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Teachers' Perceptions Regarding Reaching Struggling Learners In An Elementary School Mathematics Classroom

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TEACHERS' PERCEPTIONS REGARDING REACHING STRUGGLING LEARNERS IN AN ELEMENTARY SCHOOL MATHEMATICS CLASSROOM

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Abstract

Elementary school is a critical educational period during which students develop early mathematics skills and build a foundation for future academic success. The purpose of this study was to document the instructional practices and interventions teachers use to identify and meet the needs of struggling learners in a K-3 mathematics classroom. Specific areas of focus included how K-3 teachers identify areas of need and plan for interventions, the resources they rely on in that process, and their own self-efficacy regarding addressing students' specific needs. Results from online surveys and semi-structured, one-on-one interviews indicated that teachers identify a range of student difficulties including content specific skills (e.g., numeracy, counting, fact fluency), literacy skills, general domain skills (e.g., processing speed), math anxiety, and executive functions (e.g., working memory and attention). Participants acknowledged the range of challenges they face to support struggling students and discussed their practices of actively observing their students, intervening in the moment to address areas of difficulty, and collaborating with grade-level teams to discuss curriculum and share resources. Participants noted a need for professional development focused on targeted interventions and expressed interest in exploring supplemental materials for supporting struggling students. Extensive research that delves into the curriculum materials and assessment tools utilized across a range of K-3 settings is available; however, there is a gap in research related to targeting instruction to meet a range of learners' needs in an elementary school classroom.

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CHAPTER 1

INTRODUCTION

Elementary school is a critical educational period during which students develop early mathematics skills and build a foundation for future academic success. Although teachers utilize a variety of tools and resources to support a range of needs in a mathematics classroom, students meet with success and demonstrate mastery of skills at different rates. According to Feifer (2017), 5-7% of school-aged children are diagnosed with mathematics disabilities (p. 29). In order to support students who are struggling in mathematics, it is important to identify "how such difficulties are manifested" (Mazzocco, 2007, p. 40). When specific areas of need are identified, interventions can be tailored to meet individualized needs. McLean and Rusconi (2014) studied the heterogeneous nature of math learning disabilities and noted the challenges associated with "determining the origin of the challenge" (p. 2). Research indicates that many factors, including basic number sense, working memory, attention, and visual integration skills impact the effective and efficient development of mathematics skills (Feifer, 2017, p. 10).

The importance of early intervention highlights the need for continued research into the instructional practices that promote math achievement. Mathematics instruction builds upon previously constructed knowledge, so teachers are challenged to select instructional practices that meet the needs of diverse groups of learners. Students across a range of grade levels and groupings present with varying strengths and areas of need which must be addressed through research-based interventions. Specifically, Decker and Roberts (2015) noted the importance of understanding the "specific cognitive components of learning" and emphasized the need to be aware of typical developmental milestones (p. 484).

Throughout elementary school, students can experience difficulty in a mathematics classroom for a variety of reasons. Although some students present with difficulties in mathematics related to specific domains including early numeracy skills or computation abilities, other students experience difficulty because of broader cognitive skills such as working memory deficits (Feifer, 2017; Mazzocco, 2007). Also, environmental factors, including teaching style, curriculum presentation, and perceived competence can impact student performance (Mazzocco, Feigenson, & Halberda, 2011). Eccles (1983) defined self-concept of ability as "the assessment of one's own competency to perform specific tasks or to carry our role-appropriate behaviors (p. 82). Eccles (1983) explained that "students who see a subject or task as more difficult develop lower estimates of their own abilities for that subject or task" (p. 85).

Educators recognize the need for differentiated instruction from a content foundation; however, when a student is demonstrating difficulty in mathematics, specific information regarding particular areas of need could provide important information about relevant interventions. As elementary students engage in math lessons and work to develop critical numeracy skills, it is important for teachers to present information in a manner that is developmentally appropriate and builds on previously mastered skills.

Statement of the Problem

According to the 2018 Next Generation Massachusetts Comprehensive Assessment System (MCAS), just 50% of all 3rd grade students met or exceeded expectations on the mathematics assessment (DESE, 2018a). Mathematics abilities can impact students across the curriculum and affect future educational opportunities. For this reason, it is critically important to study teacher directed interventions that can promote a child's ability to develop math skills.

To address the needs of students, K-3 teachers' knowledge about identifying and evaluating individual students regarding the potential areas of difficulty in mathematics (e.g., counting, subitizing, comparing numbers, and completing basic computations) must be reviewed. This study focused on the tools and resources teachers utilize to intervene and support elementary school students who are demonstrating difficulty in mathematics class, and how prepared these elementary school teachers feel to effectively intervene and support students who are experiencing difficulty in math. Specific areas of focus included how teachers identify an area of need and plan for interventions, the resources they rely on in that process, and their own self-efficacy about being able to address specific student needs.

To meet the individualized needs of elementary school students in a mathematics classroom, teachers must provide targeted instruction that is tailored to address specific skills and content. Research that specifically investigates classroom-based interventions and promotes the use of targeted strategies is important because of the range of factors that can hinder the effective development of mathematics skills. A one-size-fits-all approach to supporting students experiencing difficulties is insufficient. Jankvist and Niss (2018) studied targeting instruction to "pave the way for satisfactory learning" through differentiated instruction (p.15).

In addition to providing scaffolded instruction, it is important for mathematics teachers to engage each student in the learning process and create an intervention plan that is in response to specific needs (Jordan & Hanich, 2003). The complexities of mathematics education require a carefully crafted approach to meeting the needs of a range of learners. Mazzocco (2007) studied the role of the teacher in supporting students in a mathematics classroom and emphasized that "astute observation serves an important role in assessing a child's *at-risk* status" (p. 47).

Purpose of the Study

Extensive research into the reasons why students experience difficulty in mathematics and the recommendations for intervention is widely available; however, researchers note the limited amount of information related to targeted interventions (Krasa & Shunkwiler, 2009; Feifer, 2017). The purpose of this study was to document the instructional practices and interventions teachers use, what resources are available to them, and how prepared they feel to meet the needs of struggling learners in a K-3 mathematics classroom.

Through a study focused on identifying teachers' use of targeted strategies to identify and support struggling students, valuable insights regarding instructional practices that promote productive learning experiences can be documented. To develop an understanding of how teachers can provide a continuum of services for students experiencing difficulty in mathematics class, research questions were designed to focus on instructional practices used by teachers to identify and meet the needs of students in an early elementary (K-3) mathematics classroom.

Research Questions

The following research questions guided the study:

1) How do early elementary school teachers (K-3) identify and evaluate individual students regarding the potential areas of difficulty in mathematics (e.g., counting, subitizing, comparing numbers, and completing basic computations)?
2) What tools and resources do early elementary school teachers utilize to intervene and support elementary school students who are demonstrating difficulty in mathematics class?
3) To what extent do early elementary school teachers feel prepared to effectively intervene and support students who are experiencing difficulty in math class?

Conceptual Framework

The complexity of mathematics instruction, particularly in early elementary school, requires a level of expertise and attention to detail from the teachers who are overseeing the curriculum. The primary theoretical framework for this study is based on Vygotsky's (1978) theory of socio-cultural development and related Zone of Proximal Development (ZPD). As young students develop their foundational mathematics skills, it is important for information to be presented in a structured manner that meets the individual needs of each student. Specifically, teachers must have a working understanding of the level of their students in terms of the curriculum about which they are learning. Vygotsky's theory provides a flexible framework for presenting curriculum that is appropriate for the learners in a class.

In addition to the constructivist theory, which emphasizes interactions and classroom engagement, Vygotsky also discussed the Zone of Proximal Development (ZPD). Because mathematics instruction requires individualization of skill and content instruction, the ZPD is often referenced in math research. Researchers de Freitas and Walshaw (2016) discussed Vygotsky's work and noted that the ZPD is the "distance between a child's actual developmental level and their higher level of potential development" (p. 22). Students must be provided with the support and interaction necessary to create their own understanding and make connections that will help solidify their learning. Developing an understanding of math concepts and numbers is important; however, "it is only when the student is able to use them as a vehicle for her own activity and actively deploy them that we can speak of her agency in the process" (de Freitas & Walshaw, 2016, p.18). This framework for learning provides an important basis for effective instructional intervention that meets individual needs and moves beyond memorization or rote application.

