MATHEMATICS TEACHERS AND THE INCLUSION OF STUDENTS WITH MATHEMATICAL LEARNING DISABILITIES

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

DEPARTMENT OF TEACHER EDUCATION

COLLEGE OF PROFESSIONAL EDUCATION

BY

EDWARD F. STEFFEK B.S., M.ED.

DENTON, TEXAS

DECEMBER 2019

DEDICATION

To my late brother, Robert R. Steffek Jr.,
whose passion for education lives on through me.
Thank you for your heavenly guidance, big brother.
I miss you.

ACKNOWLEDGMENTS

My advanced educational journey would not have been possible without the support of the many talented and amazing professionals that I have worked with and become friends with at Texas Woman's University, my fellow doctoral candidate colleagues, and, of course, my beloved family.

Most of all, I want to thank Dr. Diane Myers who started me on this journey and was by my side every step of the way. You always provided me with the encouragement I needed, the feedback I deserved, and the guidance to get me to the role of "researcher." I truly cannot think of a person who has taught me so much in such a short period of time. You are an inspiration to me and an academic treasure to TWU!

I have had the most incredible teachers, mentors, and friends here at TWU. There are too many phenomenal professors to mention, but please accept my heartfelt appreciation for your constant support and guidance. A special thank you to Dr. Jane Pemberton who after a pleasant chat and a short walk on campus offered me a graduate assistant position and welcomed me into the College of Professional Education family. Many thanks to Dr. Sarah McMahan and Dr. Randa Keeley for serving on my committee and guiding me through the dissertation process. Incredible support and constant assistance were provided by Madyson Plummer and Joseph Navapraditar, administrative assistants in the Department of Teacher Education. These two incredible people provided to me support well beyond their job descriptions. No one could make a journey like this without the assistance and emotional support from fellow doctoral student colleagues.

Thank you to Rachel, Tricia, Sarah, Lisa, and so many more of my “sideline cheerleaders.”

Last but not least has been the constant love and support from my family: Laura, Will, Peter, and Claire. Your support and sacrifices were very much appreciated. I persevered to show you that hard work and dreaming big really does matter.

ABSTRACT

EDWARD F. STEFFEK

MATHEMATICS TEACHERS AND THE INCLUSION OF STUDENTS WITH MATHEMATICAL LEARNING DISABILITIES

DECEMBER 2019

This study investigated teachers' perceptions of their abilities to teach mathematics and which evidence-based interventions they were currently using to teach students with mathematical learning disabilities (MLD) in their inclusion classrooms. In this descriptive study, a researcher-designed survey instrument was used to investigate (a) demographic and educational characteristics of inclusion teachers of MLD at the middle and secondary levels, (b) participants' knowledge of MLD, (c) how prepared and supported participants felt they were to teach students with MLD, and (d) whether or not participants were using evidence-based teaching strategies and interventions in their inclusion classrooms. Participants were 98 middle and high school math, special education, and/or inclusion teachers from five North Texas suburban school districts who were currently teaching mathematics classes. Survey results provided a snapshot into participants' perceptions of their abilities to teach mathematics and which evidence-based interventions they were currently using in their inclusion classrooms; these results can shape future research and highlight teachers' training needs. While the majority of the results aligned with current research, some results did not align with current research, indicating the need for caution when making broad generalizations. The findings in this study support continuing the discussion about the most effective teacher preparation

opportunities for middle and secondary mathematics teachers related to the unique characteristics and learning styles of students with MLD. Study results indicated that teacher education programs should provide current evidence-based research to their future teachers in easy-to-use methodologies with non-intimidating terminology, school administrators should support ongoing professional development opportunities that promote the instructional effectiveness of teachers, and that the participants felt overworked, undertrained, but still yet have the best of intentions to meet the educational needs of their students including their students with MLD.

TABLE OF CONTENTS

Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

While the acquisition of reading skills is universally recognized as necessary to becoming a productive member of modern society, acquiring mathematics skills is equally necessary (Berch & Mezzocco, 2007). Successfully navigating today's computer-driven world requires proficient and precise mathematical competencies in addition to well-developed reading and writing skills. To meet these needs, schools should prepare students to understand advanced mathematical concepts, process adaptable problem-solving skills, and incorporate contextual interpretations of solutions (Adler et al., 2014). Federal and state testing mandates may drive school-based efforts to implement a more arduous K-12 mathematics curriculum and enhance students' mathematical knowledge in hopes of achieving higher standardized math test scores. Educators are being challenged to develop, implement, and assess interventions designed to enhance mathematical proficiency for all students, including students who struggle with academic content and students with LD (Hwang & Riccomini, 2016).

In 2017, the U.S. Department of Education reported that 62.5% of students with disabilities were receiving 80% or more of their instruction within a general education classroom (Snyder, de Brey & Willow, 2019). Even though federal law requires students with disabilities to have access to the general education curriculum, in 2013, the U.S. Department of Education reported inequalities in access to the rigorous core academic subjects, including mathematics, between students with disabilities and students without

disabilities (Tan & Thorius, 2018). Students with disabilities often lack learning opportunities and have lower achievement scores in mathematics (Tan & Thorius, 2018). Meeting more rigorous mathematical standards, operating under increased accountability, and managing the daily demands of teaching can be challenging for mathematics teachers and special education teachers tasked with providing quality learning opportunities for their students, including their students with disabilities.

Statement of the Problem

Research indicates that while evidence-based teaching methods for teaching students with disabilities and , specifically, math learning disabilities (MLD) do exist, the research-to-practice gap affecting all areas of education impacts mathematics education, too: teachers may not be using evidence-based practices in their inclusive classrooms (Berch & Mazzocco, 2007; Fletcher, Lyon, Fuchs, & Barnes, 2018; Geary, 2004; Hannell, 2013; Hwang & Riccomini, 2016; Kiru, Doabler, Sorrells, & Croc, 2018; Monei & Pedro, 2017). The teacher education field could benefit from an investigation of current inclusion mathematics teachers' perceptions of increasing mathematics achievement for students with MLD and whether or not they feel prepared to meet the educational needs of students with MLD.

Rationale for the Study

Current research indicates a need for more exploration of what middle and secondary students with MLD need to be successful in inclusion classrooms (Lewis & Fisher, 2016). Multiple evidence-based interventions (e.g., explicit instruction, multi-sensory instruction, supplemental support, manipulatives, and technology) can be

implemented in an inclusion classroom when general education and special educations teachers are trained in their usage (Boaler, Chen, Williams, & Cordero, 2016; Doabler et al., 2018; Impecoven-Lind & Foegen, 2010; Jitendra et al., 2018; Satsangi, Hammer, & Bouck, 2019). Inclusion teachers, in addition to limited training, may overestimate their ability to teach mathematics and students with MLD (Allsopp & Haley, 2015; Rosas & Campbell, 2010). This study investigated teachers' perceptions of their abilities to teach mathematics and which evidence-based interventions they are currently using to teach students with MLD in their inclusion classrooms.

Research Questions

1. What do general education and special education math teachers report about their perceptions and confidence levels related to teaching students identified as having a learning disability in the area of mathematics in their classes and do these teachers feel prepared to teach students identified as having a learning disability in the area of mathematics?

2. Do general education and special education math teachers indicate that they are using evidence-based practices in their classes?

What do general education and special education math teachers report about their teacher training and preparedness in teaching students identified as having a learning disability in the area of mathematics in classes?

CHAPTER II

REVIEW OF LITERATURE

Mathematics is a comprehensive curriculum that requires an extensive range of skills across distinctive domains including number sense, spatial reasoning, verbal reasoning, counting, and calculations (Hannell, 2013). Students need competencies in arithmetic and basic algebra to be competitive participants in today's workforce (Geary, 2011; Kucian & von Aster, 2015). Employability, competitive wages, and job productivity in the higher-paying science, engineering, and technology fields require an even deeper comprehension of advanced mathematics, along with strong mathematical abilities and problem-solving skills (Geary, 2011). Students in the United States currently underperform in the areas of mathematics and science when compared to other leading industrial countries (Hutchison, 2012; Schmidt, Houang, & Cogan, 2011). As schools increase their focus on student attainment of advanced mathematical concepts and highly developed problem-solving skill sets, educators teaching students with LDs in mathematics are likely to face challenges meeting these increased expectations in their classrooms.

Students with Math Learning Disabilities

Almost 2.4 million students with specific learning disabilities (SLD) are receiving special education services in U.S. public schools; this is 5% of the total population of students enrolled in U.S. schools (Cortiella & Horowitz, 2014). With increased usage of intentional instructional strategies, evidenced-based interventions, early childhood

identification, and a more universally accepted criterion for identification, the number of students with SLD has been declining (Cortiella & Horowitz, 2014). A specific type of SLD, MLD is a persistent and long-term SLD affecting academic skills and may have a life-long impact on an individual's job opportunities and future earning potential (Soares & Patel, 2015). Approximately 5-8% of all school-aged children have MLDs and may require special education services (Berch & Mazzocco, 2007; Butterworth, Varma, & Laurillard, 2011; Geary, 2004; Price & Ansari, 2013; Soares & Patel, 2015). Based on this estimation and the percentage of students with disabilities who receive their education in the general education classroom (i.e., 62.5% of students with disabilities for 80% or more of the day; Snyder et al., 2019), one or more students in a general education math class is likely to have MLD.

MLD appears to have both neurological and genetic origins (Butterworth et al., 2011; Hannell, 2013; Soares & Patel, 2015). Research indicates that specific areas of the brain are associated with the development of mathematical thinking and reasoning (Hannell, 2013). Structural and functional neuroimaging of adults and children with MLD has identified a core deficit in understanding and comparing numerosities (i.e., large numbers), number symbols, and arithmetic patterns (Butterworth et al., 2011). MLD can present differently in different students. Characteristics of MLD may be detectable at any age and may differentiate by degree and nature of instruction; MLD may also be present with comorbid LDs and other developmental-behavioral conditions (Soares & Patel, 2015). Students with MLD often have dyslexia (20-60%) and ADHD (10-20%; Hannell, 2013; Landerl, Fussenegger, Moll, & Willburger, 2009; Soares & Patel, 2015).

MLD also has a genetic component: parents and siblings of students with MLD are 10 times more likely to have MLD (Hannell, 2013; Soares & Patel, 2015).

Because mathematics has so many different domains (e.g., number sense, spatial reasoning, counting, calculating), MLD can be difficult to detect because students may have strengths in certain domains and deficiencies in others (Geary, 2004). Characteristics of students with MLD include: poor number sense (e.g., using fingers to count, poor estimation skills), slow response time, difficulties with mathematics language (e.g., confusing commonly used terms, poor generalization skills); memory difficulties with mathematics facts and operations (e.g., inability to do math mentally, confusing math symbols); difficulties with sequences (e.g., losing track when counting, struggling with multi-step problem solving); and difficulties with spatial organization and position (e.g., copying math problems inaccurately, interchanging number place values, relying on imitation and rote learning; Hannell, 2013). Because of the irregularity and intensity of academic deficiencies within certain mathematical topics, MLD remains difficult to detect and screening procedures continue to evolve (Soares & Patel, 2015).

Students with MLD often demonstrate a fundamental difficulty with number sense (e.g., quantity understanding, grouping relationships, symbol recognition, number order, and comparisons; Dehaene, 2011). In addition, students with MLD, independent of IQ and reading achievement, often have a poor conceptual understanding of counting (Geary, 2004). Delayed competencies in counting may lead to poor error detection and guessed answers in arithmetic problem solving (Geary, 2004). Students with MLD frequently display inaccurate performances on number line tasks (Landerl et al., 2009).

Training in mental number line use can improve math skills (Kucian et al., 2011). Students with MLD are more likely to misalign numbers while writing down math problems or solving arithmetic problems, especially when carrying over or borrowing (Geary, 2004). Students with MLD commonly make errors in counting while solving simple arithmetic calculation and often use developmentally immature strategies (e.g., counting on fingers) and problem-solving practices (e.g., counting aloud; Hannell, 2013).

Students with MLD often have a cognitive deficit in number module (i.e., the ability to understand and represent quantities of numbers) which can affect their ability to mathematically problem solve (Landerl et al., 2009). Students with MLD frequently have a difficult time using memory retrieval-based processes to solve simple arithmetic, utilize simple formulas, and solve math word problems (Geary, 2004). Students with MLD often struggle to shift from procedure-based problem solving to memory-based problem solving, suggesting difficulties in storing arithmetic facts or the ability to access them from long-term memory (Geary, 2004). Problem-solving skills are critical for secondary students required to take higher-level mathematics courses (e.g., trigonometry, calculus).

Definitions of Math Learning Disabilities

The most common terms used to describe LDs in the area of math are *mathematical disabilities* (MD), *mathematical learning disabilities* (MLD), and *developmental dyscalculia* (DD). Kucian et al. (2011) defined DD as "a specific learning disability of mathematical abilities presumed to be due to impairments in brain function" (p. 782). Students with DD often show fundamental deficits in number sense and may misrepresent basic number quantities and arithmetical functions such as simple addition

and multiplication facts (Kucian et al., 2011). Witzel and Mize (2018) characterize DD as a LD that affects a student's ability to process numbers, perform arithmetic computations, and develop a proper number sense. Price and Ansari (2015) suggested that approximately 3-6% of the population has DD. Because MD, MLD, and DD all imply an intrinsic cognitive LD in mathematics, in this study, MLD will be used to define the population of students with a math-related disability (Mazzocco, 2007).

