	1.262	.208
Mathematical Representations *	1.268	.206
Mathematical Language *	3.228	.001
Mnemonics	-.930	.353
Graphic Organizers	-2.053	.041
Problem-solving	.480	.632
Overall Reported Use of Practices*	.529	.597

* equal variances not assumed

The data for Confidence in Implementation did not violate assumptions related to homogeneity of variance. Although there was no overall difference for Reported use of Practices by teacher role, there was a significant difference in overall Confidence in Implementation, $t(585) = 2.14$, $p = .033$ (Table 21). General education teachers were significantly more confident in using math EBPs than special education teachers. The only EBP for which special education teachers felt more confident than general education teachers was Graphic Organizers, and that difference was non-significant, $t(585) = -.1.193$, $p = .233$. In comparing the groups on each EBP, general education teachers were significantly more confident on Explicit Instruction, $t(585) = 2.974$, $p = .003$; Mathematical Representations, $t(585) = 2.009$, $p = .045$; and Mathematical Language, $t(585) = 3.204$, $p = 001$.

Table 21

Differences for Confidence in Implementation

Instructional Practice	*t*	*p*
Explicit Instruction*	2.974	.003
Mathematical Representations	2.009	.045
Mathematical Language	3.204	.001
Mnemonics	.953	.341
Graphic Organizers	-1.193	.233
Problem-solving	.717	.474
Overall Confidence in Implementation	2.135	.033

* equal variances not assumed

I also compared scores on the entire MTEBI and both subscales. Results demonstrated that on the entire scale, special education teachers reported significantly more self-efficacy (lower scores), $t(585) = 5.195$, $p < .001$. For the two subscales of the MTEBI, factor scores were also used to run t-tests to determine if there were significant differences by teacher role. MTOE factor scores were used to compare general and special education teachers self-report of outcome expectancy, which is the degree to which teachers believe that teaching can impact student outcomes and performance. In this case, there was no significant difference between the two teacher roles, $t(585) = -.172$, $p = .864$. However, when I compared teachers on the results of the PMTE subscale of the MTEBI, special education teachers scored significantly higher than general education teachers, $t(585) = 6.948$, $p < .001$. Special education teachers rated themselves higher on questions related to overall teaching efficacy, which led to differences in scores on the entire measure.

Understanding the Relationships Between the Factors

A linear regression analysis using factor scores was run to determine if Confidence in Implementation, MTOE, and PMTE could adequately predict Reported Use of Practices. Descriptive statistics for all four factor scores are presented in Table 22. Teacher role (general vs. special education) and years of experience were both added as control variables. Previous research has been inconsistent in terms of how teacher role and years of experience might impact self-efficacy and use of instructional practices. To control the influence of these variables, I added them to the regression analysis. The results of this analysis showed that these five factors together explained 20.1% of the variance in Reported Use of Practice, F (5, 578) = 30.354, $p <$ .001 (Table 23). Although the overall model was significant, the regression coefficients indicated that Confidence in Implementation was a significant predictor, but that both MTOE and PMTE did not have a significant impact on Reported Use of Practices (Table 24). In terms of the control variables, teacher role was not a significant contributor to the model. However, years of experience was a significant predictor of Reported Use of Practices, showing an inverse relationship between these two factors. That is, the more years of experience a teacher had, the less likely they were to use these math EBPs. Overall, confidence and years of experience were statistically significant when holding other items constant.

Table 22

Descriptive Statistics for Factor Scores

Factor	General Education Teachers		Special Education Teachers		Total sample	
	M	*SD*	*M*	*SD*	*M*	*SD*
Reported use of Practices	.012	.770	-.031	.952	.000	.826
Confidence in Implementation	.050	.900	-.124	.900	.000	.900
MTOE	3.493	.375	2.500	.359	2.494	.370
PMTE	1.277	.114	1.182	.163	1.25	.137

Note. PMTE = Personal Mathematics Teaching Efficacy; MTOE = Math Teaching Outcome

Table 23

Regression Statistics for the Model

R	*Adjusted* R^2	*F*	*p*
.456	.201	30.354	<.001

Table 24

Regression Coefficients for Three Factors on Reported use of Practices

Variable	*B*	*β*	*SE*	*t*	*p*
Constant	-.140		.208	-.675	.500
MTOE (Factor Score)	.102	.046	.084	1.215	.225
PMTE (Factor Score)	.271	.045	.278	0.977	.329
Confidence in Implementation (Factor Score)	.388	.427	.040	9.817	<.001
Years of Experience	-.017	-.153	.004	-3.905	<.001
Teacher Role	.009	.005	.072	0.128	.898

Note. PMTE = Personal Mathematics Teaching Efficacy; MTOE = Math Teaching Outcome

To better understand these relationships between factors, I conducted a series of correlations using the Pearson *r* statistic. Like other statistical analyses completed, the data met

the basic assumptions of a Pearson *r*, especially regarding scale, sample size, and a linear relationship. Some of the data did have a non-normal distribution and some outliers, but Pearson *r* is insensitive to even extreme violations of normality (Havlicek et al., 1976). These results (Table 25) show that all four factors main demonstrated significant positive correlations with each other, but that these correlations were relatively small. Confidence in implementation and reported use of practices were moderately correlated (*r*=.433; Schober et al., 2018). Years of experience were negatively correlated to the use of practices, but not significantly so. It was positively correlated with both self-efficacy scales and confidence.

Table 25

Correlations Between Factors

Factors	Years of Experience	Reported Use of Practices	Personal Math Teaching Efficacy	Math Teaching Outcome Efficacy
Years of Experience	--	--	--	--
Reported Use of Practices	-.060	--	--	--
Personal Math Teaching Efficacy	.293**	.234**	--	--
Math Teaching Outcome Efficacy	.112**	.124**	.168**	--
Confidence	.177**	.433**	.508**	.184**

**p < .001

Summary of Findings

The results of the analysis showed that teachers do regularly use the math EBPs targeted in this study and that they feel a relatively high degree of confidence in doing so. Despite this, their self-reported math teaching efficacy was relatively low. Factor analyses showed that this research involved four distinct factors: Reported use of Practices, Confidence in Implementation, MTOE, and PMTE. Comparisons between general and special education teachers on these

factors showed no significant difference in their use of math EBPs or their MTOE. General education teachers did report more confidence in implementing EBPs, but special education teachers had better PMTE. A regression analysis demonstrated that only Confidence in Implementation and years of experience predicted Reported Use of Practices. Years of experience was positively correlated to self-efficacy and Confidence in Implementation but had an inverse relationship to Reported use of Practices.

CHAPTER 5: RECOMMENDATIONS

This study represents an important first step in understanding the use of math EBPs and their relationship to self-efficacy and confidence. In this final chapter, I present the results and discussion by research question, summarized the major findings, and discuss these findings in turn. I offered an updated visual representation of the conceptual framework for this study, and I make recommendations for policy, practice, and leadership. Finally, I outline the limitations of this study and my recommendations for future research.