Similar to Vygotsky's theory, Bruner's (1966) scaffolding theory, which relates to the impact of environmental conditions on students' learning in a mathematics class, is also relevant to this study. Bruner (1966) discussed the instructional practices in a mathematics classroom and noted that "intellectual development depends upon a systematic and contingent interaction between a tutor and a learner" (p. 6). As practices and curriculum resources are reviewed and evaluated throughout this study, a close connection to the importance of an effective environment cannot be overlooked. Bruner (1966) recognized the range of instructional practices that different children needed in order to be successful in mathematics class and was interested in studying "how people reach their high-water mark" (p. 4).

To promote success in an elementary mathematics classroom, interventions must be tailored to meet a range of student strengths and needs. As discussed by Gordon, Meyer, and Rose (2014), a universal design for learning (UDL) model "is a transformative innovation that emphasizes flexibility and individuality" in the classroom (p. 84). When students demonstrate difficulty mastering presented mathematics skills, personalized interventions are necessary to target the specific areas of need (Gordon et al., 2014). Gordon et al. (2014) discussed the need to "guide the design, selection, and application of learning tools, methods, and environments" to promote effective teaching practices (p. 88).

Assumptions, Limitations, and Scope

It is generally accepted that there is a range of reasons for the challenges that individual students face in mathematics including number sense, math anxiety, working memory challenges, and executive function deficiencies. Despite this, teachers might have difficulty objectively reporting their practices or experiences with struggling learners during the interviews. Bloomberg and Volpe (2016) discussed participant reactivity and the potential for

interviewees to be less candid in their responses depending on the presence or absence of a relationship with the interviewer (p. 178). One potential area of bias is related to the researcher's position as an elementary school teacher in Essex County, Massachusetts. The researcher restated that the interviews are confidential and confirmed that the interviewee wanted to continue to participate in the study. To promote an environment that allowed for honest and open discussions, the researcher clearly shared the overall goals of the study and described the processes involved with coding data and maintaining confidentiality.

For the purpose of this study, non-academic issues (e.g., family dynamics, health issues, socioeconomic status) that could impact students' math achievement were not addressed. The focus of this study was based on teachers use of tools and strategies to identify and support students having difficulty in mathematics, so broader environmental issues and family dynamics were not addressed in the research questions. In addition, the study group was composed of K-3 public elementary school teachers, which does not necessarily represent the experiences of teachers in upper elementary classrooms across a range of school settings.

Significance and Rationale

The rationale for this research study was grounded in the need to support the achievement of all learners in a mathematics classroom through provision of targeted instructional supports. Although Massachusetts public schools are ranked among the top school systems across the nation, "substantial gaps in student outcomes persist in our state" (DESE, 2018b). Following the passage of the Every Student Succeeds Act (ESSA) in 2015, the Massachusetts State Educational Agency (SEA) composed and submitted a plan of action to the U.S. Board of Education that outlined specific goals to reach all learners and "strengthen the quality and breadth of the instructional program students experience" (DESE, 2018b, p. 12). In 2017, the Massachusetts

curriculum frameworks were updated; the math curriculum guidelines create "a strong foundation that prepares students for more advanced math work" (DESE, 2018c, p. 11).

Extensive research that delves into the curriculum materials and assessment tools utilized across a range of K-3 settings is available; however, there is a gap in research related to general education teachers and targeting instruction to meet a range of learners' needs. The Massachusetts Curriculum Frameworks provide information about the content that should be covered, and researchers have identified the range of challenges that students can face in math, but a strong connection to classroom interventions is lacking. As Feifer (2017) noted, it is "paramount for educators to have a deeper understanding of the true nature of deficient math skills in order to craft more individually based and targeted interventions" (p. 67). Through a study of the common practices used to identify and support struggling elementary school math students, specific areas of need can be identified and recommendations for targeted instruction can be made. Teachers utilize a variety of tools, skills, and resources to identify students in need of additional support as early as possible and align interventions to create effective instructional groups and target specific needs.

Definition of Terms

The following terms are defined to provide a content-specific foundation.

Automaticity. The ability to perform an overlearned task with "little, if any, conscious, cognitive effort" (Dehn, 2015, p. 211).

Executive functions. "A set of multiple cognitive processes that act in a coordinated way to direct cognition, emotion, and motor functions" (Feifer, 2017, p. 43).

Fluency. As defined by Leinwand and Kanter (2018), mathematics fluency is related to the "conceptual understanding of numbers, place value, and operations" (p. 19).

Math anxiety. The emotional state often characterized by "negative feelings, tension, apprehension, and /or fear that interferes with math performance in school, as well as utilizing mathematics in everyday life endeavors" (Ashcraft, 2002, as cited in Feifer, 2017, p. 81).

Number sense. The confidence associated with mental manipulation of quantities (Krasa & Shunkwiler, 2009).

Processing Speed. "How quickly the brain processes information and how efficiently simple cognitive tasks are executed over a sustained period of time" (Feifer, 2017, p. 36).

Scaffolding. An instructional technique during which students are provided with supports to complete an assigned task (e.g., visuals, models, guided questions) (Feifer, 2017).

Subitizing. The rapid identification of the number of objects in a small set, typically 3-4 objects. (Goldfarb, & Levy, 2013).

Visual-spatial processing. "The ability to perceive, analyze, synthesize, manipulate, and transform patterns and images" (Dehn, 2015, p. 37).

Working memory. The cognitive system responsible for holding information for processing (e.g., while solving a math problem) (Feifer, 2017).

Conclusion

While researchers have studied a broad range of academic difficulties, including mathematics, an additional focus on the identification and implementation of interventions to support early elementary school students in the mathematics classroom is necessary. To meet the full range of needs of elementary school students, providing targeted mathematics instruction that is tailored to meet the individualized needs of students is an important undertaking. Because mathematics is cumulative in nature, researchers and teachers recognize the need to identify students who are experiencing difficulty as early as possible.

Through a study of mathematics instruction in an early elementary school setting, information about best practices for identifying and supporting struggling learners progress can be gathered. Completing assessments to identify a mathematics disability is important; however, it is equally important to identify specific areas of difficulty and recommend instructional practices that address individual needs. A guiding principle of the Massachusetts Curriculum Frameworks notes the importance of educators' mathematics content knowledge "to help students learn how to efficiency do mathematical calculation, but also to help them understand the fundamental principles of mathematics" (DESE, 2018c, p. 14). This study examined the methods early elementary school math teachers use to identify and support students who are demonstrating difficulty accessing the mathematics curriculum.

Chapter 2 examines literature related to the range of factors that can impact student achievement in a K- 3 mathematics classroom. Chapter 3 outlines the research design, methods, and participants involved in the study.

CHAPTER 2

LITERATURE REVIEW

Elementary school is a critical educational period during which students develop early mathematics skills and build a foundation for future academic experiences. As a result of advances in technology, educators have access to a wide range of tools and resources to create engaging and effective lessons; however, 5-7% of school-aged children are diagnosed with mathematics disabilities (Feifer, 2017). Although a vast amount of literature exists on math disabilities in young adults (high school and college), this review focused on the common factors that potentially indicate difficulty accessing mathematics curriculum in an elementary school classroom. This systematic and thematic literature review assessed the research related to identifying, diagnosing, and promoting successful acquisition of skills in an elementary mathematics classroom. The data reviewed indicates that a wide range of factors, including basic number sense, working memory, and attention, impact the effective development of mathematic skills. The importance of early intervention and targeted instruction for struggling math students highlights the need for research into factors that impact math performance and strategies for supporting a range of student needs.

Research Questions

1) How do elementary school teachers (K-3) identify and evaluate individual students regarding the potential areas of difficulty in mathematics (e.g., counting, subitizing, comparing numbers, and completing basic computations)?
2) What tools and resources do teachers utilize to intervene and support elementary school students who are demonstrating difficulty in mathematics class?

3) To what extent do elementary school (K-3) teachers feel qualified to effectively intervene and support students who are experiencing difficulty in math class?

Approach and Methods

This literature review focused on the factors that impact the development of mathematics skills, the diagnostic tools and instruments used to identify students experiencing difficulty, and the range of recommendations to effectively support elementary school students experiencing difficulty mastering presented curriculum. Because individual students may experience difficulty acquiring age-appropriate mathematics skills for a wide range of reasons, specific areas of challenge were reviewed, including basic number sense, counting and sequencing, math anxiety, and working memory or executive function deficits. This review explored the tools used to identify mathematics disabilities, the range of factors that play a role in the development of mathematics skills in elementary school, and recommendations for classroom intervention.