Another term used to describe students struggling with math is *persistent mathematics difficulties* (PMD). PMD is a defining characteristic of MLD and likely results from cognitive impairments and developmental delays (Geary, 2011). Morgan, Farkas, Hillemmeier, and Maczuga (2016) analyzed two longitudinal data sets collected on children in the United States to identify certain risk factors associated with PMD, including sociodemographic characteristics of children and their families, socioeconomic status (SES), birth weight, vocabulary and reading skills, and behavior. After reviewing the data, Morgan et al. (2016) recommended early interventions to address PMD, including (a) increased access to preschool opportunities, (b) addressing any identified vocabulary and reading deficiencies, and (c) dissuading grade retention for students with PMD. Lewis and Fisher (2016) recommend that future research projects related to math disabilities accept and adapt a more precise definition of MLD and a more universal identification approach. To summarize, MLD is an intellectual deficit in the area of mathematics where mathematical achievement is consistently not meeting expectations based on intelligence and reading norms (Berch & Mazzocco, 2007). Defining, diagnosing, and researching MLD remain challenging.

Lewis and Fisher (2016) conducted a systematic review of 164 studies on MLD and found inconsistency among classification methods, a lack of demographic distinctions between the general education population and the students with MLD, and an overrepresentation of studies involving elementary-aged students learning basic arithmetic calculations. Early identification of MLD may provide more opportunities understand the complex nature of MLD (Watson, Gable, Gear, & Hughes, 2012). Mazzocco (2007) reported that defining MLD could be challenging because of the limited research on this population. Universal criteria for MLD assessment and diagnosis would be useful for researchers, diagnosticians, and interventionists (Mazzocco, 2007). MLD can be difficult to diagnose because of comorbidity with other disabilities (e.g., dyslexia, ADHD), limited access to or existence of accurate assessment tests, and an inability to draw conclusions from math-based assessments when students lack the skills to provide enough data for analysis (Watson et al., 2012). Lewis and Fisher (2016) recommended that future research also focus on older students with MLD doing more complex mathematics. The field of MLD would benefit expanding its research base, particularly in the areas of classification, diagnosis, and assessment of students with MLD at the middle and secondary level.

Educating Students with MLD

The federal government will need to recruit and prepare an estimated 100,000 new science, technology, engineering, and mathematics (STEM) teachers to teach high school and middle school students by 2020 (Schmidt et al., 2011). The President's Council of Advisors on Science and Technology (PCAST), an advisory group of the

nation's leading scientists and engineers who directly advise the President and the Executive Office of the President, recommended that educator preparation programs recruit teacher candidates who have strong academic qualifications, mastery of teaching practices, and deep content knowledge of the subject matter (Schmidt et al., 2011). One solution may be using a support team where university teacher preparation programs, state policy legislators, and school districts work together to effectively prepare and retain certified and qualified STEM teachers (Hutchinson, 2012). A support team approach could address the STEM teacher through more effective recruitment incentivized by scholarships, closely monitored university academic advising and mentoring, strategic mentoring of first-year teachers, and ongoing STEM-related professional development opportunities (Hutchinson, 2012). The field of education needs more highly qualified teachers of mathematics at all levels and for all students, including students with MLD (Rosas & Campbell, 2010).

Teacher Training

The majority of students with disabilities receive the majority of their instruction in general education classes (van Ingen, Eskelson, & Allsopp, 2016). Preparing qualified math teachers who also have the training to obtain special education certification remains a challenge; most credential programs require minimal subject area coursework at the university level and are constrained by credit hour limitations and limited planning autonomy (Board of the Mathematical Sciences, 2012; Rosas & Campbell, 2010). To ensure that their graduates can meet the needs of students with disabilities, educator preparation programs in mathematics should seek highly qualified candidates for rigorous

mathematics education programs and also provide these candidates with training to provide an equitable education for students with disabilities and, preferable, the opportunity to earn special education certification (van Ingen et al., 2016).

Preservice teachers seeking certification as math teachers and students seeking certification as special education teachers go through completely different college teacher education preparation programs. Math teacher preparation programs concentrate on mathematical content areas and may include fewer courses in effective research-based teaching methods and special education (van Garderen, Scheuermann, Poch, & Murray, 2018). While both math education and special education programs stress having high expectations for all students in the areas of mathematical curricula, special education programs usually do not provide candidates with enough in-depth coursework in mathematics to be effective mathematics teachers (Rosas & Campbell, 2010). Mathematics teacher preparation programs should include strong math content training, effective teaching methods, practice with implementing evidence-based interventions, and specific training in selecting and providing appropriate accommodations for students with disabilities (Rosas & Campbell, 2010). Sutcher, Darling-Hammond, and Carver-Thomas (2016) reported that in 2015-2016, 48 states had a shortage of special education teachers and 42 states had a shortage of mathematics teachers. With the emphasis on including students with disabilities in general education classrooms and the need for STEM teachers, teacher education programs, and school districts face numerous challenges as they strive to fill those vacancies with qualified, capable teachers (Rosas & Campbell, 2010).

Compared to other developed countries (e.g., Singapore, Korea, Japan, the Czech Republic), mathematics students in the United States often experience a K-12 mathematics curriculum taught by teachers who are not exposed to advanced math-content teacher preparation programs in college (Schmidt et al., 2011). Schmidt et al. (2011) recommend that future mathematics teachers have strong quantitative backgrounds and rigorous mathematics coursework in their teacher preparation program to better meet K-12 students' needs; this recommendation extends to those trained as special educators who will be working with students with MLD. Future mathematics teachers need specific training programs designed to engage and promote success in teaching students with and without disabilities (Berch & Mazzocco, 2007). Rosas and Campbell (2010) conducted a study to determine how mathematical background, beliefs, and perceptions affected future intervention specialists in special education. Results indicated a disconnect between the teachers' beliefs and perceptions of their own ability to teach mathematics and their limited mathematical ability, measured by their performance in undergraduate college mathematics courses and scores on a standardized eighth grade test: the teachers perceived their knowledge of mathematics was better than their test scores indicated (Rosas & Campbell, 2010). Many mathematics teachers in underperforming schools and schools with a majority of low SES students are underqualified in mathematics and underprepared to meet students' educational needs in an inclusion classroom (Berch & Mazzocco, 2007). Mathematics teachers at all levels, in all schools, must have strong backgrounds in math and realistic perceptions of their own math abilities.

Inclusive Education

Inclusive education often provides an efficient and effective education in the least restrictive environment (LRE) for students with disabilities (Goodman, Bucholz, Hazelkorn, & Duffy, 2014). Loreman (2010) defines inclusive classrooms as classrooms where all students, regardless of disability, learn in the same contexts. Many inclusion teachers are effective in adapting and calibrating inclusive practices for students with disabilities while meeting the educational needs for all students in the classroom (Jordan & McGhie-Richmond, 2014). Effective implementation of inclusive practices includes multiple means of representation, action and expression, and engagement; these practices benefit all students and align with the Universal Design for Learning (UDL) framework (Jordan & McGhie-Richmond, 2014). The goal of UDL is to give all students, with or without disabilities, equal opportunities to succeed using strategic instructional practices and evidence-based interventions while removing or reducing barriers to instruction (Jordan & McGhie-Richmond, 2014). UDL has the potential to improve instruction for students with and without disabilities (Coyne, Pisha, Dalton, Zeph, & Smith, 2012; Spooner, Baker, Harris, Ahlgrim-Delzell, & Browder, 2007).

Rojewski, Lee, and Gregg (2015) reviewed data from the National Longitudinal Transition Study – 2 (NLTS-2) and found that students with LD or emotional-behavior disorders (EBD) who earned 80% or more of high school academic credits in general education settings were twice as likely to enroll and continue postsecondary education when compared to students earning fewer credits in inclusive settings. These results align with the results of other descriptive and correlational studies demonstrating a causal

relationship between inclusion and postsecondary education (Rojewski et al., 2015). However, a study of 67,649 students with mild disabilities in Georgia found that while there was a 62% increase in the percentage of students with disabilities included in general education over a six-year period, the high school graduation rate for these students remained stable at less than 30% for the same period (Goodman et al., 2014). Potential barriers to graduation included a lack of diploma options, a major focus on college preparation and less on vocational education, ineffective co-teaching and inclusion practices, and external obstacles (Goodman et al., 2014). The rate (and definition) of successful outcomes for including students with disabilities in the general education classroom varies and indicate that inclusion may not best for every student; there are multiple variables that make a controlled study and definitive recommendation nearly impossible (Tkachyk, 2013). Because of these multiple variables (e.g., amount of time in inclusive classrooms; training of teachers in inclusive classrooms; type of instruction delivered; other systemic factors at the student, classroom, and school levels), determining how to measure and assess the impact of inclusion remains a challenge for the research and education community.

Loreman (2010) analyzed 53 peer-reviewed journal articles and 27 books or book chapters and determined seven key areas likely to impact a teacher's success in an inclusive classroom: (a) an understanding of inclusion and respect for diversity, (b) collaboration with stakeholders, (c) promoting a positive social climate, (d) teaching in methods conductive to inclusion, (e) incorporating inclusive instructional planning, (g) engaging in meaningful assessment, and (g) engaging in lifelong learning. Teacher

preparation coursework should address and provide training in these areas to increase the likelihood of success for students with and without disabilities in their graduates' classrooms (Loreman, 2010).

Improving Teacher Preparation

Given the increase of students with disabilities in general education classes, teacher preparation programs and ongoing professional development should provide training in evidence-based instructional strategies and the most effective interventions to teach students with disabilities, including MLD (Jordan & McGhie-Richmond, 2014). Allsopp and Haley (2015) synthesized results from 16 research studies on teacher education, professional development, mathematics, and students with MLD. Several of the reviewed studies demonstrated that professional development interventions (e.g., coaching, study groups, facilitated support groups), mathematical knowledge, and evidence-based practices for teaching math (when implemented with fidelity), led to positive student outcomes (Allsopp & Haley, 2015). Teachers' perceptions of their ability to teach the math content area indicated that general education teachers were more confident in their ability to teach mathematics than special education teachers. Allsopp and Haley (2015) concluded that research on supporting teachers of students with MLD is limited and much too broad in focus.

Special Education Training

Often, special education teachers are not taught the mathematics vocabulary or teaching techniques needed to be successful instructors for students with MLD. Harris, Pollinggue, Hearrington, and Holmes (2014) investigated the impact of a training

program designed to increase and improve special education teacher candidates' fluency with the mathematics vocabulary and manipulative materials necessary to understand and teach mathematical word problems. Results indicated that the 30 teacher candidates who participated in the study demonstrated increased familiarity with commonly used math terms, increased ability to explain the presented materials, and an increased confidence with their ability to teach the math lessons (Harris et al., 2014). van Ingen, Eskelson, and Allsopp (2016) studied 22 general education preservice teachers and 25 preservice special education teachers who engaged in written consultation concerning the mathematics learning needs of students with MLD and found a lack of mathematics content in teacher preparation coursework and a lack of teaching practices designed to engage students with MLD in mathematical practice. Results like these demonstrate the need to increase and improve training in mathematics for special educators, who need fluency with mathematical terminology and advanced mathematical skills to increase the likelihood of their students (especially those students with MLD) being able to meet increasingly rigorous mathematical expectations.

Special Education Training Comparisons

Special education teachers receive less training in effective methods for quality teaching of mathematical problem-solving than general education teachers, despite the necessity of fluency with these methods for teaching students with MLD (van Garderen, 2008). Echoing the support team approach espoused by Hutchinson (2012), van Garderen (2008) suggested increased collaboration between teacher education programs, professional organizations in mathematical education, and organizations serving special

education populations to provide better professional development and training opportunities for both general educators and special educators who teach students with MLD.

As teacher preparation programs increase training in effective collaboration between general education teachers and special education teachers for pre-service teacher candidates, these training endeavors should include instruction in how to generalize these collaborative skills once the candidates are in the school setting. Blanton, Pugach, and Boveda (2014) found that general education researchers are more likely to conduct research on teacher education and teaching methods while special education researchers are more likely to conduct research on interventions and strategies for specific groups of students with disabilities, resulting in missed opportunities for research collaboration between the two groups. Blanton et al. (2014) recommended teams of general educators and special educators work more closely on instruction in specific content areas (Blanton et al., 2014). Teacher preparation may need to be redesigned to address the educational needs of the growing population of students in inclusion classrooms population and to ensure that future special education teachers programs have more effective training in the general education curriculum (Jordan & McGhie-Richmond, 2014). As schools upgrade their math curricula and instructional methods to meet the current needs of their students, teacher education programs should do the same (van Garderen et al., 2018).

Interventions

With appropriate training, general and special education teachers can implement multiple evidence-based interventions (e.g., explicit instruction, multi-sensory

instruction, supplemental support, manipulatives, and technology) in an inclusion classroom (Boaler et al., 2016; Doabler et al., 2018; Impecoven-Lind & Foegen, 2010; Jitendra et al., 2018; Satsangi, Hammer, & Bouck, 2019). Lewis and Fisher (2016) have identified several effective evidence-based instructional interventions for students with MLD, although most of the research has focused on younger students with MLD rather than students in middle school and at the secondary level. Data indicate that secondary students with MLD often score significantly below grade level in math assessments and their growth rate in mathematics slows considerably as they advance in grades (Jitendra et al., 2018; Wagner, Newman, Cameto, Levine, & Garza, 2006; Wei, Lenz, & Blackorby, 2013). To help secondary students with and without disabilities maximize achievement in mathematics and meet school, state, and national expectations, secondary teachers need to learn and implement effective interventions (Jitendra et al., 2018).

Dennis et al. (2016) conducted a meta-analysis on teaching students with MLD and found that effective mathematics instructional interventions for students with MLD include common components like controlling task difficulty, elaboration (e.g., explicit explanations, modeling, and think aloud strategies), and small group instruction. Findings also suggest that participant characteristics (e.g., grade levels and level of math disabilities) and intervention parameters (e.g., grouping, intervention agent, and methodical soundness) impact the effectiveness of the intervention (Dennis et al., 2016). Effective interventions can be implemented individually, inclusively, or through various instructional formats (Monei & Pedro, 2017).