Research Question 1

To what extent do middle school teachers report the use of math EBPs when providing instruction in inclusive settings? Does the reported use of math EBPs significantly differ between general and special education teachers?

Middle school teachers reported frequent use of each of the math EBPs explored in this study. Explicit instruction was the most often used practice across both groups of teachers. Mnemonics and graphic organizers had lower averages than other practices, meaning that they were used less frequently. There were differences in how frequently teachers reported using EBPs. However, results of this six-question scale did coalesce into a single factor during EFA, meaning that this scale does measure a single construct (i.e., reported use of math EBPs in inclusive classrooms). A t-test indicated that there was not a significant difference between the overall use of these practices by general or special education teachers. General education teachers did use Mathematical Language more frequently than special education teachers and special education teachers used Graphic Organizers more frequently.

Research Question 1 Discussion

This current study explored six EBPs: explicit instruction, multiple representations, problem-solving instruction, mathematical language, mnemonics, and graphic organizers (Powell et al., 2021). Special and general education laws and regulations require that EBPs be used when teaching, but teachers might not be aware of best practices (Brownell et al., 2020); might struggle to select the best EBPs for their situation (B. G. Cook et al., 2013); or might have trouble implementing and translating practices into their specific context (Johnson & McMaster, 2013).

The results of this study are encouraging, as these EBPs were frequently implemented by the survey respondents. This shows that the research-to-practice gap in this specific area may be closing, as teachers were aware of many of these practices and likely to use them. The EBPs examined in this current study are becoming more popular, as they are included in online databases (e.g., What Works Clearinghouse) and texts used in teacher preparation and professional development (Hattie's *Visible Learning* series). This may account for the frequent use of these EBPs in middle school inclusive math classrooms. However, this study did not examine how teachers implemented EBPs in their classrooms. Fidelity of use may still be an issue. This study also did not examine the context in which teachers used these EBPs and how they may differ in terms of student demographics, student need, or math content.

Despite the differences between how frequently teachers reported using each practice, reported use of these practices represented a single factor. Explicit instruction loaded significantly lower than other EBPs but was maintained to be comparable to Confidence in Implementation, where explicit instruction loaded much higher. Teachers often use explicit instruction in tandem with the other practices. In other research about teacher instructional

practices, researchers sometimes consider and examine a set of best practices as a single factor (Hinton et al., 2015; Rubie-Davies et al., 2012). For example, teachers' use of high leverage practices is frequently studied as a single construct (Schaller, 2020). However, some research regards each individual practice and does not discuss practices as a set (Elkstam et al., 2017; Herron, 2017). There is strong theoretical justification for considering these practices as a single set, as teachers often use them together. For example, a teacher uses explicit instruction to teach a problem-solving strategy that uses a graphic organizer. Or a mnemonic helps students remember mathematical language or vocabulary. Often, teachers use more than one of these strategies in a lesson. Therefore, it is not surprising that this set of EBPs represented a single factor or construct.

There were differences in how often teachers reported using each practice, with explicit instruction and mathematical language being used more frequently, and mnemonics and graphic organizers being used less frequently. The differences between frequencies may be due to several factors. For instance, teachers may not feel that strategies like mnemonics and graphic organizers are as effective for their students, and therefore may be less likely to use these strategies. It also may be that certain practices are useful across the entirety of the curriculum, although other practices may be used for specific skills and not used for other skills. For example, explicit instruction is a very general strategy and is appropriate when teaching almost any middle school math content (National Mathematics Advisory Panel, 2008) and in working with a variety of types of learners (Doabler et al., 2021; Root et al., 2018; Spooner et al., 2018). However, although mnemonics are a very powerful strategy, not all content may lend itself to the use of this strategy. Mnemonics are most useful when students need to remember a series of information and steps (Friedt, 2012). Therefore, this strategy may not be ideal when teaching all

mathematical skills (Cardone, 2013). Finally, since the survey only asked teachers a single question about their use of each EBP, the significant differences found between the EBPs may simply be due to instrumentation.

This current study indicates that both general and special education teachers working in middle school math inclusive environments use math EBPs in their teaching. There were no significant differences between the two groups in overall use of EBPs, showing that any underlying differences in self-efficacy or content knowledge do not result in a differential use of EBPs. In an inclusive environment, general and special education teachers are likely co-teaching (Rodgers & Weiss, 2019). Co-teaching is a teaching arrangement in which both a general and special education teacher are present in the classroom. When two individuals are present together in the classroom, they likely use similar strategies. Although other researchers have shown that general education teachers may be less likely to employ EBPs (Maccini & Gagnon, 2006) or that special educators may be underprepared to deliver math instruction in general education settings (Hinton et al., 2015), this study shows both groups employ math EBPs at the same frequency.

When looking at each EBP individually, general education teachers used mathematical language more frequently than special education teachers, which may be due to special education teachers' lack of content and pedagogical knowledge (Billingsley & Bettini, 2019; Hinton et al., 2015). Graphic organizers and mnemonics were the least used EBP for each group, but special educators reported higher use of these two EBPs than general education teachers. For mnemonics, the difference was small and not statistically significant. However, special education teachers were significantly more likely to use graphic organizers. Graphic organizers may be more frequently used as a part of specially designed instruction than as a part of regular

instruction, which may account for why special education teachers were more likely to use them (Allsopp et al., 2017; Dexter & Hughes, 2011).

Research Question 2

To what extent do middle school teachers report confidence in implementing math EBPs when providing instruction in inclusive settings? Does the reported confidence in implementing math EBPs significantly differ between general and special education teachers?

Teachers reported that they were overall quite confident in using the math EBPs presented, with the highest confidence being associated with using explicit instruction and the lowest confidence with using graphic organizers. When examined using EFA, this six-question scale about confidence also represented a single factor. Unlike the reported use of practices, there were significant differences between general and special education teachers in their confidence in using these practices. A t-test using factor scores revealed that general education teachers were overall more confident than special education teachers in the use of EBPs. Special education teachers reported higher confidence in Graphic Organizers, but not significantly so. General education teachers were significantly more confident in Explicit Instruction, $t(585) = 2.974$, $p = .003$, Mathematical Representations, $t(585) = 2.009$, $p = .045$, and Mathematical Language, $t(585) = 3.204$, $p = 001$.

Research Question 2 Discussion

Much like the scale for Reported Use, Confidence in Implementation represented a single construct, despite significant differences in how confident teachers felt about individual practices. Because the use of these related EBPs was expected to form a single factor, it follows that confidence about these EBPs would also form a single factor. Although research has shown

that confidence is context- and task-specific (Hajovsky et al., 2019; Tschannen-Moran & Woolfolk Hoy, 2001), using these EBPs are all related tasks. Teachers tend to have similar confidence about similar tasks (Gulistan et al., 2017).