To conduct this literature review, an electronic search of professional journals, dissertations, books, and periodicals was completed. Scholarly articles and resources relevant to the study of mathematics and the factors that impact efficient math performance were selected from the past 10 years. During the search for sources, qualifying terms (e.g., dyscalculia, math disability, numeracy, and math anxiety) were used to narrow the volume of resources for review. A focus was on student assessment, factors that impact effective progress, and recommendations for specialized intervention. Following the initial identification of relevant sources, additional sources were located by reviewing the references section from selected articles.

Specific topics of the literature review include tools and strategies for early identification of students experiencing difficulty in mathematics. To address the range of needs that students can experience, information regarding early numeracy skills and classroom interventions were

included. General cognitive domains (e.g., working memory and executive functions) were also included because of the potential impact on math skill development.

Two primary areas of assessments were reviewed: (a) studies of school-aged students and (b) diagnostic tests for identification of math difficulties. This review focused on the potential reasons why students have difficulty with mathematics, the need for early identification of students at risk for a math disability, and the range of interventions to support students in the classroom.

Screening for Math Disabilities

To support students who are demonstrating difficulties with the effective development of age-appropriate mathematics skills, educators differentiate lessons and modify classroom routines as necessary. Across the studies related to early identification of math disabilities, researchers noted the importance of conducting screenings on students in early elementary school (Stock, Desoete, & Roeyers, 2009). According to Feifer (2017) between 6% and 14% of school-age children experience difficulty with mathematics in spite of appropriate instruction (p. 25). Other studies reported a slightly lower occurrence of 3-7% of school-age children, but they specified a diagnosis of dyscalculia rather than a broader category of math disability (McCaskey et al., 2018, p. 2). Although a general consensus was shared among the researchers with regards to a dyscalculia diagnosis, the use of targeted tools to identify students with math disabilities and dyscalculia varied. In one study reviewed, students who were performing two grades below their chronologic age were identified as dyscalculic (Ashkenazi, Mark-Zigdon, & Henik, 2009, p. 392). In contrast, students were reported to meet the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) criteria for dyscalculia because they had skills “substantially and quantifiably below those expected for the individual’s chronological age” (Lafay, St-Pierre, &

Macoir, 2017, p. 676). In order for a true comparison across studies to be reliable, diagnostic criteria for a dyscalculia diagnosis must be consistent. This is a critical area for additional review and assessment. Feifer (2017) differentiated between a math disability and dyscalculia and defined dyscalculia as a "specific aspect of mathematical cognition or processing that may be compromised" (p. 26).

Across the studies, researchers noted similar patterns between math and reading disability diagnoses and highlighted the limited amount of scientifically-based instructional support for students with mathematics disabilities (Feifer, 2017). Because mathematics is a fundamental academic content area that has far-reaching connections across the curriculum and grade levels, Krasa & Shunkwiler (2009) noted the importance of early identification of students with difficulties and emphasized the need for an increase in the level of research focused on math disabilities. While studying mathematics disabilities, researchers also considered the role of low language skills in the development of early math skills (Desoete, Ceulemans, Roeyers, & Huylebroeck, 2009). Although there is not a clear consensus across research studies, Desoete et al. (2009) emphasized the impact that limited language abilities can have on counting, subitizing, and grouping skills. Because of the importance of language in the development of math skills (e.g., more than, less than), Desoete et al. (2009) recognized the need to study a continuum of math skills in both isolated assessments and comprehensive problem-solving sessions. Screening for math disabilities is a complex process that involves orchestration of comprehensive assessment tools, observation skills, and critical analysis of recorded data.

Because students develop math skills over a period of time, it is important to gather longitudinal data based on specific diagnostic criteria for long-term comparison. An extensive range of assessment tools, instructional practices, and resources for identification of both general

domain skills (e.g., related to brain processes) and specialized mathematics skills (e.g., numeracy, counting, subitizing) should be further evaluated. In the following section, the factors involved with the early identification of students with math disabilities are discussed.

Early Identification

The development of math skills has long been believed to be the result of a number of different, yet interconnected, skills. Although much of the research included in this review focused on a particular aspect of math achievement (e.g., computations or arithmetic), a common theme was the need for early identification of students with math disabilities. Mathematics disabilities are complex to diagnose with many different characteristics that vary from individual to individual (Krasa & Shunkwiler, 2009). It is important, however, to differentiate between a student who is having difficulty mastering a new math concept and a student who is exhibiting signs of a math disability. A mathematics learning disability is a problem that does not readily respond to instruction and is not rooted in compromised intelligence (Stock et al., 2009).

To better understand the early development of math skills, researchers studied the brain structures that are involved in the completion of academic tasks. In a selective review of the literature, brain structures associated with mathematics skill development were identified to be the frontal lobe, parietal lobe, and intraparietal sulcus (Henik, Rubinsten, & Ashkenazi, 2011, p. 997). Researchers discussed the core role of the intraparietal sulcus (IPS) but noted the existence of a range of deficits associated with compromised activity in the IPS (Henik et al., 2011).

The complex nature of mathematics can hinder the ease with which a student is identified as being in need of additional support. As Krasa and Shunkwiler (2009) stated, “mathematical language has a symbol system, vocabulary, and grammar that is mathematically elegant, but complex and cognitively demanding to learn” (p. 87).

Developing mathematics skills is recognized as a complex process throughout the research reviewed. Feifer (2017) presented a detailed discussion of factors related to math difficulties and the different types of dyscalculia (i.e., procedural and verbal dyscalculia). Procedural dyscalculia is defined as deficits in the ability to use foundational skills (e.g., count objects, sequence numbers) when solving problems (Feifer, 2017, p. 57). In contrast, verbal dyscalculia manifests as challenges with retrieval of facts and automatic recognition of numbers (Feifer, 2017). Although the subtypes have different presentations, the tasks commonly completed in a classroom environment would likely require students to demonstrate the ability to count and retrieve answers. Feifer (2017) recognized that students with dyscalculia display both strengths and weaknesses in mathematics and require interventions that meet their particular area of need (Feifer, 2017). Consequently, additional targeted studies that specifically addressed the foundational math skills in isolation and in tandem with other skills should be conducted (Feifer, 2017, p. 22).

Signs and Symptoms of Mathematics Difficulty

School-age children work to complete both simple and complex mathematics tasks on a routine basis. Across the studies reviewed, mathematics skill assessments were focused on whole number computations rather than higher-level skills such as solving word problems or applying computation skills to solve problems related to geometry or fractions. Rather, basic numeracy skills including single-digit computations, number identification, counting, and magnitude assessments were the sole focus. Although data related to higher level math is important, the focus on foundational skill development is consistent across the literature.

Classroom Interventions

Within a classroom, different tools are commonly used to assess and document student progress. Although formal and informal assessments are a widely accepted process for identifying student achievement, there is a need for increased observation and analysis of collected data. Particularly in the early stages of learning a new math skill, it is critically important to individualize strategy use for students in a math classroom and intervene when children are learning early counting skills (Nguyen, Laski, Thomson, Bronson, & Casey, 2017). Nguyen et al. (2017) discussed the need to connect counting a given set and labeling the set (*one, two, three*) during early counting skill practice. The foundational skills of counting and labeling are believed to have a strong effect on future math skills, including cardinality, or recognizing that the last number stated is the total of the set counted (Nguyen et al., 2017). These early skills are vital for continued mathematics achievement.

Factors that Predict Skill Development

Along with the need to identify the specific mathematics challenges a student faces, it is also important to consider additional factors that could also hinder a student's progress in mathematics. Desoete et al. (2009) reviewed studies related to early numeracy skills and identified counting, subitizing, and ordering numbers as key factors in the development of math skills. For each student, a range of particular needs and challenges likely exists (Krase & Shunkwiler, 2009). The following section breaks down the common numeracy skills that are both explored in the studies and frequently utilized in classroom settings.

Numerical Distance and Sequencing

Accurately solving computation problems is a complex task that requires the use of a number of underlying math skills. One such skill is the ability to properly place a number on a

bound or unbound number line (Lafay et al., 2017). Ashkenazi et al. (2009) conducted a study of 29 students with an average age of 9-5; 13 students were diagnosed with developmental dyscalculia and 16 students demonstrated typically developing math skills (p. 392). Students who were performing two grades below their current grade level were identified as having dyscalculia. Askenazi et al. (2009) excluded students with coexisting disability diagnoses (e.g., reading disabilities, attention deficit disorder) from the study in order to maintain focus on math disabilities. Results of the study indicated that no distance effect, or increase in error rate, with numbers further apart (e.g., 5 and 7; 4 and 9), was noted between the groups on single-digit number tasks (Ashkenazi et al., 2009, p. 397).