Explicit Teaching

Explicit teaching can be an effective strategy for improving outcomes for secondary students with MLD (Doabler et al., 2018; Gersten et al., 2009; Jitendra et al., 2018; Witzel & Mize, 2018). Explicit mathematics instruction is a systematic instructional approach to effectively develop students' conceptual understanding and procedural fluency in mathematical content (Archer & Hughes, 2011). Doabler et al. (2018) identified three principles of effective explicit mathematics instruction: instructional scaffolding, student practice opportunities, and judicious review. In addition, explicit mathematics instruction for students with MLD should include increased instructional examples, concrete manipulatives, and student verbalizations (Doabler et al., 2018). Explicit teaching lessons often include an advanced organizer, guided practice, independent practice, and feedback (Agrawal & Morin, 2016). One goal of explicit instruction is the gradual release of teacher knowledge using interactive instruction and guided practice to student knowledge with an abundance of independent practice and feedback (Witzel & Mize, 2018). General education and special education teachers should be trained on how to effectively implement explicit teaching in order to best support students with MLD (and all students) in inclusive classrooms.

Students with MLD often struggle with the language component of math and math word problems. Fluency with the vocabulary of mathematics is critical to mathematical proficiency and achievement (Riccomini, Smith, Hughes, & Fries, 2015). van Garderen (2008) surveyed 89 middle school special education teachers about what instructional methods and materials they used to teach mathematical vocabulary to

students with MLD, how much time they spent teaching solving word problems, and the variety of problems presented to their students. Results indicated (a) special education teachers tended to incorporate instructional methods focusing on solving problems for accuracy rather than on transferring problem-solving skills or higher-order thinking skills, (b) the majority of the mathematical word problems tended to be more practice-oriented and less higher order real-world examples, and (c) most of teachers surveyed were providing one hour or less of weekly explicit teaching of problem solving skills (van Garderen, 2008). Based on these findings, special education teachers may benefit from more preparation in mathematical problem-solving practices, instructional intervention strategies, and practical mathematical knowledge and vocabulary for teaching (van Garderen, 2008). Educators should develop their own proficient mathematical vocabulary while using evidence-based instructional strategies in order to incorporate proper mathematical vocabulary into their classrooms (Riccomini et al., 2015).

Multi-Sensory Approach to Instruction

Another promising intervention for students with MLD is using a multi-sensory approach to instruction. In traditional instruction, the teacher explains the presented lesson and the students listen to the material presented using one sense (i.e., hearing). In multi-sensory instruction, materials are presented using multiple senses. The National Council for the teaching of Mathematics (NCTM) and the Mathematical Association of America (MAA) indicate that mathematics teachers at all levels should use visuals, manipulatives, and motion in instruction (Boaler et al., 2016). Multiple studies have

shown that the use of visual representations (VR) in mathematics is an effective practice for improving mathematical performance for students with LD (Gersten et al., 2009; van Garderen et al., 2018). van Garderen et al. (2018) surveyed 146 special education teachers about their knowledge of VRs in mathematics problem solving for students with MLD and to what extent the teachers utilize their knowledge in instruction. Results indicated that the teachers understood VRs and the role of VR in math instruction but lacked knowledge of VRs as an effective evidence-based intervention practice and reported their use of VRs may be limited to a peripheral role in special education math instruction (van Garderen et al., 2018).

Rosenzweig, Krawec, and Montague (2011) investigated the metacognitive strategy of using verbalizations in mathematical problem solving for 73 students with and without LD; the students "thought out loud" while solving three math problems of increasing difficulty (Rosenzweig et al., 2011). Despite differences in problem solving abilities between students with MLD and students without disabilities, results indicated that productive verbalization helped the participants develop metacognitive strategies such as self-instruction, self-questioning, and self-monitoring while problem solving (Rosenzweig et al., 2011). Nonproductive verbalizations may lead to emotional reactions and negative self-talk (Rosenzweig et al., 2011). Implementing a multi-sensory approach to instruction can likely benefit students with or without disabilities.

Supplemental Supports

Supplemental math supports such as small group instruction, one-on-one tutoring, and peer tutoring often provide students with or without MLD with access to remedial

assistance, communication skills, and extra math content reinforcement to increase the likelihood of success in their math classes. Moser Opitz et al. (2017) studied 123 middle school students with MLD in 34 classes over a period of 14 weeks. Participants were divided into two intervention groups (i.e., small group instruction outside of the regular math class and small group instruction inside of the regular math class) and a control group. Results indicated that both types of small-group instruction were effective in reducing certain mathematics deficits (Moser Opitz et al., 2017). Nelson, Parker, and Van Norman (2018) studied trained tutoring interventionists who worked with struggling math students, including students identified as MLD, for an average of 71 minutes of tutoring each week in the form of direct instruction and supervised practice in subskill mastery areas of mathematics. Results indicated that even with direct, supplemental tutoring, only 30% of the middle school students were able to show mastery on certain skill sets (Nelson et al., 2018). Earlier interventions incorporating tutoring focused on remedial subset skills may help offset later deficits and resistance to remediation (Nelson et al., 2018).

Reciprocal peer tutoring includes explicit timing, instantaneous solution feedback, and overcorrection, and is associated with improvements in math achievement, lesson engagement, and social relations (Fuchs et al., 2008; Rohrbeck, Ginsburg-Block, Fantuzzo & Miller, 2003). One strategy with extensive support in the literature is Classwide Peer Tutoring (CWPT), which uses reciprocal peer tutoring and group reinforcement to increase social engagement and improve academic outcomes for students with disabilities (Cook, Cook, & Cook, 2017). Cook et al. (2017) examined 16

single-case design research studies wherein CWPT was implemented with fidelity to explore the academic outcomes of students with high incidence disabilities (including MLD). Results indicated that CWPT is an effective intervention with considerable theoretical and empirical support for improving the academics outcomes; however, the impact of CWPT on student learning was greater at the elementary level than at the secondary level (Cook et al., 2017). CWPT can provide math teachers with an interactive instructional strategy to address students' attention issues while facilitating active student engagement with mathematical content and language (Impecoven-Lind & Foegen, 2010). CWPT can be integrated with existing curricula and provide remedial assistance for students with MLD (Impecoven-Lind & Foegen, 2010).

Hughes, Riccomini, and Witzel (2018) investigated the concrete to representational abstract sequence of instruction (CRA), a process where teachers first guide their students through a mathematical concept using manipulatives and visual representations to illustrate the abstract concept, building to a demonstration of the concept with numbers and without concrete or representational scaffolds (Agrawal & Morin, 2016). Hughes et al (2018) examined the effects of CRA instruction on teaching fractions to 35 middle school students with MLD or other documented mathematics deficiencies. After training in the CRA intervention, inclusion math teachers delivered 30 scripted CRA lessons during their math classes (Hughes et al., 2018). Pretest and posttest score data indicated that CRA-sequenced instruction was effective for teaching fractions to students experiencing challenges in mathematics, including students with MLD (Hughes et al., 2018). Agrawal and Morin (2016) reported that CRA can bridge the gap

between conceptual and procedural mathematical knowledge (a fundamental need for students with MLD) and embedding the CRA framework within explicit instruction is a promising strategy for students with MLD. An evidence-based practice synthesis also yielded results indicating that the CRA instructional framework could be considered an evidence-based practice for students with MLD (Bouck, Satsangi, & Park, 2018).

Other evidence-based instructional supports for students with MLD include schema theory instruction (STI) and schema-based instruction (SBI). In STI, teachers develop a schema or an organized step-by-step plan where effective instructional practices often used in reading comprehension education (e.g., explicit and systematic instruction, scaffolding instruction, reflective questioning, feedback) guide students' learning of mathematical word problem structures; teachers and students select strategies to solve and transfer to solve different types of mathematical word problems (Jitendra, Harwell, Dupuis, & Karl, 2017).

Similar to STI, SBI incorporates modeling problem-solving, activating of mathematical structure, using of diagrams, and developing procedural flexibility (Jitendra et al., 2016). Jitendra, Dupuis, Star, and Rodriguez (2016) investigated the impact of SBI on the proportional problem-solving skills of 260 middle school students in inclusive classrooms and found that participants with MLD made mathematical gains with both procedural and conceptual knowledge when SBI was implemented with fidelity. Jitendra et al. (2017) investigated the impact of SBI on solving problems related to ratio, proportion, and percent for 806 students with MLD in inclusive classrooms. Classrooms were randomly assigned to the SBI intervention group or the control group in the

instruction of word (Jitendra et al., 2017). Results indicated that students in SBI classrooms scored higher on average than students in control classrooms on both posttests and delayed posttests (Jitendra et al., 2017). When SBI is implemented with fidelity, students with MLD may experience enhanced proportional problem-solving performance (Jitendra et al., 2017). The positive outcomes associated with SBI may generalize to other subject areas and can improve the ability to solve mathematical word problems (Fuchs et al., 2008; Jitendra et al., 2016, 2017).

While supplemental supports can be an effective strategy for improving outcomes for students with MLD, Moser Opitz et al. (2017) found that a lack of financial and human resources might prevent supplemental in-school tutoring opportunities. Again, more collaborative and team-based approaches that involve all stakeholders (e.g., Hutchinson, 2012; van Garderen, 2008) might help alleviate barriers to these effective, evidence-based interventions.

Technology

Both general education and special education math teachers should be familiar with the impact of digital technologies tools, such as computers and tablets, on the delivery of instruction to students who struggle in mathematics, especially students with MLD (Satsangi et al., 2019). Kiru, Doabler, Sorrells, and Cooc (2018) synthesized research on technology-mediated mathematics (TMM) interventions on student mathematical outcomes for students with MLD or at risk for MLD and found that TMM could be an effective teaching intervention and had positive outcomes for students with MLD and those that are at risk of MLD.

In one study included in the Kiru et al. (2018) synthesis, researchers investigated how 20 sessions of using a handheld computer to view video clips on the concept of perimeter impacted the geometry skills of three high school students with MLD (Cihak, 2009). All three participants acquired and maintained the targeted geometry skills presented (Cihak, 2009). Satsangi and Bouck (2015) examined the impact of using virtual manipulative instruction to practice the concepts of area and perimeter on the geometry skills of three high school students with MLD. The virtual manipulatives helped the three students acquire, maintain, and generalize the geometric concepts of area and perimeter (Satsangi & Bouck, 2015). Shin and Bryant (2017) conducted a single-subject study on the effects of computer-assisted instruction (CAI; specifically, the software program *Fun Facts*) on the word problem solving ability of three middle school students with MLD and found, despite some mixed results, that all three students showed some improvement in their ability to solve word problems.

Bottge et al. (2015) investigated the effect of active enhanced anchored instruction (EAI) on the math skills of middle school students with MLD in co-taught math inclusion classes. In EAI, problems are anchored in a story-like fashion and introduced via technology (rather than text) for students to visualize and solve the problem (Bottge et al., 2015). Results indicated that EAI improved the targeted math skills for students with and without disabilities and the effect sizes were larger (i.e., the impact of EAI was greater) for students with MLD when the special education teacher directly participated in the intervention (Bottge et al., 2015).

Some researchers have compared the effectiveness of math-related technology to direct teacher instruction when teaching students with MLD. Stultz (2013) compared computer-assisted instruction (CAI) to teacher-directed instruction to teach mathematical operations using mixed fractions (Stultz, 2013). A total of fifty-eight students with MLD were randomly assigned to two groups, one where participants received 10 90-min CAI lessons and one where participants were taught via direct teacher instruction, guided practice, and pencil-and-paper activities (Stultz, 2013). Results indicated no statistically significant difference between the instructional methods (Stultz, 2013). Similarly, in an alternating treatment design study comparing video modeling to face-to-face explicit instruction when teaching geometry word problems to three secondary students with MLD, all three students demonstrated improved performance with both interventions; however, two of the three students had better results in the explicit instruction condition (Satsangi, Hammer, & Bouck, 2019). Research indicates that while TMM is promising as a strategy for improving the achievement of students with MLD, TMM should be embedded within explicit teacher instruction and not rely solely on computer-assisted instruction (Doabler et al., 2018; Kiru et al., 2018).

Summary

Given the frequency with which middle and secondary students with MLD are being educated in general education mathematics classrooms, general and special educators need preparation and ongoing training on how to best address the educational needs of students with MLD while maintaining high expectations for their success (Lewis & Fisher, 2016; Mazzocco, 2007). Although students with MLD share some common

characteristics (e.g., poor number sense, difficulties with math vocabulary, memory difficulties with math facts and formulas), MLD presents differently across students (Dehaene, 2011; Hannell, 2013; Soares & Patel, 2015). Researchers and education professionals have struggled to develop a universally accepted definition of MLD and criteria for early assessment and diagnosis (Lewis & Fisher, 2016; Watson et al., 2012). Establishing a common definition, universal criteria for early assessment and diagnosis, and a more robust research base requires understanding what current mathematics teachers know about MLD and their perceptions about their own abilities to effectively teach their students with MLD; this kind of information can help shape teacher education programs and the selection of appropriate professional development for inclusion teachers.

Teacher preparation and ongoing professional development must reflect the federal law, which mandates that students with disabilities receive evidence-based instruction in the least restrictive environment (Witzel & Mize, 2018). Preparing qualified special education and general education math teachers requires substantial higher-level mathematics and special education coursework to fully address the educational needs of students with MLD (Rosas & Campbell, 2010; van Garderen, 2008; van Garderen et al., 2018; van Ingen et al., 2016). Future and current mathematics teachers need specific training and ongoing professional development to successfully engage and promote achievement for students with or without disabilities (Berch & Mazzocco, 2007). Developing appropriate teacher preparation coursework and effective professional development for these teachers requires an examination of how current

teachers of students with MLD were prepared in their teacher preparation coursework and how they are currently supported in their math classrooms.