Although general education and special education teachers used EBPs at the same frequencies, they differed in their confidence in implementing these practices. Previous research has suggested that a lack of math content knowledge and math preparation during special education pre-service teacher training may lead to lower confidence for teaching math (Hinton et al., 2015; Powell et al., 2015). Special education teacher preparation and professional development may not focus on EBPs for use in general education classrooms (Livers et al., 2020) and special educators may feel less confident in secondary math material (Rosas & Campbell, 2010). The results of the current study seem to mostly agree with previous research, as special education teachers scored lower on the overall confidence scale and specifically in their use of explicit instruction, mathematical representations, and mathematical language. Special education teachers did score higher in the use of graphic organizers, which in the content of mathematics, are often used as a part of intervention, remediation, or specially designed instruction, rather than as a part of general education classroom instruction (Root et al., 2018; Maccini & Hughes, 2000; Strickland & Maccini, 2012). Therefore, special education teachers, who are more likely to be providing instruction above and beyond regular classroom instruction, are more likely to be familiar with the use of graphic organizers in mathematics. Previous research has demonstrated that special educator confidence in instructional practices can be improved through professional development (Harris et al., 2014; van Garderen et al., 2018). It is worth noting that although special education teachers felt less confident in their math instruction, which did not significantly impact their use of math EBPs. This may mean that even when

special educators perceive themselves as less confident than their general education counterparts, it does not prevent them from using EBPs.

Research Question 3

What is the perceived math teaching self-efficacy of middle school teachers? Does the perceived math teaching self-efficacy significantly differ between general and special education teachers?

I used the MTEBI to measure overall math teaching self-efficacy for the entire sample, as well as teacher's outcome efficacy and teaching efficacy. Mean scores showed that middle school math teachers felt overall poor in their math teaching self-efficacy. Teachers' overall teaching efficacy, which examines a teacher's belief in their ability to teach effectively, was slightly better than scores for the entire measure. However, teachers' outcome expectations, which is a teacher's belief that effective teaching can influence the outcome, or student learning (Enochs et al., 2000) was much worse than the overall scores. These results show that teachers have a higher belief in their ability to impact student learning than their math teaching efficacy.

To compare general education and special education teachers, I compared scores from each of the two subscales. There was no significant difference regarding outcome efficacy, showing that both groups have similar beliefs about their ability to influence student learning. However, special education teachers rated themselves significantly better on the teaching efficacy subscale, indicating that they have stronger positive beliefs about their overall teaching efficacy than general education teachers. This was a surprising finding given that they were less confident in using EBPs. It may be that special education teachers use other instructional methods that they believe are effective.

Research Question 3 Discussion

One of the most surprising and unexpected results of this study was the results of the MTEBI analysis, examining teacher beliefs regarding their own efficacy in teaching and their effectiveness as educators. Although the average scores for reported use of practices and confidence in implementation were relatively high, the scores on the MTEBI demonstrated that both general and special education teachers do not have strong beliefs in their efficacy as teachers. Overall scores and subscale scores hovered around between a three and a four (on a 5-point scale), which correlated to the descriptors Uncertain and Strongly Disagree on the survey. Previous research using this scale showed much higher scores for self-efficacy, particularly for experienced teachers (Segarra & Julià, 2020). More recent research has suggested that teaching self-efficacy lowered during the COVID-19 global pandemic (Pressley & Ha, 2021) and that lack of opportunity to develop self-efficacy during this time may impact self-efficacy in the future (Symes et al., 2022). There are several ways in which the pandemic may have impacted self-efficacy. Increases in teacher self-efficacy have been associated with professional development, mentorship, coaching, and support (Floyd & Rice, 2009; Y. Lee et al., 2011). Virtual learning, social distancing guidelines, and a focus on other priorities may have led to a decrease in the activities that support teacher self-efficacy. Finally, a lack of student achievement during the pandemic also likely played a large role in decreasing the self-efficacy of teachers.

During the COVID-19 pandemic, teachers found themselves facing unprecedented challenges. Many teachers delivered instruction in a virtual or hybrid format for the first time ever (National Center for Education Statistics, 2022c). Teachers felt overwhelmed and less competent in their teaching during this time (Narayanan & Ordynans, 2022). Although both teaching and the world at-large had changed, teachers were still responsible for ensuring student

learning and promoting student achievement. Unfortunately, test scores in mathematics (and other subjects as well) fell dramatically during and immediately following the pandemic (Schneider, 2022). Teachers saw that their hard work had not resulted in student learning. Because self-efficacy is informed by our experiences and a lack of success can lessen feelings of self-efficacy (Bandura, 1986), teachers' struggles and decreased student achievement during the pandemic negatively influenced teacher's self-efficacy (Narayanan & Ordynans, 2022).

Special education teachers reported overall higher math teaching self-efficacy, as measured on the MTEBI, when compared to general education teachers. The two groups did not differ on the outcome expectancy scale, which is the degree to which teachers believe that teaching can impact student outcomes and performance. Both general and special education teachers reported low outcome efficacy, meaning that they do not believe that their teaching strongly impacts student achievement. Yet, they reported differences in their self-reported teaching efficacy. The findings contrasted those related to confidence in implementing EBPs, in that special education teachers reported higher teaching efficacy than general education teachers. Special education teachers had higher overall teaching efficacy, but lower confidence in implementing specific EBPs. General education teachers held fewer positive beliefs about their own teaching practices. These findings contrast previous studies that show that special education teachers have lower self-efficacy for teaching math (Flores et al., 2010; Floyd & Rice, 2009; Hinton et al., 2015).

Research Question 4

What is the relationship between self-reported use of math EBPs, reported confidence in implementation, and perceptions of math teaching self-efficacy?

This current study was based on the hypothesis that confidence and self-efficacy might have a strong bearing on the use of EBPs in math classrooms. A regression analysis showed that confidence, along with self-reported teaching efficacy and outcome efficacy, did accurately predict reported use of practice. Further analysis showed that only confidence significantly influenced the use of EBPs. Self-reported math teaching efficacy did not significantly predict the use of EBPs. Years of experience also negatively predicted use of EBPs but was positively correlated with self-efficacy and confidence.

Research Question 4 Discussion

Previous research has shown that self-efficacy is positively correlated with the use of innovative instructional techniques (Shoulders & Krei, 2015); special education high leverage practices (Schaller, 2020); and EBPs for reading (Forston, 2018). In the current study, self-efficacy did not significantly predict or relate to the use of math EBPs. The overall low scores of math teaching self-efficacy may be partly responsible for this lack of relationship. Despite extensive research on the role of self-efficacy in teaching, this study demonstrated that teachers do not need to feel efficacious to implement EBPs.

Although overall self-efficacy did not predict the use of math EBPs, confidence in implementing these EBPs did. Confidence in implementing math EBPs is more closely related to the use of those specific EBPs than overall feelings of math teaching self-efficacy. This confirms the idea that confidence for a specific practice is related to using a specific practice. Confidence and practice likely inform each other, with teachers who are confident in a practice being more

likely to use it and using a practice increasing confidence. Unfortunately, confidence and practice had little bearing on self-efficacy.