In a three-year longitudinal study of early numeracy skills, researchers studied a group of 231 students in Kindergarten through third grades who were identified as typically achieving, math learning disabled, low achieving-mild fact retrieval, and low achieving-severe fact retrieval (Geary, Hoard, & Bailey, 2012). Data from the study identified the wide range of numerical skills on which students with developmental dyslexia demonstrated difficulty. In order to build on previous studies, Lafay et al. (2017) explored the connection between completing tasks involving a mental number line when presented with a single or multi-digit number. Out of 79 third grade students included in the study, 39 students met the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) criteria for a math disability. Lafay et al. (2017) recognized that students were being asked to not only place a number on a number line but also to identify the value of the Arabic number presented (e.g., 1, 2, 3). What was once thought to be a simple task was identified to actually include multiple steps. The complexity of the tasks and the variability within the student groups highlighted a need for future studies. Recommendations included repetition with a larger group and use of assessments to identify working memory difficulties.

Mathematics performance is a multi-faceted task that is impacted by a wide range of specific and broad skill sets. Lafay et al. (2017) noted that students with math disabilities were able to place non-symbolic numbers on a physical number line; however, this finding is inconsistent with previously conducted research (Geary, Hoard, Nugent & Gyrd-craven, 2008). For this reason, as well as the limited sample size and length of the Lafay et al. (2017) study, additional studies that evaluate the developmental progression of number skill tasks were recommended (Lafay et al., 2017).

Counting and Subitizing

Subitizing, the ability to perceive quantities without specifically counting, is considered to be an important math skill (Goldfarb & Levy, 2013). Goldfarb and Levy (2013) worked to expand on studies and evaluate subitizing skills with and without the presence of distractors. To further explore the factors that impact mathematics performance, the researchers recognized the need to isolate the impact of distractors when completing math tasks. Researchers examined the role that a distractor played when it was placed within a set of objects to subitize. In a quantitative experimental study focused on comparing organized and disorganized subitizing sets, an increase in response time was noted with a disorganized presentation of numbers (Goldfarb & Levy, 2013, p. 7). Of note, the study group was composed of young adults without any diagnosed disabilities. It was hypothesized that, as children are provided with increased opportunities to practice skills and demonstrate improved efficiency, additional skills can be introduced and specifically targeted (Goldfarb & Levy, 2013).

A study by Lee, Kotsopoulos, Tumber, and Makosz (2015) focused on the precursor skills of counting and explored the importance of gesturing while teaching pre-school students to count. Although the research was in its early stages, it was hypothesized that parents are using

gestures with their children at home (Lee et al., 2015). As a result, the entry-level skills of different kids could vary greatly due to the high variability of the home experience. This inconsistency, along with other early numeracy skill variability, can result in a wide range of achievement levels in the early elementary school year.

In a related study, students who demonstrated limited skills on the Woodcock-Johnson Assessment demonstrated more difficulty with math competence across grade levels (Bugden & Ansari, 2011). Math achievement improvements were noted in students as they transitioned from first to second grade; therefore, questions related to the level of skill instruction prior to enrollment in school were noted (Bugden & Ansari, 2011). Researchers further emphasized the complexity of mathematics and the need for additional studies over an extended period of time. Specific questions for study included the impact of developmental progress on math skills and the period of time necessary for math skills to develop across broad math measures.

Along with the need to recognize a number and attach a value to the number, school-age students are regularly assessed on their ability to rapidly complete math problems. A study by Geary et al. (2012) noted the challenges that students with math disabilities faced when presented with a task requiring automatic fact retrieval. Automaticity, a critical math skill, is the rapid and automatic recall of the answer to a fact-based math problem (Feifer, 2017). In a study of 231 students in grades 2-4, Geary et al. (2012) evaluated the development of automaticity as a foundational skill that impacts future math achievement. The study group was evaluated using a wide range of assessments, including executive functioning assessments, working memory tasks, and rapid automatic naming evaluations. Geary et al. (2012) noted a high rate of errors (e.g., 4/5 retrieved answers were errors); however, the researchers questioned the impact that general domain skills (e.g., working memory, rapid naming, executive functions) had on math

computation skills (Geary et al., 2012). Specifically, Geary et al. (2012) identified a need to determine where the diagnostic line is between a math disability and a fact recall difficulty.

Number Sense

Mathematics skill development also requires an understanding of the relationships between numbers and symbols (Henik et al., 2011). Although a well-developed number sense is an important area of research, it is suspected that additional general domain skills (e.g., attention) also impact math skill development and play a part in the diagnosis of developmental dyscalculia. Henik et al. (2011) identified the wide range of potential factors related to math disabilities and noted that deficits in the intraparietal sulcus, a brain region vital for number skills, are often associated with developmental dyscalculia, math disabilities, or deficits in attention and arithmetic fluency.

General Domains and Mathematics

The previous section focused on literature related to specific math skills; however, a full study of math skill development would be incomplete without a focus on the cognitive skills that potentially impact mathematics performance. Focusing on a specifically tailored intervention program is important in order to target individual areas of need. The impact of executive functions on efficient and effective math problem solving is a critical aspect of mathematics achievement to evaluate.

Executive Functions

Executive functions, specific skills linked to the frontal lobe of the brain, include inhibition, shifting attention, and sustaining attention to the task at hand (Feifer, 2017). Ashkenazi and Henik's 2010 study identified deficiencies in the executive functions of students with dyscalculia. In a study of college-level students, a deficit in the ability to inhibit responses

and domain-general (e.g., attention) challenges were noted (Henik et al., 2011). In a related study, neuroimaging studies revealed aberrations in the frontal lobe, which is the executive network of the brain (Ashkenazi & Henik, 2010).

To gather information about the executive functions capacity, researchers used a range of tests designed to evaluate attentional skills of participants completing math tasks (Ashkenazi & Henik, 2010, p. 3). Results from the study suggested deficiencies in the executive and alerting networks of the brain for the participants with dyscalculia and attention deficit hyperactivity disorder (ADHD) (Ahkenazi & Henik, 2010, p. 9). Similar to other studies, the study reinforced the range of challenges with which students with dyscalculia present and can therefore be identified. Specifically, a "difficulty in conflict resolution could produce deficits in retrieval of the correct solution" (Ashkenazi & Henik, 2010, p. 8). Researchers were cautious about their findings and acknowledged the need for additional evaluations of attentional skills to be completed in isolation.

Attention. In the classroom, mathematics difficulties are often initially identified through assessments and observations of students during completion of academic tasks (Feifer, 2016). Children with math difficulties present with a heterogeneous profile with regards to specific math skills (Feifer, 2017, p. 26). In a study of 14 university students, Ashkenazi and Henik (2010) used neuro-functional studies to evaluate attention, executive functions, and memory. The intraparietal sulcus and parietal lobes were identified as brain areas that are associated with completion of math tasks (Ashkenazi & Henik, 2010).

Working Memory. Working memory, categorized as an executive function skill, has a wide-ranging impact on academic tasks. Although it is broad in terms of impact, it is a limited-capacity system that temporarily stores information for manipulation (Mammarella, Hill, Devine,

Caviola, & Szucs, 2015). Mammarella et al. (2015) acknowledged the connection between working memory and math performance and worked to build upon the existing studies. To evaluate the impact of working memory and math, researchers examined a group of 24 students with dyscalculia, 22 students with math anxiety, and 23 typically developing students between 11 and 13 years of age (Mammarella et al., 2015). In contrast to previously conducted studies, dyscalculic students were identified by scores below the 16th percentile on a standardized math assessment. Similarly, students with math anxiety were identified by a score on a math anxiety test over the 16th percentile (Mammarella et al., 2015).

Similar to previously conducted studies, researchers explored the possible relationship between math anxiety and calculation skills. Mammarella et al. (2015) extended the study to include short-term memory and working memory variables and considered the role each plays in mathematics achievement. In a single-study, data reflected a decreased performance across verbal working memory tasks for children with math anxiety and decreased performance for dyscalculic students on the visual-spatial tasks (Mammarella et al., 2015, p. 884). The researchers noted the challenges related to separating out math anxiety from other factors, including executive function weaknesses, and recommended additional studies to further explore the relationships between working memory, anxiety, and math achievement (Mammarella et al., 2015).

Mathematics Anxiety. In addition to harnessing skills and resources to complete mathematics problems, managing anxiety related to mathematics can be an additional challenge for some students. Vukovic, Kieffer, Bailey, and Harari (2013) completed a longitudinal study of 113 students in second and third grades. Researchers collected quantitative and qualitative data through math computation tasks and questionnaires in an attempt to quantify the impact of

anxiety on math performance. Findings included a negative correlation between math anxiety and calculation skills, as well as a connection to visual-spatial working memory deficits (Vukovic et al., 2013). Researchers also reported that when children had a higher working memory capacity, the presence of math anxiety was found to negatively impact the development of math application skills (Vukovic et al., 2013).