Researchers have identified several evidence-based interventions for students with MLD (Boaler et al., 2016; Doabler et al., 2018; Impecoven-Lind & Foegen, 2010; Jitendra et al., 2018; Satsangi et al., 2019). Teachers of students with MLD need to build fluency with these interventions and be able to implement them with fidelity (Jitendra et al., 2018). The research-to-practice long identified by educational researchers means that teachers may not be using evidence-based practices in their inclusive classrooms (Berch & Mazzocco, 2007; Fletcher et al., 2018; Geary, 2004; Hannell, 2013; Hwang & Riccomini, 2016; Kiru et al., 2018; Monei & Pedro, 2017). Bridging this gap requires investigating current inclusion mathematics teachers' perceptions of improving mathematics achievement for students with MLD, the teachers' preparation to teach students with MLD, and the teachers' familiarity and fluency with evidence-based practices for teaching students with MLD. The purpose of the current study was to examine the perceptions of teachers currently serving students with MLD, including (a) confidence levels related to teaching students with MLD, (b) their use of evidence-based practices in the classroom, and (c) training and preparedness for teaching students with MLD. Additional study goals including being able to (a) provide a snapshot of what is currently happening in local mathematics inclusion classrooms, (b) generate recommendations for improvement of the education of students with MLD and preparation of general and special educations, and (c) decrease the research-to-practice gap between teacher preparation programs and teachers' actual performance in the field.

CHAPTER III

METHODOLOGY

For this descriptive study, I used a self-designed survey instrument (see Appendix A) to investigate (a) demographic and educational characteristics of inclusion teachers of MLD at the middle and secondary levels, (b) their knowledge of MLD, (c) how prepared and supported they felt they were to teach students with MLD, and (d) whether or not they were using evidence-based teaching strategies and interventions in their inclusion classrooms. Survey research design allows researchers to administer a survey to a sample population and generalize the analyzed data to a similar larger population (Gliner, Morgan, & Leech, 2011). The survey also included open-ended questions to collect additional qualitative information about what participants felt they needed to be successful when teaching students with MLD in inclusive classrooms. Prior to conducting the research for this survey study, I obtained study approval from the Texas Woman's University Institutional Review Board.

Participants and Recruitment

Participants included middle and secondary teachers who were currently teaching mathematics classes. Using the internet (specifically, the Google search engine) to search publicly information available on school and district websites, I generated a list of 1,948 middle and high school math, special education, and/or inclusion teachers in five North Texas suburban school districts and their email addresses. I also generated list of 148

principals and vice principals from the same five school districts (and their email addresses).

I emailed the principals and vice principals with a recruitment letter and a link to the survey (see Appendix B), asking them to forward the email with the link to any teachers in their schools meeting the criteria (i.e., educators currently teaching grades 6-12 with mathematics as part of their regular teaching assignments). I then emailed the 1,948 teachers directly with the link to the survey (see Appendix C). Approximately two weeks later, I sent a follow-up email to remind the principals and teachers about the survey and to thank those who had already completed the survey. Participation in the survey was voluntary and anonymous.

Survey Instrumentation

The survey used was developed after an extensive literature review (see Chapter 2) on the constructs of MLD, students with MLD, teachers of students with MLD, inclusive education, teacher preparation and professional development for teachers of students with MLD, and evidence-based teaching interventions for students with MLD. After developing the first draft of the survey, I piloted the survey to gain feedback on quality and establish item and content validity. Piloting a survey prior to using it for research purposes can provide information concerning whether or not study participants will be able to successfully complete the survey and if they will provide accurate information (Johnson & Morgan, 2016). I emailed the first draft of the survey to professional colleagues, doctoral students, and experts in the field with a request to review the survey and provide feedback. Reviewing the draft survey was voluntary and

no incentives were offered. A total of twenty-six people reviewed the survey and provided feedback, which I used to make appropriate changes (e.g., more clearly defined terminology, eliminating of repeated questions, and creating sections for organization) to the instrument.

The survey was organized into four sections: two prescreening questions, 15 demographics items, 22 statements using a Likert scale with values ranging from 4 (*strongly disagree*) to 1 (*strongly agree*), and four open-ended questions.

Survey Questions

The 22 Likert scale survey items were categorized according to the three research question topics (i.e., teacher perceptions of their knowledge and ability to teach students with MLD, evidence-based practices or interventions currently being used in their inclusion classrooms, and teacher preparation and support for teaching students with MLD). There were 10 questions pertaining to teachers' perceptions of their knowledge and ability to teach students with MLD, nine questions pertaining to evidence-based practices or intervention currently being used in the inclusion classrooms, and three questions pertaining to teacher preparedness and support. The survey also included four optional open-ended questions which asked about (a) which learning characteristics or limitations were associated with students being identified as having MLD; (b) the teachers' strengths related to supporting students with MLD; (c) the teachers' weaknesses related to supporting their students with MLD; and (d) what teacher preparation and professional development the teachers felt they needed to better support their students with MLD.

Administration of the Survey

The survey was administered using PsychData (https://www.psychdata.com), a free online survey application. Potential participants received an email (either sent directly or forwarded from the principal; see Appendices B and C) with an invitation to participate; this email included instructions to click on a hyperlink if the reader was interested in participating. The hyperlink led to the first page of the survey, which included a summary of and key information about the study, a description of the procedures, any potential risks involved, contact information if questions regarding the study arose, and a link to click if the reader wished to participate. After clicking the link to participate, participants landed on a page with two screening questions (i.e., "Are you currently employed as a classroom teacher of students in the range of grades 6-12 in the United States?" and "Do you currently teach a math class as part of your regular teaching assignment?"). Answering "yes" to both of those questions led participants to the rest of the survey. Participants had the option to skip any question at any time and were able to exit the survey at any time. The survey took approximately 15 to 20 minutes to complete. The survey was open for a period of 28 days (i.e., 4 weeks).

Data Analysis

Data were analyzed using the PsychData analysis function for descriptive statistics (e.g., frequency distributions, mean). I calculated percentages from responses related to demographics. I calculated both percentages and averages for the 22 Likert scale items and categorized answers visually according to the three generalized research question topics.

Open-ended questions solicit unanticipated responses and provide participants with an opportunity to express their views, allowing the researcher to use additional information to express study findings (Johnson & Morgan, 2016). I visually analyzed responses to each of the four open-ended questions to look for common themes, highlighting certain words or phrases to streamline the sorting process. I then developed a listing of five to seven common themes or topics for each of the four questions. I color-coded each open-ended response according to the matching theme, then calculated the percentages of themed responses from total responses. The major themes, sample comments, and results from both quantitative and quantitative analyses are reported in Chapter 4.

CHAPTER IV

RESULTS

The purpose of this study was to examine the perceptions of teachers currently serving students with MLD, including confidence levels related to teaching students with MLD, teachers' use of evidence-based practices in the classroom, and teachers' perceptions of their training and preparedness for teaching students with MLD. The intent of the study was to provide insight into what is currently happening in local mathematics inclusion classrooms, generate recommendations for improvement of the education of students with MLD and preparation of general and special educators, and decrease the impact of the research-to-practice gap on teacher preparation programs and teachers' performance in the field.

Participant Demographics

A total of 138 teachers clicked the link began the survey; 135 teachers agreed to participate. After answering qualifying questions, 122 teachers continued to the first section of the survey. A total of 98 teachers completed the entire survey. The results reported below are based on data provided by the 98 participants who completed the entire survey.

A total of 16 (16.3%) of the survey participants identified as male, 81 (82.7%) identified as female (82.7%), and one participant preferred not to answer (see Table 1).

Table 1

Gender

Gender	Number of Participants	Percentage
Male	16	16.3%
Female	81	82.7%
Other	0	0.0%
Prefer not to answer	1	1.0%
Total	98	100%

A total of 63 (63.3%) participants had a bachelor's degree, 32 participants (32.7%) had a master's degree, three participants (3.1%) had additional work beyond master's degree, and one participant (1.0%) had a doctorate degree (see Table 2).

Table 2

Highest Degree Earned

Degree	Number of Participants	Percentage
Bachelors	62	63.3%
Masters	32	32.7%
Additional coursework	3	3.1%
Doctorate	1	1.0%
Total	98	100%

A total of 20 teachers (20.4%) reported one to three years of teaching experience, 27 teachers (27.6%) reported four to nine years of teaching experience, and 51 teachers (52.0%) reported having 10 or more years of teaching experience (see Table 3).

Table 3

Years in Teaching

Years	Number of Participants	Percentage
1-3	20	20.4%
4-9	27	27.6%
10 or more	51	52.0%
Total	98	100%

Among them, the 98 study participants reported having a total of 165 current Texas teaching licenses; several had more than one concurrent Texas teaching license (see Table 4).

Table 4

Texas Teaching License

Certificate Type	Number of Participants
Standard Certificate – Math 6-12	28
Standard Certificate – Math 8-12	25
Standard Certificate – Math 6-12	18
Standard Certificate –Math/Science 4-8	6
Standard Certificate –Special Education EC-12	31
Standard Certificate – Generalist 4-8	22
Standard Certificate – Core 4-8	3
Other	32

Of the 98 participants, 77 (78.6%) reported certification in mathematics, while 31 (31.6%) reported certification in special education.

Participants categorized their schools from among 11 different classification choices (see Table 5).

Table 5

Type of School

Type of School	Number of Participants
Public	98
Public Charter	0
Public Magnet	0
Alternative	0
Private	0
Parochial	0
Urban	3
Rural	0
Suburban	27
Low socioeconomic	12
Other	0

All 98 participants identified their schools as public (100%). A total of 27 (27.6%) described their schools as suburban, while three (3.1%) described their schools as urban. A total of 12 participants (12.2%) described their school as low socioeconomic. Participants were asked to report their current roles in the inclusion math classroom. Some participants reported having multiple roles (see Table 6). A total of 71 participants (72.2%) described their roles in the inclusion math classroom as general education, while 20 participants described their role as special education. Participants reported the mathematics courses they previously taught and math courses they are currently teaching (see Tables 7 and 8 for a complete breakdown of subjects taught). A total of 77 (77.2%) participants identified as middle school teachers.

Table 6

Teacher Role in Inclusion Math Classroom

Teaching Role	Number of Participants
General education	71
Special education	20
General education inclusion	5
Special education inclusion	17
General education co-teacher	4
Special education co-teacher	6
Other	2

Table 7

Math Classes Previously Taught

Classes taught	Number of Participants
6th Grade Math	49
7th Grade Math	50
8th Grade Math	48
Pre-algebra	26
Algebra	46
Geometry	37
Algebra 2	26
Trigonometry	11
Calculus	5
H.S. General mathematics	7
Probability/Statistics	8
Other	20

Table 8

Math Classes Currently Teaching

Class	Number of Participants
6th Grade Math	26
7th Grade Math	27
8th Grade Math	24
Pre-algebra	4
Algebra	23
Geometry	19
Algebra 2	16
Trigonometry	4
Calculus	4
H.S. General mathematics	3
Probability/Statistics	3
Other	16

Other demographic information collected included college coursework and professional development opportunities. Participants reported their college coursework in the following areas: mathematics, special education, and teaching of mathematics (see Tables 9, 10, and 11 for detailed breakdown).

Table 9

College Math Classes Taken

Math Courses Taken	Number of Participants	Percentage
0	5	5.1%
1	2	2.0%
2-3	22	22.4%
4-5	16	16.3%
6 or more	53	54.1%

Total	98	100%

Table 10

College Special Education Courses Taken

Special Education Courses	Number of Participants	Percentage
0	47	48.0%
1	22	22.4%
2-3	18	18.4%
4-5	4	4.1%
6 or more	7	7.1%
Total	98	100%

Table 11

College Teaching of Mathematics Courses Taken

How to Teach Courses	Number of Participants	Percentage
0	43	43.8%
1	8	8.2%
2-3	29	29.6%
4-5	7	7.1%
6 or more	11	11.2%
Total	98	100%

Over half (i.e., 54.1%) of participants reported taking six or more college math classes, while five participants (5.1%) reported taking none at all. Nearly half (i.e., 48.0%) of participants reported taking no college special education courses. Fewer than half (i.e., 43.8%) of participants reported taking no college teaching of mathematics courses. Participants reported their overall math-related professional development opportunities

and math-related professional development opportunities during the past year (see Tables 12 and 13 for detailed breakdown).

Table 12

Overall Math-related Professional Development Opportunities

Overall PD Opportunities	Number of Participants	Percentage
0	1	1%
1-5	6	6.1%
6-10	14	14.3%
10 or more	77	78.6%
Total	98	100%

Table 13

Math-related Professional Development Opportunities in Past Year

PD Opportunities	Number of Participants	Percentage
0	6	6.1%
1	5	5.1%
2-3	18	18.4%
4-5	14	14.2%
6 or more	55	56.1%
Total	98	100%

More than half of the participants (i.e., 56.1%) reported having six or more math-related professional development opportunities during the past year. Over three quarters of participants (i.e. 78.6%) reported having six or more math-related professional development opportunities during their teaching careers.

Survey Responses

A total of 98 teachers completed the entire survey. The results reported below are based on data provided by the 98 participants who completed the entire survey (see Table

14 for survey results).