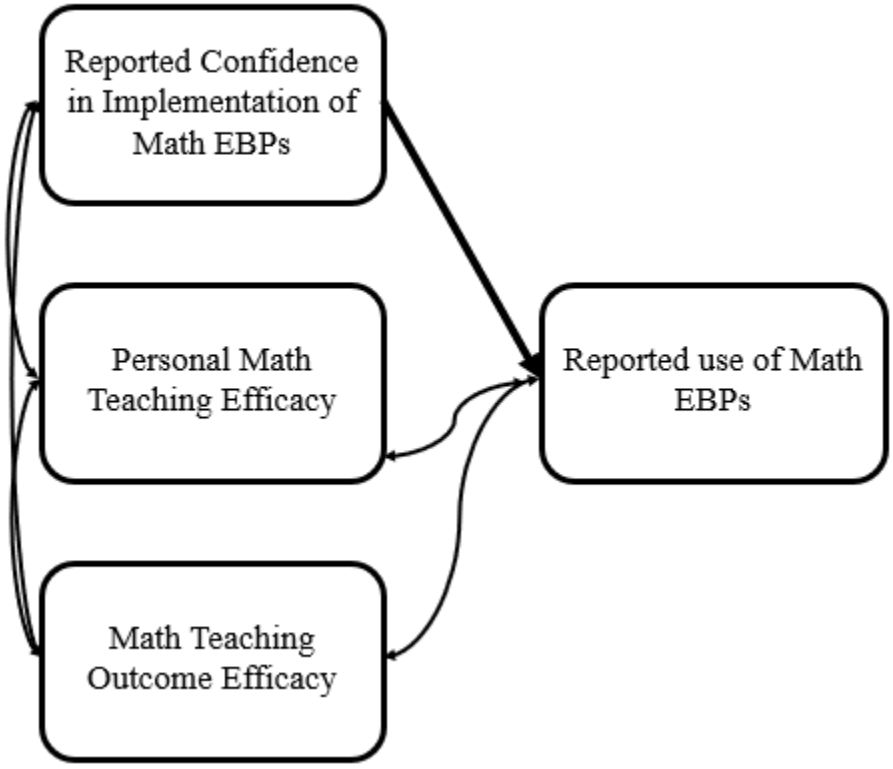
I used years of experience as a control variable in this regression analysis. The correlations showed that experienced teachers were more confident and had higher self-efficacy, they were less likely to use the EBPs included in the present study. This is consistent with some previous research that demonstrated that self-efficacy increases with experience (Penrose et al., 2007), but that use of effective instructional practices may decrease with experience (Ünal & Ünal, 2012). Although veteran teachers have years of experience to feel efficacious in their teaching, they may not be using current EBPs as they were trained to use a different set of instructional practices.

Revisiting the Conceptual Framework

In this study, I theorized that confidence in implementation for each individual practice and math teaching self-efficacy would have a strong positive relationship to reported use of math EBPs (Chapter 1, Figure 1) as teachers are more likely to use specific instructional practices when they feel effective, confident, or skilled in using them (Hadley & Dorward, 2011). Results from this study did not support this framework. A revised visual framework is presented in Figure 5. Although PMTE and MTOE correlated with each other, confidence, and reported use of practices (indicated by curved lines), only confidence predicted use of practices (bold straight line).

Figure 5

Revised Conceptual Framework



Note. EBP = Evidence-Based Practice

Implications for Policy and Practice, and Leadership

This study was a first step in understanding the use of math EBPs and its relationship to confidence and self-efficacy, but the findings have implications for middle school math education. This section discussed implications for policy, including policies in place for teacher preparation. I also addressed recommendations for teachers who wish to improve their teaching practice. Finally, I offered suggestions for school leaders based on the findings of this study.

Policy Recommendations

The findings of this study point to two policy recommendations, the first related to funding and the second related to teacher preparation. The findings were encouraging in terms of the state of classroom practice. Most participants frequently used math EBPs, but they did not use all EBPs at the same frequency, and veteran teachers were less likely to use EBPs These findings represent a good estimate of the use of practices among middle school math teachers due to the sample size and representativeness of the sample. To continue to close the research-to-practice gap in this area, research funding should be focused on action research, studies, and practitioner materials (articles, websites, professional development, etc.) that can be implemented in classrooms. For example, researchers often conduct math intervention research, and it can be difficult for teachers to translate into practice (B. G. Cook & Cook, 2016). Research that is conducted more authentically by teachers in classrooms may be more impactful in continuing to understand practices that benefit a diverse group of learners and to making those practices accessible to teachers (Huillet et al., 2011; Kyei-Blankson, 2014). Action research allows teachers to act as researchers and work collaboratively to conduct research in their own classrooms (P. Wright, 2021). Action research in secondary mathematics has been shown to help better prepare pre-service teachers (Mostofo & Zambo, 2015); increase critical reflection by teachers (P. Wright, 2021); and promote significant change in teaching practices that impact student achievement (Beckett et al., 2011).

Collaborative action research has been particularly effective for veteran or more experienced teachers (Buckley-Marudas et al., 2021). As opposed to traditional professional development in K-12 schools, veteran teachers benefit from the mix of freedom and focus that action research provides (Buckley-Marudas et al., 2021). Action research can create meaningful

change in practice for veteran teachers (Manfra, 2019) and veteran math teachers (Edwards & Hensien, 1999). Also, the work that results in practice focused articles and practitioner friendly publications should also be properly funded to ensure that teachers at all stages of their career continue to have information about EBPs (Hott et al., 2018).

One of the research findings was that special education teachers had lower confidence in implementing math EBPs regardless of their classroom practice. This result echoed earlier findings (Flores et al., 2010; Floyd & Rice, 2009; Hinton et al., 2015). I did not examine the role of math preparation during preservice instruction in teacher confidence or use of practices. Previous research has established the lack of math preparation for special education teachers can lead to a lack of content knowledge (Smith-Moyler, 2020) and an over-reliance on procedural teaching (Hinton et al., 2015), both of which are needed to use effective instructional practices (Maccini & Gagnon, 2006). Math content and pedagogy instruction can increase teacher's math content knowledge, pedagogical practice, and confidence in teaching mathematics (Cantimer et al., 2020). Despite direct findings related to special education teacher preparation in the current study, previous research has shown that preservice teacher preparation can influence teacher confidence and use of effective instructional practices. To ensure that special education teachers feel confident in teaching secondary math, a policy change around teacher preparation is necessary to include required coursework in both secondary math methods and content (Powell et al., 2015). This requirement would help teachers feel better prepared to deliver high quality specially designed instruction in inclusive settings and more confident in their ability to do so.