Mathematics anxiety was frequently associated with low performing math students and was reported to be inversely related to math achievement (Maloney & Beilock, 2012). Maloney and Beilock (2012) discussed the relationship between low performing math students and anxiety and emphasized the importance of also considering the impact of social influences in a math classroom when gathering information about a student and math anxiety. In a similar study, Jansen et al. (2013) studied similar patterns of mathematics performance and anxiety and recommended that researchers continue to explore the role that a teacher's math anxiety has on the development of math skills in a classroom setting.

Math Anxiety and Working Memory. The presence of mathematics anxiety can tax other cognitive resources, including working memory, which can hinder a student's ability to manage the complexity often associated with mathematics problems (Maloney & Beilock, 2012). In a study of 162 first and second-grade students, a relationship between self-reported math anxiety and low math performance was identified in students with high working memory skills but not students with low working memory skills (Ramirez, Gunderson, Levine, & Beilock, 2013, p. 194). Researchers hypothesized that students with high working memory abilities would more often rely on their mental math abilities, which could be hindered when a student is experiencing math anxiety (Ramirez et al., 2013). In contrast, students with lower working

memory performance often rely on counting on their fingers, so their working memory skills are not impacted by the presence of math anxiety (Ramirez et al., 2013).

Similar to the presence of other math challenges including counting skills and subitizing abilities, the presence of math anxiety is a heterogeneous situation across disciplines that requires individualized and specialized interventions. Although the initial recognition of the signals that a student is experiencing math anxiety is a necessary step, it is important to distinguish math disabilities from emotional disabilities or generalized anxiety disorders. Although the presentation can be similar, the clinical interventions are different and should be specifically selected to match the type of anxiety or difficulty (Ramirez et al., 2013).

Supporting Students with Math Anxiety. Addressing the broad range of mathematics difficulties experienced by students requires specialized and targeted interventions and supports. To respond to the wide range of math learning patterns of elementary school students, providing targeted mathematics instruction that can be tailored to meet the needs of students with and without developmental dyscalculia is an important undertaking. Researchers recognized the complexity of the steps required to develop math skills and identified that although the diagnosis of a math disability is critical, the implementation of targeted interventions is equally important (Krasa & Shunkwiler, 2009). Mammarella et al. (2015) emphasized the importance of targeted interventions and reminded instructors to avoid overtaxing students' working memory during mathematics lessons.To add to the research base, Maloney and Beilock (2012) explored the antecedents of math anxiety. Although evidence of math anxiety has been noted in young adults, researchers have begun to note the presence of anxiety in elementary aged students (Maloney & Beilock, 2012). Because anxiety can present in a wide range of ways, it is important to clearly identify what is causing the anxiety and individualize interventions and strategies for managing

the condition (Maloney & Beilock, 2012). It is widely recognized that math anxiety is not fully understood, but specific interventions, including active engagement and student reflection, are being explored as potential sources of relief (Everingham, Gyuris, & Connolly, 2017).

Theoretical Framework

The complexity of mathematics instruction, particularly in early elementary school, requires a level of expertise and attention to detail from the teachers and administrators who are overseeing the curriculum (Feifer, 2017, p. 91). In order to provide a framework for a study of mathematics difficulties and recommendations for intervention, theories related to learning and instruction were reviewed. Vygotsky's (1978) theory of socio-cultural development and related Zone of Proximal Development (ZPD) (Vygotsky, 1978) provide the primary theoretical framework related to learning. Bruner's (1966) scaffolding theory emphasized the importance of structured learning processes, which relates to the impact of environmental conditions on students in a mathematics class. As young students develop their foundational mathematics skills, it is important for information to be presented in a structured manner that meets the individual needs of each student. Specifically, teachers must have a working understanding of the level of their students in terms of the curriculum about which they are learning. Vygotsky's theory provides a flexible framework for presenting curriculum that is appropriate for the learners in a class.

Vygotsky's Theory of Socio-cultural Development

In a synopsis of Vygotsky's work, de Freitas and Walshaw (2016) noted that "children's development is influenced by their interactions with other people and the wider social environment which encompasses cultural and historical artifacts and practices" (p. 14). Over the years, Vygotsky's work has been extensively studied by researchers interested in expanding on

his ideas and adding to the overall bank of information regarding how students learn and develop. As discussed by Fani and Ghaemi (2011), Vygotsky "strongly criticized positions that assumed development is impervious to instruction" (p. 1551). In a mathematics classroom, a wide range of skills and interventions are necessary in order for students to meet with success. In an additional discussion of Vygotsky's beliefs and theories, de Freitas and Walshaw (2016) noted that supporting the development of "independence and critical appreciation and interrogation tools, rather than focusing on transmitting facts, will contribute not only to cognitive development but also to their physical, social and emotional development" (p. 19). Although a desire to recall and complete mathematics computations is common, the fundamental beliefs of Vygotsky emphasize the connection between learning and culture, which is a dynamic and complex situation, particularly in an elementary school classroom.

Zone of Proximal Development

In addition to the constructivist theory, which emphasizes interactions and classroom engagement, Vygotsky also discussed the Zone of Proximal Development (ZPD). Because mathematics instruction requires individualization of skill and content instruction, the ZPD is often referenced in math research. Researchers de Freitas and Walshaw (2016) discussed Vygotsky's work and noted that the ZPD is the "distance between a child's actual developmental level and their higher level of potential development" (p. 22). Although mathematics curriculum is sequential in nature, it is important to consider the pace at which new information is provided. Similarly, students must be provided with the support and interaction necessary to create their own understanding and make connections that will help solidify their learning. This framework for learning provides an important basis for effective instructional intervention that meets individual needs and moves beyond memorization or rote application.

Scaffolding Theory

Similar to Vygotsky's theory, Bruner (1966) discussed the instructional practices in a mathematics classroom and noted that "intellectual development depends upon a systematic and contingent interaction between a tutor and a learner" (p. 6). Bruner (1966) recognized the range of instructional practices that different children needed in order to be successful in mathematics class and was interested in studying "how people reach their high-water mark" (p. 4). In the mathematics classroom, all students, including students with and without learning disabilities, present with a range of skills. Through a carefully scaffolded curriculum that provides support for students as necessary, teachers can provide students with opportunities to actively participate in successful learning experiences.

As students move through the elementary school grades and begin building their foundation of math skills, they meet with success at varying rates. Although teachers can provide instruction that enables students to master concepts in the classroom, it is also important for students to develop an ability to work independently and make connections to other content areas. Vygotsky's theory of socio-cultural develop and implication in the math classroom provides a framework for building a scaffolded curriculum; however, many issues potentially impact students' math achievement that are not specifically addressed through this framework.

Classroom Interventions

Utilization of a range of assessment tools, instructional practices, and resources for identification of both general domain skills (e.g., related to brain processes) and specialized mathematics skills (e.g., numeracy, counting, subitizing) could provide additional information that is necessary for effective groupings and instructional interventions. In addition, although Vygotsky's theory provides a strong basis for instructional practices in the classroom, the

research does not specifically consider additional factors that could severely limit performance. For example, math anxiety is an emerging topic of study that can have a lasting impact on a student. Through the lens of a supportive and engaging teacher, students can be monitored and supervised so their particular needs can be met. Along the same lines, managing a dynamic classroom environment requires a highly skilled teacher that not only understands Vygotsky's theory of socio-cultural learning and Bruner's scaffolding theory but also has a fluid and extensive mastery of math concepts. Effective math instruction is a key component of a successful experience, but it is not the single answer to a challenging issue in our elementary schools across the nation.

Universal Design for Learning

To promote success in an elementary mathematics classroom, interventions must be tailored to meet a range of student strengths and needs. As discussed by Gordon, Meyer, and Rose (2014), a universal design for learning (UDL) model "is a transformative innovation that emphasizes flexibility and individuality" in the classroom (p. 84). When students evidence difficulty mastering presented mathematics skills, personalized interventions are necessary to target the specific areas of need (Gordon et al., 2014). Gordon et al. (2014) discussed the need to "guide the design, selection, and application of learning tools, methods, and environments" (p. 88) to promote effective teaching practices. Within an elementary mathematics classroom, utilization of a variety of tools and resources is necessary in order to effectively scaffold instruction to meet the individual needs of each learner.