Table 14

Results from Survey Items

Survey Questions	Strongly Agree	Agree	Disagree	Strongly Disagree
I am familiar with the term dyscalculia.	22	49	14	13
Dyscalculia and having a learning disability in the area of mathematics are the same.	5	23	51	19
Students identified as having a learning disability in the area of mathematics also have learning disabilities in the area of reading.	2	20	58	18
The earliest possible assessment of having a learning disability in the area of mathematics is key to future success in math curriculum.	41	53	4	0
Knowing a student has been identified as having a learning disability in the area of mathematics makes it easier for me to support the student.	43	47	8	0
I am comfortable with my ability to teach students identified as having a learning disability in the area of mathematics.	33	55	8	2
I am an effective math teacher for my students identified as having a learning disability in the area of mathematics.	29	57	11	1
I am able to support my students identified as having a learning disability in the area of mathematics in the classroom.	33	55	9	1
I am familiar with the Individualized Education Program (IEP) goals and objectives for my student(s) identified as having a learning disability in the area of mathematics in my math class.	60	36	1	1
I was properly prepared in my college teacher preparation classes to teach my students identified as having a learning disability in the area of mathematics.	7	28	42	21
My school has provided me with enough professional development opportunities to best support my students identified as having a learning disability in the area of mathematics.	18	45	32	3

Survey Questions	Strongly Agree	Agree	Disagree	Strongly Disagree
I have the resources and supports available to me to successfully teach students identified as having a learning disability in the area of mathematics.	25	60	10	3
I use evidence-based practices (interventions based in scientific research) in my mathematics classroom to best support my students identified as having a learning disability in the area of mathematics.	29	59	9	1
I use tutoring support outside of classroom for my students identified as having a learning disability in the area of mathematics.	33	54	8	3
I use reciprocal peer tutoring (collaborative learning strategy where students interchange roles as tutor and learner) in my classroom to support my students identified as having a learning disability in the area of mathematics.	19	60	16	3
I use assistive technology (any device, piece of equipment or system that helps compensate for an individual's specific learning disabilities) with my students identified as having a learning disability in the area of mathematics in my classroom.	27	55	13	3
I use small group instruction in my classroom to support my students identified as having a learning disability in the area of mathematics.	41	49	8	0
I use schema-based instruction (identifying structures of different types of math problems and what strategies to use for each) in my classroom to support my students identified as having a learning disability in the area of mathematics.	14	59	23	2
I use explicit instruction (supporting or scaffolding instruction to teach specific skills) embedded with evidence-based interventions (based in scientific research) in my classroom to support my students identified as having a learning disability in the area of mathematics.	39	55	4	0
I use co-teaching as an instruction method to support my students identified as having a learning disability in the area of mathematics.	20	32	35	11
I use multi-sensory (visual, auditory, and sensory-motor) teaching in my mathematics classroom to support my students identified as having a learning disability in the area of mathematics.	25	66	7	0
I am confident with the proper vocabulary associated with the curricula of my mathematics class.	63	31	4	0

Survey Questions	Strongly Agree	Agree	Disagree	Strongly Disagree

Note. Numbers represent number of participants that selected each answer.

The following research questions guided the study and the development of the open-ended survey questions:

1. Perceptions of knowledge and ability: What do general education and special education math teachers report about their perceptions and confidence levels related to teaching students identified as having a learning disability in the area of mathematics in their classes and do these teachers feel prepared to teach students identified as having a learning disability in the area of mathematics?

2. Evidence-based practices and interventions in use: Do general education and special education math teachers indicate that they are using evidence-based practices in their classes?

3. Teacher preparedness and ongoing support: What do general education and special education math teachers report about their teacher training and preparedness in teaching students identified as having a learning disability in the area of mathematics in classes?

Research Question 1: Teacher Perceptions of their Knowledge and Ability

The term dyscalculia was familiar to 71 (72.4%) of the 98 participants ($M = 2.18$; the reported mean is an average of the score on the Likert scale for the related item,

where 1 = *strongly agree* and 5 = *strongly disagree*). A total of participants (71.4%) disagreed that dyscalculia and having a LD in the area of mathematics are the same (*M* = 2.86). When asked about the comorbidity of have a learning disability in both mathematics and reading, 76 participants (77.5%) disagreed (*M* = 2.94). A total of 90 participants (91.85%) agreed that it is easier to support students knowing that the students have been identified as having MLD (*M* = 1.64). A total of 94 participants (95.9%) agreed that the earliest possible assessment for MLD is the key to success in the math curriculum (*M* = 1.62). A total of 96 (97.9%) of the participants agreed that they are familiar with the Individualized Education Program (IEP) goals and objectives for their students with MLD (*M* = 1.42).

Of the 98 participants, 86 (87.7%) indicated they were an effective math teacher for students with MLD (*M* = 1.84). A total of 88 participants (89.7%) indicated they were comfortable with their ability to teach their students with MLD (*M* = 1.79). A total of 88 participants (89.7%) indicated they were able to support their students with MLD in their classrooms (*M* = 1.78).

The first open-ended question asked the participants what learning characteristics or limitations they felt were associated with being identified as having MLD. Forty of the 98 participants (40.8%) responded to the question. I categorized participants' responses according to six recurring themes: number sense/poor basic skills, memorization/times tables, slower pace/extra time, comorbidity, learned helplessness/lack of confidence, and inclusion misplacement.

Of the 40 participants who answered the first open-ended question, 19 participants

(47.5% of those who answered the question) indicated that number sense or poor basic skills were limitations or characteristics of students with MLD. Deficit areas commonly mentioned in participants' responses included comprehension, problem-solving, calculation skills, advanced formulas, number manipulation, reading graphs and charts, and overall basic math skills. A total of six participants (15.0% of those who answered the question) indicated that memory issues (e.g., not knowing the multiplication tables) were a limitation or characteristic of students with MLD. Deficit areas commonly mentioned in participants' responses included short-term memory, basic multiplication facts, remembering formulas, recalling multi-step procedures, and retaining previously learned information and concepts. A total of six participants (15.0% of those who answered the question) indicated that learned helplessness or a lack of effort was a limitation or characteristic of students with MLD.

Additional characteristics of students with MLD noted in participants' answers to the first open-ended question included a dislike for math, easily discouraged and shutting down, lacking confidence, and a reinforced attitude of math failure. A total of five participants indicated that needing extra time or a slower pace was a limitation or characteristic of students with MLD; the participants mentioned extra time to problem solve and comprehend the material, not being able to keep up with the rest of the class, and slower processing speeds. A total of two participants indicated that comorbidity with another LD was a limitation or characteristic of students with MLD, mentioning students' inability to read material due to a LD and disorganization because of dysgraphia. One participant indicated that inclusion misplacement was a limitation or characteristic of

students with MLD. The participant indicated that the best placement for students with MLD is in a "self-contained resource room."

The second open-ended question asked the participants what strengths they felt they had as a mathematics teacher to support their students with MLD in the classroom. Of the 98 participants, 49 participants (50.0%) responded to the question. After reading the 49 responses, I categorized the responses into the following seven themes: natural ability to work with students with disabilities, use of interventions, special education certification or support, differentiated instruction, experience, has a LD, and a strong math content background.

Of the 49 participants who responded to the second open-ended question, 15 (30.6% of those who answered the question) indicated that natural ability was a strength they had as a mathematics teacher to support their students with MLD in the classroom; participants mentioned their excellent classroom management, willingness not to ever give up on students, flexibility, teaching at a slower pace, patience, natural connection with students, excellent communication skills, strong relationships and rapport with students, and adaptability to teaching and learning situations. A total of 11 participants (22.4% of those who answered the question) indicated that their use of interventions was a strength they had as a mathematics teacher to support their students with MLD in the classroom; interventions cited included using small group instruction, scaffolding and chunking lessons, multisensory instruction, mnemonic strategies, peer tutoring, online instruction aides, and one-on-one tutoring opportunities. A total of seven participants (14.4% of those who answered the question) indicated that their special education

certification or use of special education support was a strength they had as a mathematics teacher to support their students with MLD in the classroom; they cited using intervention specialists, inclusion teachers, and special education teachers as resources, their own experiences as a resource paraprofessional and resource teacher, being a certified special education teacher, and knowing IEP accommodations and goals. A total of six participants (12.2% of those who answered the question) indicated that their use of differentiated instruction was a strength they had as a mathematics teacher to support their students with MLD in the classroom; participants mentioned teaching different approaches to solving the same problem, teaching using various teaching methods, and varying teaching strategies to accommodate different learning styles. A total of five participants (10.2% of those who answered the question) indicated that their years of experience as a teacher was a strength, mentioning their professional development opportunities, knowing what works and what does not work, anticipating needs of students from experience, and knowing that additional support is both needed and necessary before it is too late for students. A total of three participants indicated that their own experience with having a LD was a strength, giving them empathy for students with LDs, teaching skills that personally helped them succeed in the classroom, and creating an accepting learning environment for all students. A total of two participants indicated that their strong background in the math content area was a strength; these teachers mentioned that knowing the subject content boosted confidence in teaching the subject and the ability to look at the material in different ways instead of one approach.

The third open-ended question asked the participants what weaknesses they

indicated they had as a mathematics teacher to support their students with MLD in the classroom. Of the 98 participants, 48 participants (49.9%) chose to answer the question. After reading the 48 responses, I was able to categorize the responses into the following six themes: lack of training, too many students/not enough time, lack of support, lack of patience, too much material to cover, and being a special education teacher teaching a mathematics class.

Of the 48 participants who answered the question, 17 (35.4% of those who answered the question) indicated that lack of training was a weakness they had as a mathematics teacher to support their students with MLD in the classroom. Their comments included being an overwhelmed new teacher, not having enough training in teaching students with disabilities, poor college coursework in special education, relying too heavily on the inclusion teacher to teach students with MLD, and not enough training or support for using proper interventions in math classroom. A total of 17 participants (35.4% of those who answered the question) indicated that too large of class size and not having enough time were weaknesses; they mentioned having a too large of a class of 30 students with 10-20 special education students, too many students with various disabilities in one class, not enough time to devote to students with extra needs, too many responsibilities outside of the classroom, too much paperwork, and not enough time in the day. A total of six participants (14.4% of those who answered the question) indicated that lack of support was a weakness, mentioning helping students who do not qualify for special services (despite needing them), students with and without disabilities being placed in inappropriate classes, and not enough materials, technology, or behavior

support. A total of three participants indicated that lack of patience was a weakness; they mentioned being frustrated with students' lack of trying and not being sympathetic to students who do not take advantage of tutoring or reassessments. A total of three participants indicated that too much material was a weakness; they mentioned demanding TEKS (Texas Essential Knowledge and Skills), higher order math content classes, and the amount and depth expected of the curriculum to cover. A total of two participants indicated that being a special education teacher teaching mathematics was a weakness; they mentioned they (as teachers) were not grasping the material in order to teach it and they lacked the confidence to teach new math concepts.

Research Question 2: Evidence-based Practices Used in the Classroom

Of the 98 participants, 88 (89.8%) agreed that they used evidence-based practices in their classrooms to best support their students with MLD, while 10 (11.1%) disagreed with the statement ($M = 1.82$). The survey included usage statements about eight different evidence-based practices from the review of literature with short identifying definitions for five of the intervention practices. Of the 98 participants, 87 (88.8%) agreed with the statement that they used tutoring support outside of the classrooms to support their students with MLD ($M = 1.81$). A total of 79 participants (80.6%) agreed that they used reciprocal peer tutoring in their classrooms to support their students with MLD ($M = 2.03$). A total of 90 participants (91.8%) agreed with the statement that they used small group instruction in their classrooms to support their students with MLD ($M = 1.66$). A total of 82 participants (83.6%) agreed with the statement that they used assistive technology in their classrooms to support their students with MLD ($M = 1.92$). A total of

90 participants (91.8%) agreed with the statement that they used schema-based instruction in their classrooms to support their students with MLD ($M = 2.13$). A total of 94 participants (95.9%) agreed with the statement that they used explicit instruction in their classrooms to support their students with MLD ($M = 1.64$). A total of 52 participants (53.0%) said they used co-teaching in their classrooms to support their students with MLD, while 46 participants (46.9%) are not using co-teaching ($M = 2.38$). A total of 91 participants (92.9%) agreed with the statement that they used multi-sensory teaching in their classrooms to support their students with MLD ($M = 1.82$).

Research Question 3: Teacher College Preparedness and Support

Thirty-six participants (i.e., 36.7%) agreed that their college teacher preparation classes prepared them to effectively teach their students with MLD ($M = 2.79$). A total of 63 participants (64.3%) agreed that their schools provided them with enough professional development opportunities to best support their students with MLD ($M = 2.20$). A total of 85 participants (86.7%) agreed that they have the resources and supports available to them to successfully teach students with MLD ($M = 1.91$). Almost all of the participants (i.e., 95.6%) indicated that they were confident with the proper vocabulary associated with the curricula of their math classes ($M = 1.40$).

The fourth open-ended question asked the participants what teacher preparedness and professional development they had that would best support their students with MLD in the classroom. Of the 98 participants, 42 participants (42.9%) chose to answer the question. After reading the 42 responses, I categorized the responses into the following four themes: more college special education courses and/or professional development,

more college mathematic courses and/or professional development, more time, and more courses and/or professional development on technology.

Of the 42 participants who answered the question, 23 (54.8% of those who answered the question) indicated they needed more college special education coursework and/or professional development to best support their students with MLD in the classroom. Participants mentioned taking weak or no college special education courses, hearing about intervention strategies at monthly math department meetings, wanting more information on both the strengths and weaknesses of students with MLD, a need for training on supports for students with MLD in upper level/more complex math areas, ongoing professional development dedicated to accommodations directly related to MLD, combined professional development opportunities for both special education teachers and general education math teachers, and more information on what works instead of generic goals and accommodations for students with MLD. A total of eight participants (19.0% of those who answered the question) indicated they needed more college mathematics courses and/or professional development, mentioning more training using math manipulatives, math conferences offering sessions on MLD, more training on how to best teach math concepts to all students, offering a master's degree in math education, and collaborative sessions with fellow math teachers on how they best teach students with MLD. A total of seven participants (16.6% of those who answered the question) indicated that they needed more time, including extra time to work with students with MLD, more planning time to implement interventions, more time to work with case managers and parents, and more time in class to teach student and not simply to teach to the test. A total

of two participants indicated they needed more college technology courses and/or professional development, including more training with technology to give students more individualized attention and the acceptable use of calculators for all math assignments. One participant was not sure what is needed to best support students with MLD in the classroom, and one participant indicated that school districts provide ample amounts of resources and professional development opportunities to best support students with MLD in the classroom.