Practice Recommendations

The findings from the current study support three primary recommendations for practice. Teachers had low math teaching self-efficacy even though they frequently used EBPs. It is

imperative that teachers develop self-efficacy in their teaching practices to support their instruction (Rubie-Davies et al., 2012; Shoulders & Krei, 2015); positively affect student outcomes (Gulistan et al., 2017); and prevent teacher burn out (Cansoy et al., 2017). One way that teachers can increase their self-efficacy is to monitor their use of EBPs and use data to determine how these EBPs are affecting student achievement. By making a direct connection between their instruction and student achievement, teachers may feel empowered by their use of EBPs and develop a better sense of self-efficacy. Teachers can and should monitor their use of EBPs, not only in terms of frequency, but in terms of fidelity. They should also use data-based decision-making to help determine which practices are beneficial to their students. In this way, they are self-evaluating the fidelity of their practices. This creates a reflective cycle of teaching, evaluating the learning, adapting instruction, evaluating the learning, and so forth. This cycle not only helps promote academic success for students, but helps teachers see how their instruction directly impacts students, which may increase their math teaching self-efficacy. When teachers understand how and why to use EBPs, this should increase the use of these practices, the effectiveness of these practices, and student outcomes.

Veteran teachers had higher self-efficacy and confidence than less experienced teachers. Although less experienced teachers may benefit from the process outlined above, this current study demonstrates that self-efficacy is not the main concern for veteran teachers. More experienced teachers had higher self-efficacy, but lower use of math EBPs. More experienced teachers should focus on increasing their use of current math EBPs in their classrooms. Veteran teachers often experience change fatigue, as they have been asked to change practices numerous times during their careers (Orlando, 2014). This can make some experienced teachers resistant to change, especially in terms of instructional practices (Snyder, 2017). However, strategies such as

professional learning communities (Powers et al., 2016); reflective coaching (Nolan & Hillkirk, 1991); peer coaching (Arnau et al., 2004); and administrative feedback (Leggett & Smith, 2019) have all been demonstrated effective in supporting veteran teachers through change.

Special education teachers had lower confidence in implementing EBPs. Although their overall self-reported math teaching efficacy was higher than general education teachers, it was still quite low. Special education teachers may lack the content knowledge or content-specific pedagogy to feel effective in their use of EBPs. Special education teachers can increase their confidence and self-efficacy by seeking out up-to-date and relevant professional development for their content (Tassell et al., 2019; Tschannen-Moran & McMaster, 2009). For example, as a veteran special education teacher, I began co-teaching seventh-grade math, which was an entirely new content area for me. I found myself struggling to teach fraction concepts and operations to students, as I relied too heavily on procedural rather than conceptual understandings. I also struggled with using and teaching students to use mathematical language. I found a great resource, *Number Talks: Fractions, Decimals, and Percentages* by Parrish and Dominick (2016). The book provided pedagogical strategies for using mathematical language related to the content of fractions, decimals, and percentages but also thoroughly introduced each new skill (for example, adding fractions) using conceptual understandings and visuals. By seeking out professional development in the form of this book, I was able to address weaknesses I had in both content and pedagogy. By seeking out professional development in the form of college courses, continuing education, books, videos, conferences, professional learning communities, and so forth, special education teachers can increase their confidence and self-efficacy for teaching math.

Leadership Recommendations

School leaders play an important role in supporting teachers and ensuring that best practices are utilized appropriately in classrooms (Day et al., 2016; Thoonen, Sleegers, Peetsma, & Oort, 2011). The current study demonstrated that these specific EBPs are used frequently, but that some are used less frequently than others. Also, veteran teachers were less likely to use EBPs. School leaders can help ensure that the use of EBPs continues by all teachers and that the use of less-used practices is increased through professional development, training, and coaching opportunities focused on math EBPs (Grissom et al., 2013). School leaders can also address issues around fidelity of implementation, helping to ensure that teachers are not only using math EBPs, but using them appropriately and effectively.

Research demonstrates that school leaders can directly impact the use of EBPs through coaching (Kretlow & Bartholomew, 2010). Supervisory coaching by school leaders after professional development is an effective way that they can directly affect instructional delivery by teachers (Kretlow & Bartholomew, 2010), even for veteran teachers (Leggett & Smith, 2019). School leaders can also employ others as coaches (team leaders, skilled peers, instructional specialists) who can provide feedback to teachers on their use of newly adopted EBPs to ultimately improve the frequency and fidelity of implementation (Kretlow et al., 2012).

Professional learning communities (PLCs) are another structure that administrators can support and provide to teachers to help increase the use of effective instructional practices. Although PLCs can serve several purposes, increasing student achievement through changing teacher practices is at the heart of the goal of PLCs (Vescio et al., 2008). PLCs give teachers the structure to collaborate, communicate, share teaching strategies, conduct peer observations, and engage in other collaborative activities that can affect how teachers teach in the classroom

(Teague & Anfara, 2012). PLCs have been identified as a way to engage veteran teachers and get buy-in towards instructional change (Powers et al., 2016). School leaders can support PLCs by arranging schedules to allow time for this important work and by supporting a collaborative culture of change in their buildings (Wells & Feun, 2013).

The current study did not find that self-efficacy predicted the use of EBPs; there were small, but significant correlations between these two factors. Self-efficacy is also essential to teacher quality in other ways. Previous research has established a strong connection between teacher self-efficacy and burn out (Cansoy et al., 2017). Teachers who do not feel that they are effective and impactful in their jobs may be more likely to leave the profession (Klassen & Chiu, 2011). Special education continues to be a high need area in many locations across the United States, with districts having consistent difficulty filling special education teaching positions (Billingsley & Bettini, 2019). The same is also true for secondary mathematics (Sutcher et al., 2016). In the current study, both special and general education middle school math teachers demonstrated overall low self-efficacy for teaching mathematics. School leadership can positively affect teacher self-efficacy, which may decrease teacher turnover. Bandura (1977) proposed that there are four main sources of information that informs our self-efficacy beliefs: verbal persuasion, affective states, vicarious experiences, and mastery experiences. School leaders can help promote self-efficacy among teachers in each of these four ways. For example, school leaders can use verbal persuasion by providing informative feedback to teachers, which can increase teacher self-efficacy and job satisfaction (Hipp, 1997). Feedback can coaching combine verbal persuasion and mastery experiences. When teachers use EBPs, experience success, and get positive coaching, this will increase their use of EBPs and can, in turn, increase teacher self-efficacy as teachers feel more effective at their jobs. Establishing PLCs can give

teachers a structure to examine student data for understanding and increasing teacher self-efficacy. This collaborative structure contributes to positive affective states and can allow teachers to have vicarious experiences when they discuss instructional practices with their colleagues.

Promoting teacher autonomy can also lead to increased teaching self-efficacy and job satisfaction (Skaalvik & Skaalvik, 2010). School leaders can promote teacher autonomy by decreasing non-teaching workloads (Van Droogenbroeck et al., 2014), providing teacher support, and allowing teachers to be a part of policy making decisions (Skaalvik & Skaalvick, 2009). Allowing teachers to set their own professional goals and create their own professional development plans can also increase their sense of autonomy (Hyslop-Magison & Sears, 2010; Worth & Van den Brande, 2020). This practice is also consistent with coaching practices discussed above (Devine et al., 2013).