Conclusions

While researchers have studied a broad range of academic difficulties, including mathematics, additional focus on teacher-directed interventions for students experiencing

difficulty in mathematics is necessary. To meet the range of needs of elementary school students, providing targeted mathematics instruction that is tailored to meet the needs of students is an important undertaking (Feifer, 2017, p. 91). Because mathematics is cumulative in nature, researchers and teachers recognize the need to identify struggling students as early as possible (Henik et al., 2010, p. 990). Although a wealth of information about math disabilities and recommended interventions are available, the factors that potentially interfere with individual progress need to be further studied. As researchers continue to study the causes, features, and interventions for identifying students with math difficulties, a specific focus should also include identifying targeted interventions that could support struggling students and promote the successful acquisition of mathematics skills.

Across a number of studies, researchers tested students with and without disabilities. Although students with a wide range of abilities were assessed during different studies, the specific criteria for identifying a mathematics disability varied greatly; some based a diagnosis on teacher reports while others focused on prolonged difficulties with grade level mathematics or a formal math assessment. From the reviewed studies, it can be seen that there is a need to develop specific criteria for identification of a math disability, including the parameters for distinguishing a math disability from dyscalculia (Ramirez et al., 2013, p. 196). In addition, providing early intervention that is specifically targeted to address individual vulnerabilities is necessary. Mathematics intervention literature recognizes the benefits associated with individualized instruction.

CHAPTER 3

METHODOLOGY

Elementary school is a critical educational period during which students develop early mathematics skills and build a foundation for future academic success. Because mathematics instruction builds upon previously constructed knowledge, it is important for teachers to utilize instructional practices that are effective for the specific students in the classroom. Students across a range of grade levels and groupings present with varying strengths and areas of need which must be addressed through research-based interventions.

To meet the individualized needs of elementary school students in a mathematics classroom, teachers must provide targeted instruction that is tailored to address specific skills and content. As a result, research that delves into the potential causes of math challenges as well as investigates interventions is critically important. Because of the range of factors that can hinder the effective development of mathematics skills, a one-size-fits-all approach to intervention and identification is insufficient. The complexities of mathematics education require a carefully drafted approach to meeting the needs of a rage of learners. Because mathematics abilities impact students across the curriculum, studying the range of skills necessary for educators to effectively develop lessons to support students with a range of computation and problem-solving skills is an important area of research.

The purpose of this study was to document the practices used by teachers and the types of interventions they utilize to support struggling mathematics students. Research questions were designed to focus on the tools and resources teachers use and explore how qualified teachers feel to be effective in the classroom.

Research Questions

1) How do elementary school teachers (K-3) identify and evaluate individual students regarding the potential areas of difficulty in mathematics (e.g., counting, subitizing, comparing numbers, and completing basic computations)?
2) What tools and resources do teachers utilize to intervene and support elementary school students who are demonstrating difficulty in mathematics class?
3) To what extent do elementary school (K-3) teachers feel qualified to effectively intervene and support students who are experiencing difficulty in math class?

Research Design

The primary method for data collection was a qualitative phenomenological study. A phenomenological design focuses on trying to "understand, describe, or explore a phenomenon" (Bloomberg & Volpe, 2016, p. 90). A qualitative design "relies on general interviews or observations so that we do not restrict the views of participants" (Creswell, 2015, p. 204). Surveys and semi-structured interviews were conducted and provided data to address the proposed questions related to identifying and providing targeted mathematics instruction to elementary students.

Setting

The research site is a small public elementary school district located in Essex County, Massachusetts. Before participants were contacted, data from the Massachusetts Department of Elementary and Secondary Education (DESE) were reviewed and potential schools for this study were selected based on the 3rd grade 2017-2018 Next Generation Massachusetts Comprehensive Assessment System (MCAS) mathematics assessment. Massachusetts state-wide performance indicates that 50% of all public school 3rd grade students were meeting or exceeding expectations

on the 2017 mathematics assessment (DESE, 2018b). Four local school districts in Essex County that met the criteria for data collection were initially contacted (Appendix A), and one district agreed to participate in the study (Appendix G). Following receipt of IRB approval, teachers from a small public-school district in Essex County Massachusetts that met or exceeded the state performance on the 2017-2018 Next Generation Mathematics assessment were invited by email to participate in the survey. Schools that were identified as needing additional support (DESE, 2018b) were not be included in this study due to the potential impact of district-directed professional development on teachers' autonomy in meeting students' needs in their classrooms.

Participants

Participants for this study were Massachusetts licensed teachers currently teaching full-time in a K-3 public school classroom located in Massachusetts. The target group for this study was K-3 teachers because they work with students who are building foundational math skills. For the purpose of this study, participants were initially invited to participate in a survey about elementary mathematics and challenges related to reaching struggling learners. At the end of the survey, participants were asked if they would like to participate in a one-on-one, semi-structured interview. The participants for the interview portion of this research study were selected after the survey portion of the study was completed. Only one survey responder volunteered to participate in an interview, so the researcher sent a series of emails to the original sixteen potential participants until eight individuals volunteered to participate in a one-on-one interview. The eight individuals who volunteered are full-time K-3 teacher in Massachusetts.

Participants' Rights

For this study, participants were initially contacted through email (Appendix B) that explained the purpose of the study and provided a link to an online survey. The first question on

the survey asked participants to mark a box to provide consent to participate in the survey (Appendix E). Participants were notified that they may skip questions or stop providing information at any point. At the end of the survey, participants were asked if they would like to participate in a semi-structured interview (Appendix F).

Informed consent was obtained prior to beginning the interview (Appendix D). The researcher explained the purpose of the research and expected duration of the interview. Interview participants were informed that their participation was voluntary and were advised that they could withdraw from the study or decline to answer any questions at any time. Each interview was recorded on *Just Hit Record* and submitted to an outside company, *Simon Says*, for transcription; a copy of the transcribed interview was provided to the interviewee for review.

Confidentiality of participants was maintained through the use of pseudonyms and coding of any identifiable information. During the interview, participants were identified by number (e.g., Participant 1, Participant 2); all references to participants followed that naming structure throughout the remainder of the study. Following receipt of an interview transcription, the researcher deleted the audio recording from the respective device.

Data Collection

To elicit feedback from teachers about beliefs and instructional practices related to supporting struggling math students, surveys and semi-structured, one-on-one interviews were conducted. Following receipt of University of New England IRB approval, surveys were emailed to K-3 teachers currently working in a public school in Essex County, Massachusetts. As each survey was received, the researcher identified if the participant volunteered for an interview. One participant volunteered for a follow-up interview, so the original sixteen teachers were emailed by email until a total of eight volunteers were identified (Appendix C).

Surveys

A survey was emailed to teachers from K-3 public schools to gather background information about experiences, education, and instructional practices. The survey was administered through REDCap, a secure web instrument for managing online surveys. Passwords to access data on REDCap were not shared, and data was accessed by the researcher through password protected wifi. Survey questions were designed based on information obtained during the literature review. Questions were formatted to gather details about general practices in the classroom that teachers utilize while working with students experiencing difficulty in mathematics.

Interviews

Following receipt of consent to interview, each 45-minute, semi-structured interview (Appendix F) was conducted in a location of the interviewee's choice or over the telephone. As Bloomberg and Volpe (2016) noted, "interviewing is often the major source of data needed for understanding the phenomenon under study" (p. 192). Through the direct contact with teachers in the field, data related to specific classroom experiences can be gathered and analyzed in order to recommend areas for improved intervention and additional studies in the field. Each interview was recorded using *Just Press Record* and transcribed by the transcription service, *Simon Says*. A copy of the transcribed interview was provided to the respective interviewee so the transcript could be reviewed for accuracy and edited as necessary. By completing this process of member checking, the researcher confirmed that each transcript accurately reflected the statements and beliefs of the respective participant. Member checking also provided the interviewees with an opportunity to clarify information they shared during the interview, which promoted trustworthiness.

Interview questions were based on information gathered during the literature review and designed to elicit information about the day-to-day instructional practices in an elementary school mathematics classroom. Specific questions targeted information about the strategies and resources teachers utilize to identify and support students who are experiencing difficulty in mathematics class. Open-ended questions were utilized so "participants can best voice their experiences unconstrained by any perspectives of the researcher" (Creswell, 2015, p. 216) and share both positive and negative classroom experiences. To encourage elaboration of responses and "elicit more information" (Creswell, 2015, p. 216), probes, or follow-up questions, were utilized.