These results are discussed in the following chapter.

CHAPTER V

DISCUSSION AND CONCLUSIONS

The goal of this study was to examine teachers' perceptions of their abilities to teach students with MLD, teachers' knowledge of MLD, teachers' familiarity and usage of evidence-based practices for teaching students with MLD, and teachers' training and preparedness to teach students with MLD, and to see how these findings align with the indications from current research. The data provided a snapshot into participants' perceptions of their abilities to teach mathematics and which evidence-based interventions they are currently using in their inclusion classrooms; this information can help guide future research and highlight teachers' training needs. While the majority of the results align with current research, some results did not align with current research, indicating the need for caution when making broad generalizations. The findings in this study support the continuing discussion about the most effective teacher preparation opportunities for middle and secondary mathematics teachers related to the unique characteristics and learning styles of students with MLD.

Ability to Teach and Knowledge of MLD

Research indicates that as many as 60% of students with MLD also have dyslexia (Hannell, 2013). While a majority of study participants (72%) said they were familiar with the term "dyscalculia," only 28 participants (29%) agreed that having dyscalculia and having an MLD were the same (despite research indications that there is a good deal of overlap, if not identical presentation). This perception aligns with the research

indicating a need for a common definition and criteria for students who have a LD in the area of mathematics (Fisher & Lewis, 2016). The majority (76%) of study participants disagreed with the statement that there is comorbidity between MLD and having a LD in reading, contradicting the research that says students with MLD often have a concurrent reading disability. Math teachers likely need more training in special education, particularly as related to math-related disabilities and the comorbidities that often are associated with MLD.

Overwhelmingly, participants responded that early assessment (96%) and early identification (92%) made it easier for them to support their students with MLD. In addition, the majority of the participants (98%) reported that they were familiar with the Individualized Education Program (IEP) goals and objectives for their students with MLD. These findings indicate that participants are aware of best practices (e.g., early assessment) and the importance of knowing the needs of their students with MLD as well the services and the annual goals of the IEP. This aligns with the research that indicated that general education teachers, the majority of participants in this survey, often feel more confident and capable to teach students with MLD, but at times are not properly trained or proficient in the most effective instructional practices (Allsopp & Haley, 2015; Boaler et al., 2016; Berch & Mazzocco, 2007).

Responses to the open-ended question asking participants about the learning characteristics and limitations of students with MLD yielded aligned with current research (Butterworth et al., 2011; Geary, 2004; Hannell, 2013). Study participants reported observing poor number sense, slower calculation abilities, below average math

skills, and issues with memorization as characteristics of MLD. A few participants reported that learned helplessness, a dislike for math, a lack of confidence, and a lack of trying contributed to students' MLD, characteristics that are not supported by current research. Better-informed teachers can better serve their students with MLD. For example, if teachers believe that a student with MLD is underperforming because the student does not like math, the teacher may attempt to intervene by making math more fun rather than implementing an evidence-based strategy like peer tutoring. Results from the current study show the importance of getting the most current evidence-based research to teachers through either college preparation coursework or ongoing professional development opportunities.

Evidence-Based Interventions Being Used

With an increase in the number of students with disabilities in general education classrooms, general education teachers and special education need to be prepared to effectively implement evidence-based interventions and teaching strategies to meet the educational needs of their students, with and without disabilities, in their inclusion classrooms (Jitendra et al., 2018; Jordan & McGhie-Richmond, 2014). Nearly all study participants reported (90%) they are currently using evidence-based practices in their mathematics classrooms to support their students with MLD.

Participants expressed a willingness to implement effective interventions and teaching strategies, but also noted a lack of professional training, limited time in class to effectively execute evidence-based interventions, and a disconnect between special education and general education departments. These responses are consistent with

research findings indicating that even though math teachers and special education teachers may have different college coursework and teacher education preparation programs, they still are expected to similarly address the educational needs of all students, with or without disabilities, with high expectations (Rosas & Campbell, 2010; van Ingen et al., 2016).

Moser Opitz et al. (2017) indicated that small-group instruction is effective in reducing certain mathematics deficits while providing students with more individualized attention. The majority of participants in the current study indicated using supplemental supports for their students, including 87 (88.8%) participants using outside classroom tutoring (M = 1.81), 79 (80.6%) using reciprocal peer tutoring (M = 2.03), and 90 (91.8%) participants using small group instruction (M = 1.66). Study participants indicated that the ability to teach and reteach students struggling with *m*aterial in a smaller setting with more personalized attention would be ideal for supporting their students, indicating that specialized attention was beneficial to address specific areas of difficulty as well as best utilizing support staff time. Research indicates that any type of early intervention tutoring with a concentration of remedial subset skills may be advantageous for students struggling with higher order topics (Nelson et al., 2018).

Satsangi et al. (2019) emphasized that math teachers need to effectively utilize digital technology tools, such as computers and tablets, in the delivery of instruction to students who struggle in mathematics, especially those identified with MLD. Many participants in the current study (i.e., 84%) reported using assistive technology to support students with MLD. Several participants pointed to a lack of training as well as a lack of

time as a weakness for not using technology as often as they would like in their classrooms. They also added that including technology as a supplementary support would be helpful to those struggling students needing extra help without the need for immediate teacher guidance and assistance. Most participants (87%) indicated that their schools offered them enough resources and supports. When the assistive technology is available to teachers, teachers should be comfortable using it with their students as a supplement to explicit teaching practices.

While current research indicates that a research-to-practice gap exists and teachers may not be using evidence-based instruction practices in their inclusive classrooms (e.g., Berch & Mazzocco, 2007; Geary, 2004; Hannell, 2013; Monei & Pedro, 2017), many participants in the current study reported that they are currently using evidence-based teaching strategies such as schema-based instruction (75%), explicit instruction (93%), and multisensory instruction (93%) to support their students with MLD. While self-reporting may not always be an accurate reflection of practice, these results indicate that for this small sample of math teachers, awareness and broad implementation of some of the most well-researched evidence-based practices for serving students with math disabilities are quite common. However, further research may be useful to determine whether these teachers are using the interventions with validity, as well as investigating the quantity and quality of the intervention training the teachers are receiving.

In addition, over half of the participants (53%) reported using co-teaching in their classes to support their students with MLD; several indicated that they would benefit from having a more collaborative relationship between special education and general

education teachers, and that positive co-teacher relationships directly benefit the students in their classrooms. Research indicates that with proper training, general education and special education teachers can use multiple evidence-based interventions effectively to benefit students with disabilities in their inclusion classrooms (Boaler et al., 2016; Doabler et al., 2018; Impecoven-Lind & Foegen, 2010; Jitendra et al., 2018; Satsangi et al., 2019).

Teacher Training and Preparedness

At the secondary level, teacher preservice training programs tend to focus more on the core subject content and less on effective instructional strategies (van Ingen et al., 2016). Schools have increased their focus on student attainment of advanced mathematical concepts and advanced problem-solving skills at the secondary level (Geary, 2011). Teachers instructing students with LDs in mathematics face challenges meeting these increased expectations in their classrooms. Teacher preparation classes and ongoing professional development should provide training in evidence-based instructional strategies and the most effective to teach students with disabilities, including MLD (Rosas & Campbell, 2010).

In this study, only 35 participants (35%) agreed that that they were properly prepared in their college teacher preparation classes to teach their students with MLD, while 21 participants (21%) strongly disagreed with that statement. Rosas and Campbell (2010) found that teachers might have overly optimistic beliefs and perceptions of their own ability to teach mathematics in light of their performances in undergraduate college mathematics courses and scores on a standardized eighth grade test. Similarly, results

from the current study indicate that participants felt very confident and perceived themselves to be effective teachers in their inclusion classrooms even as they indicated they were not being properly trained to teach mathematics to students with MLD. Overwhelmingly, 94 participants (96%) indicated that they felt confident in their knowledge of the necessary vocabulary associated with teaching the curricula of their mathematics class, which contradicts current research indicating that special education teachers are not taught the mathematics vocabulary or teaching techniques needed to be successful instructors for students with MLD (Harris et al., 2014). Is there a disconnect between their perceived effectiveness and measurable or observable effectiveness? Participants (and, likely the field of mathematics education) would benefit from more extensive teacher training programs and ongoing professional development that focuses on math teaching techniques that directly benefit students with MLD.

Mathematics teachers at all levels, in all schools, must have strong backgrounds in math and realistic perceptions of their own math abilities. Participants in the current study reported that they needed more special education training to effectively teach students with MLD, including identifying and knowing the characteristics of MLD, more collaboration between general education and special education teachers, and simple easy-to-implement strategies or interventions that are effective to use with their students with MLD. Study participants frequently mentioned a lack of time as an obstacle to effectively teaching students with MLD.

While 64 participants (64%) reported that their schools are providing them with enough professional development opportunities and a large majority (87%) of the

participants indicated that they have enough resources and supports to successfully teach their students with MLD, open-ended responses from several teachers indicated that additional professional development, summer enrichment classes, and ongoing collaboration sessions with the core subject teachers and the special education teachers would be beneficial. Schools may want to consider additional options and alternatives to current models and schedules of professional development to effectively meet teachers' needs.

The results of this study align with current research indicating that mathematics teachers of students with MLD identify their college preparation programs as an area of weakness in their preparation to effectively teach students with MLD (van Garderen et al., 2018). General education mathematics teachers experience a strong emphasis on higher order math classes in their college coursework and fewer classes devoted to teaching techniques and strategies, including working with students with disabilities (Rosas & Campbell, 2010). Teacher education programs need to continue working toward ways to increase the content knowledge of special education teachers and the special education knowledge of content teachers.

Limitations

This study has several limitations; results should be interpreted with caution. First, the survey instrument was developed by the researcher after a literature review. There may be various assumptions or exclusions of questions that could have led to different results. Second, survey responses were self-reported, which may have resulted in differences in understanding and interpreting of the questions as well as implications in

the veracity of answers. Third, survey research frequently suffers from low response rates which may affect the sample integrity of the targeted participants; in the current study, 98 out of the 1,948 people to whom the survey was sent responded (i.e., 5%). Fourthly, the representativeness of the sample was limited to a small pool of 98 teachers in five geographically and demographically similar Texas school districts, limiting the generalizability of results. Finally, the time of the survey distribution (i.e., late spring, when mandatory state testing takes place) may have affected teachers' attitudes and further limits the generalizability of the results.

Implications for Further Research

Overall, results from the current study align with existing research indicating that more information is needed to examine the educational needs of middle and secondary students with MLD (as well as those who teach these students). Future follow-up studies should focus on a larger and more diverse sample of teachers. In addition, while this study focused on teachers' perceptions, future research should investigate if those perceptions align with observable and measurable dependent variables, including the effectiveness of teacher training, the implementation of evidence-based interventions in the classroom, and the post-intervention performance of students with MLD.

Implications for Practitioners

Participants in this study overwhelmingly reported that they are currently using several evidence-based instruction strategies or interventions in their classrooms. Existing research indicates that evidence-based practices for teaching math (when implemented with fidelity) lead to positive student outcomes (Allsopp & Haley, 2015). However,

open-ended responses indicated that several teachers desired more training on how to effectively implement these interventions. Future research on evaluating whether or not teachers are implementing evidence-based interventions properly and with fidelity would be of benefit to the field and potentially identify more effective training strategies.

In the current study, teachers reported a willingness to incorporate more evidence-based interventions if the interventions are easy to implement and not too time-consuming. Teacher trainers and professional development providers should create concise, easy-to-use introductions to the basics of some of these evidence-based interventions in the form that can be distributed and used to design training for current teachers.

Researchers may also want to examine why teachers frequently have such highly favorable perceptions of their ability to teach students with MLD, even when the performance of those students (and the teachers' own comments) indicate otherwise. A realistic, efficient way to measure teachers' effectiveness with the implementation of evidence-based practices and students' subsequent improvements would be beneficial for both practitioners and those conducting research on this disparity between perception and reality.

Implications for Policymakers

Results from the study indicate that teachers of students with MLD may be willing to implement evidence-based interventions and strategies but limited time and additional responsibilities may prevent teachers from implementing evidence-based practice as often as is optimal and as often as they would prefer. Perhaps policymakers

could look at teacher scheduling and strategies to improve teachers' time management skills, since teachers do not have sufficient time to fully, accurately, and effectively implement evidence-based interventions for their students with MLD.

Findings from the current study align with existing research indicating that college preparation programs for middle and secondary mathematics teachers need to examine the effectiveness of their programs and whether or not these programs are meeting the academic needs of teacher candidates adequately preparing teacher candidates to teach students with and without disabilities. Further research should focus on introducing teachers to and training them in the effective use of these strategies and interventions and how to self-assess if they are using implementing the strategies correctly and with fidelity.

Participants in the current study also indicated a disconnect between general education teachers and special education teachers. Policymakers should look at ways their schools can become more collaborative and student-centered through additional training, restructuring how schools and classrooms are designed, and revising teacher training as a whole to prepare teachers to better meet the needs of all students.