Limitations and Recommendations for Future Research

This exploratory study was an important first step in understanding the use of math EBPs in middle school inclusive classrooms and the factors that might influence the use of those practices, but limitations should be noted. First, reported use of practices was examined through self-report. Although self-report is a common feature in educational research, self-report is vulnerable to response bias and social desirability bias. Findings were also limited to frequency data and did not assess other facets of instructional practice, including how teachers select EBPs and how they are implemented in classrooms. The use of EBPs could be more fully assessed through teacher observation or teacher interview. Teacher observation and structured interview would allow researchers to explore not only the frequency of the use of each of these math EBPs, but also more nuanced information including whether EBPs are implemented with fidelity or, if

they are used more frequently when teaching certain contents or, if non-EBPs are used as well. Findings also demonstrated that some EBPs are used more frequently than others. Additional research using teacher survey, observations, and interviews could explore the frequency of these specific lower use practices, including teacher decision making for using these strategies, the availability of these strategies in published curricula, and ease of implementation to better understand why some practices are used more frequently than others.

Second, although frequency of use of EBPs was explored, I did not examine or explore student outcomes in any way. I looked only at self-efficacy and not actual efficacy of teachers. Previous research has demonstrated the effectiveness of EBPs. Findings indicated these EBPs are being used in classrooms. Future research should examine not only the frequency of use of EBPs, their fidelity and appropriateness of use, but also their impact on student achievement.

Third, each variable was compared based only on teacher role (general vs. special educator). It is unclear whether other factors may influence implementation of EBPs, confidence in implementation and math teaching self-efficacy. For example, a follow-up study could look at whether years of experience, licensure type, or math coursework in college were associated with frequent use of each of the math EBPs. Hadley and Dorward (2011) found that anxiety about teaching math decreases with years of experience and that lower math teaching anxiety led to use of best practices in math classrooms, yet other studies have shown no relationship between years of experience and effective instructional practices (Sartawi & Alghazo, 2006). Math teaching self-efficacy was also low in the overall sample, but self-efficacy can also be influenced by education (Brown, 2012; Bursal & Paznokas, 2010) or years of experience (Klassen & Chiu, 2011). Future studies might examine other factors that may influence instructional practice,

including collective efficacy, infrastructure, curriculum, building expectations and culture, or school leadership.

Fourth, teachers were recruited on social media through professional online communities and existing networks, indicating that these individuals were already seeking additional information and support for their teaching. The sample of teachers on social media might differ significantly from the overall population of teachers, which would limit the generalizability of this study. This study should be replicated with teachers who are recruited in a different way.

Fifth, the scale for Reported Use of Practices might not have been sufficiently nuanced to properly measure this construct. The scale only included five possible response options, with the highest being "Daily/Almost Daily." Given that so many respondents marked EBPs under this frequency, expanding this point in the scale could provide additional information. For example, if a teacher teaches five classes in 1 day and uses an EBP in only one class, that is different using that EBP in all five classes. Future research should use a scale with additional gradations to assess frequency of use more accurately. Additionally, there are no established norms for how often each of these practices should be used. Therefore, although findings seem encouraging about how often teachers use EBPs, more research is needed to develop and determine these norms.

Sixth, there were instrumentation concerns with the MTEBI. First, the scores on the MTEBI were significantly lower with this sample than with previous in-service teacher samples. This indicates that this tool might not be the best for this group of teachers or that changes in self-efficacy of teachers overall may necessitate changes to how we conceptualize and measure teaching self-efficacy. Second, the CFA on the MTEBI suggested that the two-factor model of the MTEBI might not be accurate or adequate. Although the overall fit indices demonstrated fit

to the two-factor model, this required significant adjustments to the model based on misfit statistics. Also, some fit statistics (GFI and TLI) did not meet current norms. The MTEBI is likely due for revision and re-evaluation.

This study also points to the need for additional research in math teaching self-efficacy post COVID-19. The results of this survey indicated that teachers' overall math teaching efficacy was poor, despite that they reported using best practices and feel confident in doing so. One important question is whether there have been actual changes to teachers' efficacy or if a revision of the MTEBI for current in-service teachers might more accurately measure math teaching efficacy. For example, during cognitive interviews conducted while participants filled out the entire survey instrument, including the MTEBI, participants noted that student success or failure might be due to several factors outside of the teachers' control. Even very competent teachers might feel uncertain about their ability to make a difference given the complexities of current middle school teaching. Additional research should explore that notion.

Summary

The use of EBPs when teaching SWD in inclusive settings has been shown to increase student achievement. I examined six math EBPs for middle school students and found that each of these practices was being frequently used by survey participants, although explicit instruction was used the most frequently, and graphic organizers and mnemonics were used the least frequently. Special education teachers use math EBPs at the same rate as general education teachers but tend to feel less confident in implementing these practices. Additionally, teachers' overall math teaching self-efficacy was low and teachers tended to believe that despite the quality of their teaching, their ability to affect student achievement is uncertain. Special education teachers had higher self-efficacy than general education teachers.

This study was a first step in understanding these math practices and additional studies could add to our understanding of how and why teachers use effective instructional strategies. This research demonstrates that teachers are using best practices, but continue to need the support of their leadership, training, and access to practitioner friendly articles to continue and expand their use of EBPs. This research also showed that special education teachers continue to feel under confident when using math EBPs, pointing to the need for secondary math teaching courses in special education teacher programming and support to increase their teaching self-efficacy.

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APPENDIX A

Survey Instrument

Consent Form

Dear Participant,

You are invited to participate in this research study about the use of math evidence-based practices for students with disabilities in middle school math classrooms. Participants for this survey should have worked in the last year as a general or special education teacher in a middle school (grades 5-8) math classroom and have taught students with disabilities in a general education math setting. Understanding which practices teachers use and factors that may influence the use of those practices is the focus of this study.

Participation in this survey involves completion of an online survey containing 43 items. The survey is designed to take 10-15 minutes to complete.

There are no anticipated risks to participation and your responses will be anonymous. You may drop out or revoke consent at any time by contacting Heather Kennedy at hmkennedy01@wm.edu. There are no penalties or consequences of any kind if you decide that you do not want to participate.

The primary benefit of participation is contributing to research, helping researchers, school leaders, and teachers better understand the current classroom practices in middle school mathematics. You will be presented with an opportunity at the end of the survey to share your email address to be entered into a raffle to win a $25 gift certificate to Target for participating. There will be 10 winners chosen.

If you have questions or concerns during the time of your participation in this study, or after its completion or you would like to receive a copy of the final aggregate results of this study, please contact the principal investigator, Heather Kennedy at hmkennedy01@wm.edu or her supervising professor, Dr. Heartley Huber at hbhuber@wm.edu.

Yes, I agree.
No, I do not agree. You may exit the window now.

Demographics

1. What is your primary current teaching role?

General Education Teacher
Special Education Teacher
Other:

2. Which of these grades do you currently teach?

5th
6th
7th
8th
Other

3. Have you taught math to students with disabilities in a general education classroom setting in the past year?

Yes
No

4. In what state were you working when you taught math to students with disabilities in a general education classroom setting?