Data Analysis

On an ongoing basis, information from the surveys and interviews was coded and analyzed using an a priori method. Bloomberg and Volpe (2016) discussed data analysis and noted that the researcher "analyzes the data by reducing information to significant statements or quotes and combines these into thematic categories" (p. 49). Categories and themes were identified to develop "a textual description of the experiences of participants, as well as a structural description of their experiences" (Bloomberg & Volpe, 2016, p. 49). Analytic memos were written to reflect on ongoing patterns in the data and document emerging themes.

Surveys

Upon receipt of a submitted survey, the data was reviewed and coded for themes by hand. As new completed surveys were received, a second cycle of coding was completed to connect new data with previously identified information. Open-ended questions were coded, and analytic memos were composed to organize and document emerging themes.

Interviews

Following each interview, the recording was saved as an MP3 file and submitted for transcription to *Simon Says*. While the transcription was being generated, the researcher listened to the recordings multiple times to identify emerging themes and organize the initial data set. Coding notations were generated and utilized to identify categories of information and subsequent themes. Upon receipt of each transcribed interview, the transcription was coded following a lean coding process to identify an initial list of codes (Creswell, 2015, p. 24). Lean coding, as defined by Creswell (2015), is a process utilized to "manage the volume of information" within related sentences and paragraphs (p. 243).

Potential Limitations

It is generally accepted that there is a range of reasons for the challenges that individual students face in mathematics including number sense, math anxiety, working memory challenges, and executive function deficiencies. Despite this, teachers might have difficulty objectively reporting their practices or experiences with struggling learners during the interviews. Bloomberg and Volpe (2016) discussed participant reactivity and the potential for interviewees to be less candid in their responses depending on the presence or absence of a relationship with the interviewer (p. 178). One potential area of bias is related to the researcher's position as an elementary school teacher in the district in Essex County, Massachusetts. To promote an environment that allows for honest and open discussions, the researcher clearly shared the overall goals of the study and described the processes involved with coding data and maintaining confidentiality.

For the purpose of this study, non-academic issues (e.g., family dynamics, health issues) that could impact students' math achievement were not addressed. Research questions were

developed to identify challenges associated with basic numeracy skills and general cognitive abilities (e.g., working memory) that are specific to mathematics skill development, rather than general academic performance. In addition, the study group was composed of public elementary school teachers in grades K-3, which does not necessarily represent the experiences of teachers in upper elementary classrooms or across a range of school settings.

CHAPTER 4

RESULTS

The purpose of this qualitative study was to explore teachers' use of targeted strategies to identify and support struggling learners in an elementary math class. The research questions that guided this study included:

1. How do early elementary school teachers (K-3) identify and evaluate individual students regarding potential areas of difficulty in mathematics?
2. What tools and resources do early elementary school teachers utilize to intervene and support students who are demonstrating difficulty in mathematics class?
3. To what extent do early elementary school teachers feel prepared to effectively intervene and support students who are experiencing difficulty in math class?

To address the stated research questions, two data sets were collected. Surveys and semi-structured interviews were conducted and provided data regarding identifying and providing targeted mathematics instruction to struggling elementary students. The survey sought to identify common areas of need, interventions, professional development, and common practices in the classroom. Sixteen teachers were initially invited to participate in the survey, and fourteen submitted a completed survey. One teacher volunteered to participate in a one-one-one interview on the survey. To increase the number of interview participants, a series of emails were sent to the initial sixteen teachers to invite them to participate in a follow-up interview. Seven additional teachers volunteered to participate in an interview, for a total of 8 interviewees. This chapter presents the data analysis process, provides a description of the participant sample, and summarizes the survey and interview data.

Survey Participant Demographics

The research site is a small public elementary school district located in Essex County, Massachusetts. Across Massachusetts public schools, just 50% of 3rd grade students met or exceeded expectations in mathematics on the 2018 Next Generation MCAS. The researcher used publicly available MCAS results to identify school districts that met or exceeded the statewide performance to mirror the overall state performance on the Next Generation MCAS in mathematics. The district for this study was selected because it met or exceeded the statewide performance on the 2018, 3rd grade mathematics MCAS. Sixteen K-3 general education certified teachers were initially contacted by email and invited to participate in the study. Fourteen completed surveys were submitted through RedCap. Table 1 presents information about the survey participant's certification, grade level, and Masters' degree area of study.

Table 1

Survey Participant Demographics

Survey #	Teaching Certification	Current Grade	Masters' Degree Major
1	1-6	3	Elementary Education and Reading and Language
2	K-2	K	Early Childhood Education
3	1-6	1	Elementary Education
4	PreK-2 and 1-6	2	Curriculum and Instruction
5	PreK-2	2	NA
6	K-2 and 1-6	K	Elementary Education
7	1-6	3	Curriculum and Instruction
8	K-2	K	Early Childhood Education
9	K-2 and 1-6	2	Teaching and Learning
10	1-6	3	Unspecified
11	1-6	3	Curriculum and Instruction
12	1-6	2	Elementary Education
13	K-2	1	Reading
14	1-6	1	Elementary Education

Additional information about teaching experience was requested, and data reflect that over half of the survey participants have over fifteen years of experience in the classroom. All participants indicated that they have at least 5 years of teaching experience. Table 2 summarizes the years of teaching experience for the participants.

Table 2

Teacher Participants by Years of Experience

Years of Experience	Frequency of Responses
5-10	4
10-15	2
>15	8

Survey Data Analysis

Survey data was collected through RedCap, a secure web application for building and managing online data. The survey included twenty questions and required approximately 20 minutes to complete. The questions were grouped into five main sections: Certification and Education, Instructional Practices, Student Assessment, Interventions, and Professional Development. Questions included prompts to elaborate or note *none of the above* in order to encourage maximum participation.

Survey data was compiled and reviewed for trends. Each completed survey was read to identify initial trends and then the full collection of surveys was reviewed as a comprehensive data set. The researcher utilized an a priori method of coding the surveys, during which research questions were continually referenced while coding. Information was broken down into categories that related to the research questions. Three specific areas of focus emerged: common challenges, assessment tools, and intervention strategies, which are directly related to the conceptual framework and research questions. Table 3 summarizes the primary data themes and related research questions.

Table 3

Survey Data Themes

Research Question	Survey Data Categories	Theme
1	Students have a range of challenges that teachers use different tools to identify	Teachers use a variety of instructional practices to assess students.
2	Interventions vary	Teachers expressed variable levels of comfort with identifying specific interventions for their struggling students.
3	Professional development varies	Professional development was primarily focused on Everyday Math curriculum resources.

Presentation of Survey Data

Survey participants reported to utilize a range of strategies to assess their students, work to identify targeted interventions, and engage in professional development activities. Data collected from the surveys was organized into categories (Table 3) that addressed the research questions. Following analysis of the full set of survey data, three main themes emerged that addressed the research questions.

Theme 1: Teachers Use a Variety of Instructional Practices to Assess Students

Participants reported to use a range of practices to assess students' performance in mathematics class. As a whole, they reported a variable amount of time allotted for math instruction throughout a week. Table 2 summarizes the number of minutes of math instruction teachers reported to have each week. Participants reported a range of 170-450 per week, with the majority of teachers reporting to utilize 300-390 minutes for math instruction. The two participants who reported to provide the least amount of math instruction each day reported to integrate additional math activities and routines throughout the school day.

Table 4

Number of Minutes of Math Instruction Per Week

Minutes of Instruction	Number of Responses
170	1
180	1
300-390	8
400	1
450	3

To identify what, if any, additional resources or tools teachers used in their mathematics classroom, a list of five options that are considered to be commonly utilized in an elementary classroom was presented. Table 3 summarizes the use of supplemental resources. All participants identified that they utilize manipulatives; most (13/14) participants reported that they use technology, and 12/14 participants noted that they use activities in addition to their curriculum-based resources. One participant responded that volunteers were used, and one participant identified Prodigy, an online math game, as an additional resource.

Table 5

Use of Supplemental Tools and Resources in the Classroom
"What, if any, additional resources or tools do you use in your mathematics classroom?"

Resource or Tool	Number of Responses
Technology	13
Volunteers	1
Manipulatives	14
Activities	12
Other	1

To further investigate the factors that impact student performance, teachers were asked to select the common areas of difficulty that they observe in their classrooms. Table 4 shows the range of responses and indicates that teachers note a variety of difficulties. One teacher identified "their level of independence and their skills at/willingness to persevere at difficult problems" as an additional area of difficulty for some students.

Table 6

Factors Impacting Student Performance
"Which areas have you identified to impact student performance?"