Summary

In summary, the purpose of the current study was to examine how current general education teachers and special education perceived their knowledge, effectiveness, and training as related to teaching students with MLD in their mathematics inclusion classrooms. Participants also reported on the evidence-based interventions they were currently using in their classrooms. The findings in this study indicated that teachers are

confident in their knowledge of MLD and their teaching abilities, aligning with existing research that indicates inclusion teachers may overestimate their ability to teach mathematics and students with MLD (Allsopp & Haley, 2015; Rosas & Campbell, 2010).

Many highly effective teaching strategies and evidence-based inventions can be implemented in an inclusion classroom when general education and special educations teachers are trained in their usage (Boaler et al., 2016; Doabler et al., 2018; Impecoven-Lind & Foegen, 2010; Jitendra et al., 2018; Satsangi et al., 2019). The majority of teachers in this study reported using evidence-based strategies (e.g., explicit instruction, multi-sensory instruction, supplemental support, manipulatives, and technology) in their inclusion classrooms, contradicting research that teachers may not be using evidence-based practices in their inclusive classrooms (Berch & Mazzocco, 2007; Geary, 2004; Hannell, 2013; Monei & Pedro, 2017). It is possible that study participants were overstating their use of evidence-based interventions or not using them effectively or with fidelity. Students, educators, and policymakers will benefit from further research comparing whether teachers' perceptions of their ability to implement these interventions actually reflect the proper and effective usage of these interventions for students with MLD.

In conclusion, the goal of this study was to take a closer look at the perceptions of teachers currently teaching students with MLD in their classrooms. Teacher education programs should provide current evidence-based research to their future teachers in easy-to-use methodologies with non-intimidating terminology. Administrators should support ongoing professional development opportunities that promote the instructional

effectiveness of teachers. Participants in this study revealed that they are overworked, undertrained, but still try daily to meet the educational needs of their students including their students with MLD.

References

Adler, J., Hossain, S., Stevenson, M., Clarke, J., Archer, R., & Grantham, B. (2014). Mathematics for teaching and deep subject knowledge: Voices of mathematics enhancement course students in England. *Journal of Mathematics Teacher Education*, *17,* 29-148.

Agrawal, J., & Morin, L. L. (2016). Evidence-based practices: Applications of concrete representational abstract framework across math concepts for students with mathematics disabilities. *Learning Disabilities Research & Practice*, *31*, 34-44.

Allsopp, D. H., & Haley, K. C. (2015). A synthesis of research on teacher education, mathematics, and students with learning disabilities. *Learning Disabilities--A Contemporary Journal*, *13*, 177-206.

Archer, A., & Hughes, C. A. (2011). *Explicit instruction: Efficient and effective teaching*. New York, NY: Guilford Publications.

Berch, D. B., & Mazzocco, M. M. (2007). *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities*. Baltimore, MD: Paul Brookes.

Blanton, L. P., Pugach, M. C., & Boveda, M. (2014). *Teacher education reform initiatives and special education: Convergence, divergence, and missed opportunities* (Document No. LS-3). Retrieved from University of Florida, Collaboration for Effective Educator, Development, Accountability, and ReformCenter website: http://ceedar.education.ufl.edu/tools/literature-syntheses/

Boaler, J., Chen, L., Williams, C., & Cordero, M. (2016). Seeing as understanding: The importance of visual mathematics for our brain and learning. *Journal of Applied & Computational Mathematics*, *5*, 1-6.

Board of the Mathematical Sciences. (2012). *The mathematical education of teachers II*. Providence, RI: American Mathematical Society.

Bottge, B. A., Toland, M. D., Gassaway, L., Butler, M., Choo, S., Griffen, A. K., & Ma, X. (2015). Impact of enhanced anchored instruction in inclusive math classrooms. *Exceptional Children*, *81*, 158-175.

Bouck, E. C., Satsangi, R., & Park, J. (2018). The concrete–representational–abstract approach for students with learning disabilities: An evidence-based practice synthesis. *Remedial and Special Education*, *39*, 211-228.

Butterworth, B., Varma, S., & Laurillard, D. (2011). Dyscalculia: from brain to education. *science*, *332*, 1049-1053.

Cihak, D. F. (2009). Using video modeling via handheld computers to improve geometry skills for high school students with learning disabilities. *Journal of Special Education Technology*, *24*, 17-29.

Cook, S. C., Cook, B. G., & Cook, L. (2017). Classifying the evidence base of classwide peer tutoring for students with high-incidence disabilities. *Exceptionality*, *25*, 9-25.

Cortiella, C., & Horowitz, S. H. (2014). The state of learning disabilities: Facts, trends and emerging issues. *New York: National center for learning disabilities*, *25*.

Coyne, P., Pisha, B., Dalton, B., Zeph, L. A., & Smith, N. C. (2012). Literacy by design: A universal design for learning approach for students with significant intellectual disabilities. *Remedial and Special Education*, *33*, 162–172.

Dehaene, S. (2011). *The number sense how the mind creates mathematics*. New York: Oxford University Press.

Dennis, M. S., Sharp, E., Chovanes, J., Thomas, A., Burns, R. M., Custer, B., & Park, J. (2016). A meta-analysis of empirical research on teaching students with mathematics learning difficulties. *Learning Disabilities Research & Practice*, *31*, 156-168.

Doabler, C. T., Smith, J. L. M., Nelson, N. J., Clarke, B., Berg, T., & Fien, H. (2018). A guide for evaluating the mathematics programs used by special education teachers. *Intervention in School and Clinic*, *54*, 97-105.

Fletcher, J. M., Lyon, G. R., Fuchs, L. S., & Barnes, M. A. (2018). *Learning disabilities: From identification to intervention*. New York, NY: Guilford Publications.

Fuchs, L. S., Fuchs, D., Craddock, C., Hollenbeck, K. N., Hamlett, C. L., & Schatschneider, C. (2008). Effects of small-group tutoring with and without validated classroom instruction on at-risk students' math problem solving: Are two tiers of prevention better than one?. *Journal of Educational Psychology*, *100*, 491-509.

Geary, D. C. (2004). Mathematics and learning disabilities. *Journal of learning disabilities*, *37*, 4-15.

Geary, D. C. (2011). Consequences, characteristics, and causes of mathematical learning disabilities and persistent low achievement in mathematics. *Journal of Developmental and Behavioral Practices*, *32*, 250-263.

Gersten, R., Beckmann, S., Clarke, B., Foegen, A., Marsh, L., Star, J. R., & Witzel, B. (2009). Assisting students struggling with mathematics: Response to Intervention (RtI) for elementary and middle schools. NCEE 2009-4060. *What Works Clearinghouse*.

Gliner, J. A., Morgan, G. A., & Leech, N. L. (2011). *Research methods in applied settings: An integrated approach to design and analysis*. New York, NY: Routledge.

Goodman, J. I., Bucholz, J., Hazelkorn, M., & Duffy, M. L. (2014). Using graduation rates of students with disabilities as an indicator of successful inclusive education. In *Measuring inclusive education* (pp. 279-301). Bradford, UK: Emerald Group Publishing Limited.

Hannell, G. (2013). *Dyscalculia: Action plans for successful learning in mathematics*. New York, NY: Routledge.

Harris, P. P., Pollingue, A. B., Hearrington, D., & Holmes, A. (2014). Effects of training on pre-service special educators' abilities to co-teach math vocabulary in preparation for inclusion settings. *Journal of the International Association of Special Education*, *15*, 94-99.

Hughes, E. M., Riccomini, P. J., & Witzel, B. (2018). Using concrete-representational-abstract sequence to teach fractions to middle school students with mathematics difficulties. *Journal of Evidence-Based Practices for Schools*, *16*, 171-190.

Hutchison, L. F. (2012). Addressing the STEM teacher shortage in American schools: Ways to recruit and retain effective STEM teachers. *Action in Teacher Education*, *34*, 541-550.

Hwang, J., & Riccomini, P. J. (2016). Enhancing mathematical problem solving for secondary students with or at risk of learning disabilities: A literature review. *Learning Disabilities Research & Practice*, *31*, 169-181.

Impecoven-Lind, L. S., & Foegen, A. (2010). Teaching algebra to students with learning disabilities. *Intervention in School and Clinic*, *46*, 31-37.

Jitendra, A. K., Dupuis, D. N., Star, J. R., & Rodriguez, M. C. (2016). The effects of schema-based instruction on the proportional thinking of students with mathematics difficulties with and without reading difficulties. *Journal of Learning Disabilities*, *49*, 354-367.

Jitendra, A. K., Harwell, M. R., Dupuis, D. N., & Karl, S. R. (2017). A randomized trial of the effects of schema-based instruction on proportional problem-solving for students with mathematics problem-solving difficulties. *Journal of Learning Disabilities*, *50*, 322-336.

Jitendra, A. K., Lein, A. E., Im, S. H., Alghamdi, A. A., Hefte, S. B., & Mouanoutoua, J. (2018). Mathematical interventions for secondary students with learning

disabilities and mathematics difficulties: A meta-analysis. *Exceptional Children*, *84*, 177-196.

Johnson, R. L., & Morgan, G. B. (2016). *Survey scales: A guide to development, analysis, and reporting*. New York, NY: Guilford Publications.

Jordan, A., & McGhie-Richmond, D. (2014). Identifying effective teaching practices in inclusive classrooms. In *Measuring Inclusive Education* (pp. 133-162). Bradford, UK: Emerald Group Publishing Limited.

Kiru, E. W., Doabler, C. T., Sorrells, A. M., & Cooc, N. A. (2018). A synthesis of technology-mediated mathematics interventions for students with or at risk for mathematics learning disabilities. *Journal of Special Education Technology*, *33*, 111-123.

Kucian, K., Grond, U., Rotzer, S., Henzi, B., Schönmann, C., Plangger, F., ... & von Aster, M. (2011). Mental number line training in children with developmental dyscalculia. *Neuroimage*, *57*, 782-795.

Kucian, K., & von Aster, M. (2015). Developmental dyscalculia. *European Journal of Pediatrics*, *174*, 1-13.

Landerl, K., Fussenegger, B., Moll, K., & Willburger, E. (2009). Dyslexia and dyscalculia: Two learning disorders with different cognitive profiles. *Journal of experimental child psychology*, *103*, 309-324.

Lewis, K. E., & Fisher, M. B. (2016). Taking stock of 40 years of research on mathematical learning disability: Methodological issues and future directions. *Journal for Research in Mathematics Education*, *47*, 338-371.

Loreman, T. (2010). Essential inclusive education-related outcomes for Alberta preservice teachers. *Alberta Journal of Educational Research*, *56*, 124-142.

Mazzocco, M. M. M. (2007). Defining and differentiating mathematical learning disabilities and difficulties. In D. B. Berch & M. M. M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 29-47). Baltimore, MD: Paul H Brookes.

Monei, T., & Pedro, A. (2017). A systematic review of interventions for children presenting with dyscalculia in primary schools. *Educational Psychology in Practice*, *33*, 277-293.

Morgan, P. L., Farkas, G., Hillemeier, M. M., & Maczuga, S. (2016). Who is at risk for persistent mathematics difficulties in the United States? *Journal of Learning Disabilities*, *49*, 305-319.

Moser Opitz, E., Freesemann, O., Prediger, S., Grob, U., Matull, I., & Hufmann, S. (2017). Remediation for students with mathematics difficulties: An intervention study in middle schools. *Journal of Learning Disabilities*, *50*, 724-736.

Nelson, P. M., Parker, D. C., & Van Norman, E. R. (2018). Subskill mastery among elementary and middle school students at risk in mathematics. *Psychology in the Schools*, *55*, 722-736.

Price, G. R., & Ansari, D. (2013). Developmental dyscalculia. *Handbook of clinical neurology pediatric neurology part I*, 241–244. doi: 10.1016/b978-0-444-52891-9.00025-7

Riccomini, P. J., Smith, G. W., Hughes, E. M., & Fries, K. M. (2015). The language of

mathematics: The importance of teaching and learning mathematical vocabulary. *Reading & Writing Quarterly*, *31*, 235-252.

Rohrbeck, C. A., Ginsburg-Block, M. D., Fantuzzo, J. W., & Miller, T. R. (2003). Peer-assisted learning interventions with elementary school students: A meta-analytic review. *Journal of Educational Psychology*, *95*, 732-749.

Rojewski, J. W., Lee, I. H., & Gregg, N. (2015). Causal effects of inclusion on postsecondary education outcomes of individuals with high-incidence disabilities. *Journal of Disability Policy Studies*, *25*, 210-219.

Rosas, C., & Campbell, L. (2010). Who's teaching math to our most needy students? A descriptive study. *Teacher Education and Special Education*, *33*, 102-113.

Rosenzweig, C., Krawec, J., & Montague, M. (2011). Metacognitive strategy use of eighth-grade students with and without learning disabilities during mathematical problem solving: A think-aloud analysis. *Journal of Learning Disabilities*, *4*, 508-520.

Satsangi, R., & Bouck, E. C. (2015). Using virtual manipulative instruction to teach the concepts of area and perimeter to secondary students with learning disabilities. *Learning Disability Quarterly*, *38*, 174-186.

Satsangi, R., Hammer, R., & Bouck, E. C. (2019). Using video modeling to teach geometry word problems: A strategy for students with learning disabilities. *Remedial and Special Education*. doi:10.1177/0741932518824974

Schmidt, W. H., Houang, R., & Cogan, L. S. (2011). Preparing future math teachers. *Science*, *332*, 1266-1267.

Shin, M., & Bryant, D. P. (2017). Improving the fraction word problem solving of students with mathematics learning disabilities: Interactive computer application. *Remedial and Special Education*, *38*, 76-86.

Snyder, T. D., de Brey, C., & Dillow, S. A. (2019). Digest of Education Statistics 2017, NCES 2018-070. *National Center for Education Statistics*.