5. Which of the options best describes your teaching license(s)? You can select more than one.

Special Education K-6
Special Education 6-12
Special Education K-12
General Education Generalist
General Education Content Specific
Emergency/Provisional License
No teaching License

Reported Use of Practices (Questions 6-11)

The following questions ask about your use of some instructional practices in inclusive math classrooms. When providing instruction to students with disabilities in general education classrooms, how often do you use each of the following practices?

	Never	A few times in a school year	One to three times in a month	Weekly	Daily/ Almost Daily
Explicit instruction involves direct, systematic instruction that begins with teacher modeling of strategies, moves to guided practice, and ends with independent practice where students receive feedback on their performance.					
Multiple representations involves using different representations of mathematical concepts and procedures, including physical, visual, and symbolic representations. This includes the use of pictures, manipulatives (including virtual manipulatives), and concrete-representational-abstract teaching sequences.					
Mathematical language involves direct instruction in math vocabulary and engaging in "math talk" or dialogue in the classroom.					
Mnemonics connect visual or phonetic clues to information that needs to be remembered. It can include first letter mnemonics (PEMDAS for order of operations), songs, rhymes, or visuals specifically designed to help students remember information or procedures.					
Graphic organizers are visual displays that help students understand the relationships between concepts. The use of graphic organizers involves direct instruction on how to use them.					

Problem-solving instruction involves thinking strategies for solving word problems, including schema instruction (where students are taught problem types). Often real world problems, application of skills, and higher level thinking are involved.					

Confidence in Implementation (Questions 12-17)

The following questions ask about your confidence in implementing instructional practices in inclusive math classrooms. How confident do you feel about implementing each of these instructional strategies for students with disabilities in inclusive general education classrooms?

	Not at all	A little confident	Somewhat confident	Quite confident	Extremely confident
Explicit instruction involves direct, systematic instruction that begins with teacher modeling of strategies, moves to guided practice, and ends with independent practice where students receive feedback on their performance.					
Multiple representations involves using different representations of mathematical concepts and procedures, including physical, visual, and symbolic representations. This includes the use of pictures, manipulatives (including virtual manipulatives), and concrete-representational-abstract teaching sequences.					
Mathematical language involves direct instruction in math vocabulary and engaging in "math talk" or dialogue in the classroom.					
Mnemonics connect visual or phonetic clues to information that needs to be remembered. It can include first letter mnemonics					

(PEMDAS for order of operations), songs, rhymes, or visuals specifically designed to help students remember information or procedures.					
Graphic organizers are visual displays that help students understand the relationships between concepts. The use of graphic organizers involves direct instruction on how to use them.					
Problem-solving instruction involves thinking strategies for solving word problems, including schema instruction (where students are taught problem types). Often real world problems, application of skills, and higher level thinking are involved.					

MTEBI (Questions 18-38)

This section of the survey asks questions related to math teaching self-efficacy. Please indicate the degree to which you agree or disagree with each statement below.
1--Strongly agree
2—Agree
3—Uncertain
4—Disagree
5—Strongly disagree

16. When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.

17. I will continually find better ways to teach mathematics.

18. Even if I try very hard, I will not teach mathematics as well as I will most subjects.

19. When the mathematics grades of students improve, it is often due to their teachers having found a more effective teaching approach.

20. I know how to teach mathematics concepts effectively.

21. I am not very effective in monitoring mathematics activities.

22. If students are underachieving in mathematics, it is likely due to ineffective mathematics teaching.

23. I generally teach mathematics ineffectively.
24. The inadequacy of a student's background can be overcome by good teaching.
25. When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.
26. I understand mathematics concepts well enough to be effective in teaching mathematics.
27. The teacher is generally responsible for the achievement of students in mathematics.
28. Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.
29. If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.
30. I find it difficult to use manipulatives to explain to students why mathematics works.
31. I am typically able to answer students' questions.
32. I wonder if I have the necessary skills to teach mathematics.
33. Given a choice, I will not invite the principal to evaluate my mathematics teaching.
34. When a student has difficulty understanding a mathematics concept, I am usually at a loss as to how to help the student understand it better.
35. When teaching mathematics, I usually welcome student questions.
36. I do not know what to do to turn students on to mathematics.

Additional Demographics (Questions 39-44)

37. At the end of this school year, how many years have you been teaching?
38. At the end of this school year, how many years have you been teaching middle school mathematics?
39. At the end of this school year, how many years have you been teaching students with disabilities?
40. What is your highest level of education?

41. Which best describes the type of school you teach at?

Public

Private

42. Please identify your gender:

Male
Female
Non-binary/Transgender
Prefer not to answer

43. Which of the following best describes your college math coursework?

I have a degree in mathematics (Masters, Bachelors, Major).
I completed a minor in mathematics.
I completed some coursework in mathematics in college.
I completed minimal coursework in mathematics in college.
I completed no coursework in mathematics in college.

APPENDIX B

Email Accompanying Survey

Dear colleagues,

My name is Heather Kennedy, and I am a doctoral student at William &Mary completing research for my dissertation. My research focuses on the use of math evidence-based practices in middle school inclusive classroom settings and how the use of these practices might be related to confidence and self-efficacy. I am looking for general and special education teachers who teach math to middle school (grades 5-8) students in general education inclusive settings.

I am asking these teachers to consider participating in a brief online survey (10-15 minutes) asking about the use of specific math practices and math teaching self-efficacy. At the end of the survey, teachers have the option of entering their name in a drawing for one of ten $25 Target gift cards.