Soares, N., & Patel, D. R. (2015). Dyscalculia. *International Journal of Child and Adolescent Health*, *8*, 15-26.

Spooner, F., Baker, J. N., Harris, A. A., Ahlgrim-Delzell, L., & Browder, D. M. (2007). Effects of training in universal design for learning on lesson plan development. *Remedial and Special Education*, *28*, 108–116.

Stultz, S. L. (2013). The Effectiveness of computer-assisted instruction for teaching mathematics to students with specific learning disability. *The Journal of Special Education Apprenticeship*, *7*, 1-13.

Sutcher, L., Darling-Hammond, L., & Carver-Thomas, D. (2016). *A coming crisis in teaching? Teacher supply, demand, and shortages in the US.* Retrieved from https://learningpolicyinstitute.org/product/coming-crisis-teaching-brief

Tan, P., & Thorius, K. K. (2018). En/countering inclusive mathematics education: A case of professional learning. *Mathematics Teacher Educator*, *6(2)*, 52-67.

Tkachyk, R. E. (2013). Questioning secondary inclusive education: Are inclusive classrooms always best for students?. *Interchange*, *44*, 15-24.

van Garderen, D. (2008). Middle school special education teachers' instructional practices for solving mathematical word problems: An exploratory study. *Teacher Education and Special Education*, *31*, 132-144.

van Garderen, D., Scheuermann, A., & Poch, A. L. (2018). Special education teachers' perceptions of students' with disabilities ability, instructional needs, and difficulties: Using visual representations to solve mathematics problems. *Teacher Education and Special Education*, *41,* 7-23.

van Ingen, S., Eskelson, S. L., & Allsopp, D. (2016). Evidence of the need to prepare prospective teachers to engage in mathematics consultations. *Mathematics Teacher Education and Development*, *18*, 73-91.

Wagner, M., Newman, L., Cameto, R., Levine, P., & Garza, N. (2006). *An Overview of Findings from Wave 2 of the National Longitudinal Transition Study-2 (NLTS2). NCSER 2006 3004*. Washington, D.C.,: National Center for Special Education Research.

Watson, S. M., Gable, R. A., Gear, S. B., & Hughes, K. C. (2012). Evidence-based strategies for improving the reading comprehension of secondary students: Implications for students with learning disabilities. *Learning Disabilities Research & Practice*, *27*, 79-89.

Wei, X., Lenz, K. B., & Blackorby, J. (2013). Math growth trajectories of students with disabilities: Disability category, gender, racial, and socioeconomic status differences from ages 7 to 17. *Remedial and Special Education*, *34*, 154-165.

Witzel, B., & Mize, M. (2018). Meeting the needs of students with dyslexia and dyscalculia. *SRATE Journal*, *27*(1), 31-39.

APPENDIX A

Survey

Title of Study: Mathematics Teachers and the Inclusion of Students Identified as Having a Learning Disability in the Area of Mathematics

Author: Edward Steffek, M. Ed.

Summary and Key Information about the Study

You are invited to participate in this survey regarding teacher beliefs and knowledge about your experiences teaching students identified as having a learning disability in the area of mathematics. I am a graduate student at Texas Woman's University and am conducting this survey as part of my dissertation study. I am interested in finding out what current middle and secondary mathematics teachers know about learning disabilities in the area of mathematics, their beliefs, their professional training, and whether they are currently using evidence-based practices in their classrooms.

Description of Procedures

Your participation in this study will require the completion of the attached questionnaire. This should take approximately 15-20 minutes of your time. You may skip any question at any time.

Potential Risks

Your participation will be anonymous, and you will not be contacted again in the future. There is a potential risk of loss of confidentiality in all email, downloading, electronic meetings, and internet transactions. Confidentiality will be protected to the extent that is allowed by law.

Participation and Benefits

You will not be paid for being in this study. Although you may find it interesting to participate in this study, there will be no direct benefit to you from your participation.

Questions Regarding the Study

You do not have to be in this study if you do not want to be. I will be happy to answer any questions you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact me, Edward Steffek, at esteffek@twu.edu, or at (940) 898-2271 or my academic advisor, Dr. Diane Myers, at dmyers1@twu.edu, or at (940)898-2246. Thank you in advance for your kind participation.

Please complete the following survey and return it as soon as possible. Thank you.

- o I agree to participate in this study. *(if selected, participants will be taken to the screener question)*
- o I do not agree to participate in this study. *(if selected, the survey will be terminated)*

Screening items:

1. Are you currently employed as a classroom teacher of students in the range of

grades 6–12 in the United States?

- Yes *(if selected, participants will be taken to the next screening question)*
- No *(if selected, the survey will be terminated)*

2. Do you currently teach a math class as part of your regular teaching assignment?

- Yes *(if selected, participants will be taken to the survey)*
- No *(if selected, the survey will be terminated*

Demographic Items:

1. Gender

- Male
- Female
- Other
- Prefer not to answer

2. What is the highest degree you have earned?

- Bachelors

- Masters
- Additional coursework beyond Masters
- Doctorate

3. What Texas teaching license do you currently have? (Select ALL that apply.)
   - Standard Certificate – Math 4-8
   - Standard Certificate – Math 8-12
   - Standard Certificate – Math 6-12
   - Standard Certificate – Math/ Science 4-8
   - Standard Certificate – Math 8-12
   - Standard Certificate – Special Education EC-12
   - Standard Certificate – Generalist 4-8
   - Standard Certificate – Core 4-8
   - Other

4. How many years have you been a teacher?
   - 1–3

- o 4–9
- o 10 or more

5. What grades do you teach? (Select ALL that apply.)

- o 6–8
- o 9–12

6. How would you describe your school type? (Select ALL that apply.)

- o Public
- o Public Charter
- o Public Magnet
- o Alternative Education Setting
- o Private
- o Parochial
- o Urban
- o Rural
- o Suburban
- o Low socio-economic

- Other

7. How many years have you been teaching mathematics?
   - 1-3
   - 4-9
   - 10 or more.

8. How would you describe your role in the math classroom? (Select ALL that apply.)
   - General education teacher
   - Special education teacher
   - General education inclusion teacher
   - Special education inclusion teacher
   - General education co-teacher
   - Special education co-teacher
   - Other

9. What mathematics courses are you currently teaching? (Select ALL that apply.)

    - 6th Grade Mathematics
    - 7th Grade Mathematics
    - 8th Grade Mathematics
    - Pre-Algebra
    - Algebra
    - Geometry
    - Algebra 2
    - Trigonometry
    - Calculus
    - High School General Mathematics
    - Probability/Statistics
    - Other

10. What mathematics courses have you taught in the past? (Select ALL that apply.)

    - 6th Grade

- 7th Grade
- 8th Grade
- Pre-Algebra
- Algebra
- Geometry
- Algebra 2
- Trigonometry
- Calculus
- High School General Mathematics
- Probability/Statistics
- Other

11. In the past year, approximately how many hours of math-related professional development training opportunities have you had?
    - 0
    - 1
    - 2-3

- 4-5
- 6 or more

12. Overall, approximately how many hours of math-related professional development training opportunities have you had?
    - 0
    - 1
    - 2-3
    - 4-5
    - 6 or more

13. How many college mathematics courses did you take?
    - 0
    - 1
    - 2-3
    - 4-5
    - 6 or more

14. How many college special education courses did you take?

- 0
- 1
- 2-3
- 4-5
- 6 or more

15. How many college teaching of mathematics courses did you take?

- 0
- 1
- 2-3
- 4-5
- 6 or more

Survey Directions: For each of the statements listed below, please select the response

that best represents your belief.

Choices for each survey item:

- Strongly agree
- Agree
- Disagree
- Strongly disagree

Survey Items:

1. I am familiar with the term dyscalculia.
2. Dyscalculia and having a learning disability in the area of mathematics are the same.
3. Students identified as having a learning disability in the area of mathematics also have learning disabilities in the area of reading.
4. The earliest possible assessment of having a learning disability in the area of mathematics is key to future success in math curriculum.
5. Knowing a student has been identified as having a learning disability in the area of mathematics makes it easier for me to support the student.

6. I am comfortable with my ability to teach students identified as having a learning disability in the area of mathematics.

7. I am an effective math teacher for my students identified as having a learning disability in the area of mathematics.

8. I am able to support my students identified as having a learning disability in the area of mathematics in the classroom.

9. I am familiar with the Individualized Education Program (IEP) goals and objectives for my student(s) identified as having a learning disability in the area of mathematics in my math class.

10. I was properly prepared in my college teacher preparation classes to teach my students identified as having a learning disability in the area of mathematics.

11. My school has provided me with enough professional development opportunities to best support my students identified as having a learning disability in the area of mathematics.

12. I have the resources and supports available to me to successfully teach students identified as having a learning disability in the area of mathematics.

13. I use evidence-based practices (interventions based in scientific research) in my mathematics classroom to best support my students identified as having a learning disability in the area of mathematics.

14. I use tutoring support outside of classroom for my students identified as having a learning disability in the area of mathematics.

15. I use reciprocal peer tutoring (collaborative learning strategy where students interchange roles as tutor and learner) in my classroom to support my students identified as having a learning disability in the area of mathematics.

16. I use assistive technology (any device, piece of equipment or system that helps compensate for an individual's specific learning disabilities) with my students identified as having a learning disability in the area of mathematics in my classroom.

17. I use small group instruction in my classroom to support my students identified as having a learning disability in the area of mathematics.

18. I use schema-based instruction (identifying structures of different types of math problems and what strategies to use for each) in my classroom to support my students identified as having a learning disability in the area of mathematics.

19. I use explicit instruction (supporting or scaffolding instruction to teach specific skills) embedded with evidence-based interventions (based in scientific research) in my classroom to support my students identified as having a learning disability in the area of mathematics.

20. I use co-teaching as an instruction method to support my students identified as having a learning disability in the area of mathematics.

21. I use multi-sensory (visual, auditory, and sensory-motor) teaching in my mathematics classroom to support my students identified as having a learning disability in the area of mathematics.

22. I am confident with the proper vocabulary associated with the curricula of my mathematics class.

Open-ended questions:

Q1: What academic learning characteristics/limitations are associated with being identified as having a learning disability in the area of mathematics?

Q2: What strengths do you feel you have as a mathematics teacher to support your students identified as having a learning disability in the area of mathematics?

Q3: What weaknesses do you feel you have as a mathematics teacher to support your students identified as having a learning disability in the area of mathematics?

Q4: What type of teacher preparedness and professional development do you feel would support your students identified as having a learning disability in the area of mathematics?

APPENDIX B

Email to Principals

Dear Principal,

I am currently working on my doctoral degree in the area of Special Education at Texas Woman's University. As a part of my doctoral dissertation, I am hoping to conduct an online survey of general education and special education middle and high school math teachers that teach classes with students identified as having a learning disability in the area of mathematics. I am asking you to help distribute my survey to your math teachers. Specifically, the purpose of this study is to determine how prepared the teachers feel teaching students identified as having a learning disability in the area of mathematics, whether they are using evidence-based practices in their classes, and to report on their perceptions and confidence levels related to teaching students identified as having a learning disability in the area of mathematics. The information gained from this research will be helpful in formation of teacher preparation courses and professional development opportunities for teachers of students identified as having a learning disability in the area of mathematics.

A self-administered survey will be delivered electronically via the PsychData website. The survey has been designed so that participants can complete it easily. It should take 15-20 minutes to complete it. Teacher participation will be completely voluntary, and data will be kept strictly confidential. Results will be reported in group summary form only and no individual names will be used. Any potential publications resulting from this study will not identify the teachers involved in the survey. There is a potential risk of loss of confidentiality in all email, downloading, electronic meetings, and internet transactions. Confidentiality will be protected to the extent that is allowed by law.

If you have questions or concerns, please contact me at esteffek@twu.edu or by phone at 940-898-2271. You may also contact my advisor and dissertation chair, Dr. Diane Myers at dmyers1@twu.edu or by phone at 940-898-2246.

Thank you so much for your time. I sincerely appreciate your consideration for survey distribution.

Here is the link to the survey: https://www.psychdata.com/s.asp?SID=185427

Sincerely,

Edward Steffek

APPENDIX C

Letter to Teacher

Dear Math Teacher,

I am currently working on my doctoral degree in the area of Special Education at Texas Woman's University. As a part of my doctoral dissertation, I am hoping to conduct an online survey of general education and special education middle and high school math teachers that teach classes with students identified as having a learning disability in the area of mathematics and am kindly asking your participation. Specifically, the purpose of this study is to determine how prepared you feel teaching students identified as having a learning disability in the area of mathematics, whether you are using evidence-based practices in their classes, and to report on your perceptions and confidence levels related to teaching students identified as having a learning disability in the area of mathematics. The information gained from this research will be helpful in formation of teacher preparation courses and professional development opportunities for teachers of students identified as having a learning disability in the area of mathematics.

A self-administered survey will be delivered electronically via the PsychData website. The survey has been designed so that participants can complete it easily. It should take 15-20 minutes to complete it. Your participation will be completely voluntary, and data will be kept strictly confidential. Results will be reported in group summary form only and no individual names will be used. Any potential publications resulting from this study will not identify the teachers involved in the survey. There is a potential risk of loss of confidentiality in all email, downloading, electronic meetings, and internet transactions. Confidentiality will be protected to the extent that is allowed by law.

If you have questions or concerns, please contact me at esteffek@twu.edu or by phone at 940-898-2271. You may also contact my advisor and dissertation chair, Dr. Diane Myers at dmyers1@twu.edu or by phone at 940-898-2246.

Thank you so much for your time. I sincerely appreciate your consideration in participating in this survey.

Here is the link to the survey: https://www.psychdata.com/s.asp?SID=185427

Sincerely,

Edward Steffek