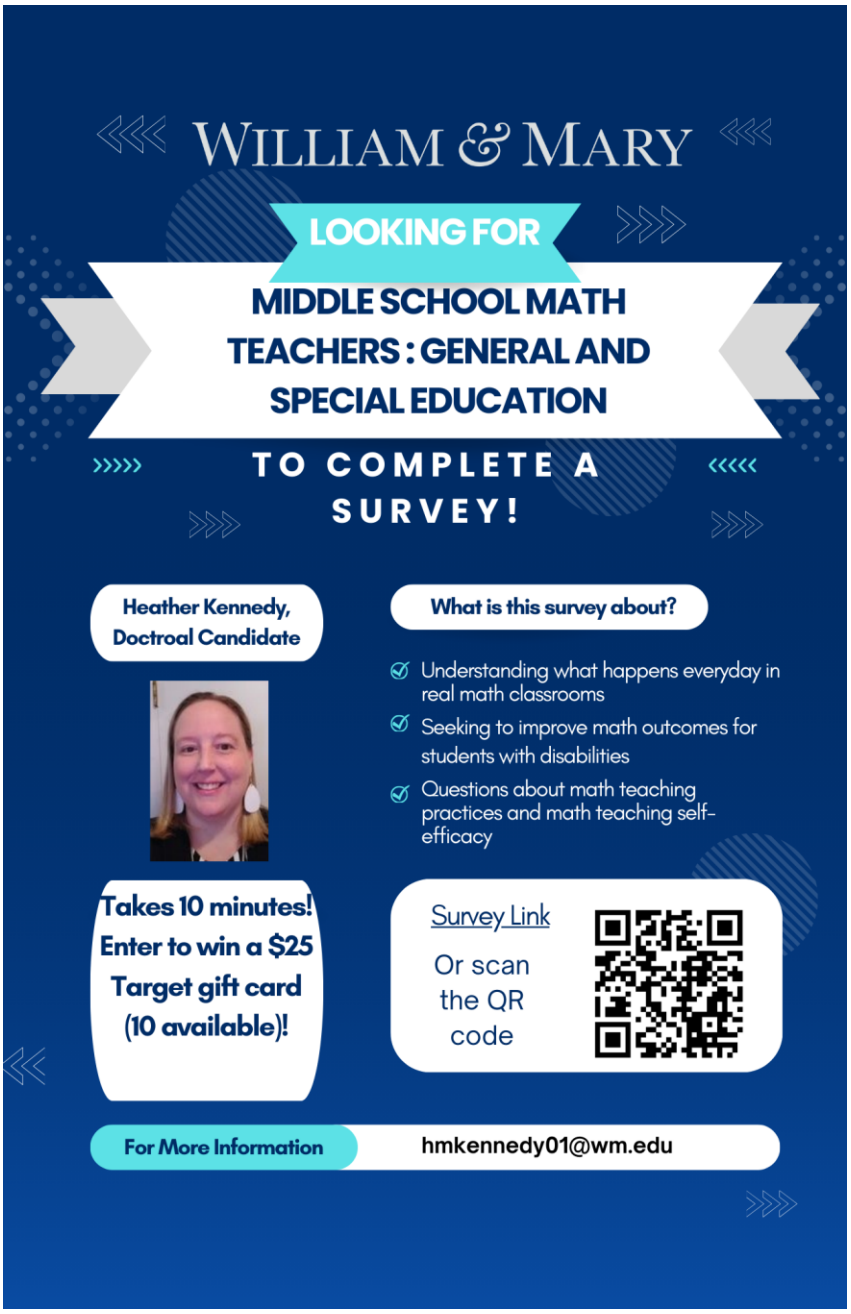
Here is the link to the survey in order for you to participate:

Insert link here.

This research is important to understanding what is actually happening in classrooms and how we can improve outcomes for students with disabilities. If you have any questions or concerns, please reach out to Heather Kennedy at hmkennedy01@wm.edu or my advisor for this research project, Heartley Huber at hbhuber@wm.edu.

APPENDIX C

Social Media Posts




COMPLETE A 10 MINUTE SURVEY! WIN A $25 GIFT CARD!
MIDDLE SCHOOL MATH TEACHERS: GENERAL AND SPECIAL EDUCATION
WILLIAM & MARY
QUESTIONS ABOUT MATH TEACHING PRACTICES AND SELF EFFICACY
Follow the QR code or the link below the post.
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COMPLETE A 10 MINUTE SURVEY! WIN A $25 GIFT CARD! LOOKING FOR:
• Middle School Math
• General Education Teachers
• Special Education Teachers
Complete a short survey about math teaching practices and self-efficacy. Help researchers understand what it is like in real math classrooms.
Use this QR code or click on the link attached to this post.

APPENDIX D

Reported Use of Practices Two-Factor Analysis

Table D1

Reported use of Practices Factor Loadings and Communalities for Two-Factor Model

Instructional Practice	Factor 1	Factor 2	Extraction Communalities
Explicit Instruction	.282	.038	.081
Mathematical Representations	.486	.261	.304
Mathematical Language	.403	.373	.302
Mnemonics	.774	-.295	.686
Graphic Organizers	.528	.010	.279
Problem-Solving	.485	.392	.389

APPENDIX E

Additional CFA Data

Table E1

Descriptive Statistics for MTEBI by Question

Item	*M*	*SD*
1	3.278	0.9466
2	4.591	0.6573
3	4.429	0.8191
4	3.685	0.8136
5	4.213	0.6914
6	4.087	0.7752
7	2.707	0.9077
8	4.422	0.6356
9	3.532	0.8620
10	3.606	0.8216
11	4.540	0.6091
12	3.286	0.9263
13	3.348	0.9311
14	3.690	0.8167
15	3.685	1.003
16	4.491	0.6132
17	4.210	0.9149
18	4.164	0.9716
19	4.196	0.7085
20	4.688	0.5215
21	3.625	0.9675

Note: MTEBI=Math Teaching Efficacy Beliefs Instrument

Table E2

Covariance Matrix for MTEBI by Question

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	.896	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2	.044	.432	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3	-.034	.087	.671	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4	.278	.084	.055	.662	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5	.035	.079	.224	.047	.478	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6	.017	.073	.230	.068	.196	.601	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7	.150	.013	-.043	.243	-.036	-.017	.824	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8	.017	.067	.238	-.008	.201	.186	-.103	.404	--	--	--	--	--	--	--	--	--	--	--	--	--
9	.151	.006	.087	.157	.078	.099	.197	.058	.743		--	--	--	--	--	--	--	--	--	--	--
10	.309	.047	-.012	.227	.033	.019	.082	.006	.160	.675	--	--	--	--	--	--	--	--	--	--	--
11	-.007	.059	.216	-.007	.227	.135	-.050	.170	.054	.030	.371	--	--	--	--	--	--	--	--	--	--
12	.164	.080	-.029	.194	.080	.074	.174	-.020	.151	.240	.028	.858	--	--	--	--	--	--	--	--	--
13	.202	.062	.013	.299	.096	.084	.250	.005	.265	.227	.025	.401	.867	--	--	--	--	--	--	--	--
14	.190	.054	.077	.137	.059	.083	.078	.048	.136	.176	.062	.165	.222	.667	--	--	--	--	--	--	--
15	-.011	.024	.144	.063	.127	.174	.071	.143	.064	-.012	.117	.022	.046	-.014	1.006	--	--	--	--	--	--
16	-.044	.027	.191	.010	.163	.143	-.025	.144	.059	.009	.193	-.018	.036	.046	.114	.376	--	--	--	--	--
17	-.014	.053	.379	.006	.300	.283	-.087	.291	.085	.002	.267	-.002	.026	.038	.230	.231	.837	--	--	--	--
18	-.018	.091	.277	.050	.216	.209	-.024	.193	.061	.015	.196	.023	.018	.010	.193	.158	.347	.944	--	--	--
19	.027	.055	.188	.046	.185	.181	.011	.168	.112	.038	.151	.046	.070	.073	.220	.129	.228	.232	.502	--	--
20	-.005	.041	.142	.024	.104	.080	.011	.089	.052	.027	.114	.019	.030	.007	.079	.148	.139	.143	.117	.272	--
21	.061	.121	.205	.076	.230	.222	-.011	.247	.160	.001	.158	.041	.071	.080	.260	.099	.274	.313	.293	.111	.936

Note: MTEBI=Math Teaching Efficacy Beliefs Instrument

VITA

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EDUCATION

2024 **Ph.D. in Curriculum & Learning Design**
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