Impact Student Performance	Number of Respondents
Number sense	14
Comprehension	11
Working memory	13
Processing speed	13
Executive functions	12
Math anxiety	12
Reading skills	10
Student groupings	6
Other	1

As a follow-up question, participants were asked about their level of comfort regarding identifying specific areas of need. As noted in Table 5, participants noted a strong level of comfort with identifying the needs of struggling students across a range of skills, including number sense (14/14), comprehension (13/14), executive functions (13/14), attention (12/14), working memory (11/14), math anxiety (10/14), processing speed (9/14), and reading (10/14).

Table 7

Teachers' Perspectives on Identifying Students' Specific Areas of Difficulty

Area	Reported to *strongly agree* or *agree* with ability to identify specific needs		Reported to *strongly disagree* or *disagree* with ability to identify specific needs	
	Number of responses	Percentage	Number of Responses	Percentage
Number Sense	14	100	0	0
Comprehension	13	93	0	0
Executive Functions	13	93	0	0
Attention	12	86	1	7
Working Memory	11	79	1	7
Math Anxiety	10	71	0	0
Processing Speed	9	64	3	21

In addition to the areas that teachers identified that they can identify specific needs, the areas they disagreed with were also identified. Table 5 shows that 3/14 teachers *disagreed* or

strongly disagreed when asked if they felt capable of identifying students with processing speed difficulties. Attention and working memory were the only other areas that teachers identified to have difficulty identifying specific student needs.

Theme 2: Teachers Use of Resources to Provide Interventions

Teachers were asked a series of questions related to the interventions used in the classroom and were asked to select options related to identification of targeted interventions for struggling students. The majority of participants reported that they collaborate with grade-level teachers and special education teachers. Many collaborated with paraprofessionals, with the fewest participants collaborating with a math intervention specialist or principal. Table 6 shows the building-based professional with whom teachers reported to collaborate and the number of responses for each.

Table 8

Teacher Collaboration
"Do you collaborate with other building-based professionals?"

Building-based professionals	Number of responses
Grade-level teacher	13
Special education teacher	12
Math intervention specialist/ math coach	7
Principal	4
Paraprofessional	9
Other	0
No, I do not collaborate	0

In addition to daily classroom instruction, all teachers reported that some of their students received Response to Intervention (RTI) support during at least part of the previous school year. Table 7 shows the breakdown of students, which indicates that the largest number of RtI students are from kindergarten and first grade, with between fifty-three and fifty-six total students receiving intervention at some point during the previous school year.

In contrast to the responses regarding the identification of difficulties their students face, teachers reported less confidence with the identification of specialized interventions. As shown in Table 8, 13 out of 14 teachers responded that they *strongly agree* or *agree* that they feel qualified to identify interventions to support students with number sense difficulties. General domain skills, including working memory and processing speed, were areas that teachers reported to be less comfortable with their ability to identify specific interventions. Only 5/14 teachers reported to *strongly agree* or *agree* that they feel qualified to identify interventions for students exhibiting difficulties with working memory or processing speed.

Table 9

Number of Students Receiving RTI Services

Grade Level	Number of Students
K	17-19
1	12-13
2	8
3	16

With regards to identifying interventions, 4/14 teachers reported to *disagree* or *strongly disagree* when asked if they feel qualified to identify interventions for students with executive functions difficulties. Similar to the difficulty with identifying interventions for students with domain general difficulties, 6/14 participants reported to *disagree* or *strongly disagree* when asked about interventions for students with working memory or processing speed difficulties.

Overall, there were only 5 *disagree* responses to the question related to identifying an area of difficulty in contrast to a total of 21 *disagree* responses to the question related to identifying an intervention for a specific area of difficulty. The data indicates that teachers feel more skilled at identifying an area of difficulty as compared to identifying a specific intervention. Of note, working memory and processing speed were the most reported skills that

teachers noted as difficult areas to identify targeted interventions (6/14), with executive functions as the next most difficult area for identifying specific interventions (4/14).

Table 10

Teachers' Perspectives on Identifying Targeted Interventions

Area of Difficulty	S*trongly agree* or *agree* about ability to identify targeted interventions		S*trongly disagree* or *disagree* about ability to identify targeted interventions	
	Number of responses	Percentage	Number of responses	Percentage
Number Sense	13	93	0	0
Comprehension	9	64	2	14
Executive Functions	6	43	4	29
Attention	9	64	2	14
Working Memory	5	38	6	43
Math Anxiety	6	43	1	7
Processing Speed	5	38	6	43

Theme 3: Access to Resources to Meet the Needs of a Range of Struggling Learners

The survey participants reported extensive experience in the classroom and indicated the use of a range of strategies to assess and support their students. To further investigate the availability of resources, participants were asked about access to supplemental materials. When asked about access to curriculum tools and supplemental resources to meet the range of learners in their mathematics classroom, responses varied; however, the majority of participants reported to strongly agree or agree, with 5/14 reporting neutral feelings, and 1/14 reporting to disagree.

Table 11

Access to Tools and Resources

Response Category	Frequency of Responses
Strongly Agree	2
Agree	6
Neutral	5
Disagree	1
Strongly Disagree	0

Although teachers were experienced and reported at least 5 years of teaching experience, the researcher was interested in learning about opportunities for ongoing professional development. Tables 10 and 11 summarize the data about workshop attendance and professional development. A small number of participants reported participating in school-sponsored professional development (4/14). With regards to professional development, participants expressed an appreciation for the training with Everyday Math; however, teachers expressed a desire for increased training beyond the district-wide math curriculum.

Table 12

School Sponsored Professional Development

PD	Number of Responses	Specific Comments
School Sponsored Professional Development	4	Once per year Twice per year Three sessions during 2016-17 school year One time - related to EM tools to meet a range of student needs

A majority of participants (10/14) reported to attend workshops or complete graduate coursework. Of the ten participants, five referenced Everyday Math training. Other participants identified attending program-based workshops, guided math workshops, Massachusetts Department of Education Content Institutes, and seminars focused on a math workshop model.

Table 13

Workshop Attendance / Graduate Coursework

PD	Number of Responses	Specific Comments / Workshops
Workshops and Coursework	10	Everyday Math workshops (5) Math pedagogy courses. Manipulatives and differentiation, math workshop Visiting speaker - math instruction Box it Bag it Math Math Their Way Guided Math / Math Workshop in the Elementary Classroom Graduate Math Introduction Course MADESE Content Institutes

Qualitative Feedback from Survey Participants

Six of the fourteen survey respondents included additional comments that were reviewed and organized by theme. Comments were related to student needs, curriculum resources, and professional development.

Table 12

Survey Feedback

Feedback Theme	Examples of Participants' Comments
Student Needs	Many first-grade students want to or are being pushed to move to a representational stage before they are ready.
	They need more work with hands on and concrete models of problem solving.
	Processing and understanding the question and finding a way to solve it. This is something that is often already ingrained in them before they even get to first grade and is very hard to get them to unlearn.
Curriculum	The Everyday Math (EM) program is very difficult for most students with reading difficulties.
	I find that the math program we are using moves quickly and is difficult for the struggling math student to keep pace with. I use the supplementary materials, but these students need more opportunities to work with strategies or manipulatives.
Resources: Professional Development and Instructional Support	I would like to see more systematic intervention and support around math in our district in order to identify learning disabilities more accurately and earlier when possible.
	We have many resources for reading and this often preempts math intervention.
	Literacy seems to get priority over math in our school. Students who are struggling in literacy and math typically get RTI groups for literacy and not math due to lack of time.
	Currently our school doesn't have a math enrichment, math coach, or math support unless dictated by special education. This makes it difficult to plan math workshop effectively.
	We do not have any math instructional support personnel. If there happens to be a TA with an open period, he/she may be assigned to a classroom to help, but not all classes have that support.

Interview Participant Demographics

Of the sixteen teachers initially contacted, eight teachers agreed to participate in a one-on-one interview. One teacher indicated she would participate in an interview on her survey, but the remaining teachers volunteered after receiving additional email requests. Email requests were sent to the initial sixteen participants until eight participants agreed to participate in a one-on-one interview. The researcher reviewed the grade levels for the teachers to confirm that the teachers were from grades K-3. Table 13 shows the grade level each participant currently teaches and the years of teaching experience. As each participant volunteered to be interviewed, the interviews were scheduled and completed at a time and location convenient for the interviewee.

Table 15

Interview Participant Demographics

Interview #	Current Grade Level	Years Teaching
1	K	7
2	2	11
3	1	14
4	1	17
5	3	21
6	2	25
7	2	23
8	3	14

Interview Methodology and Analysis

Following collection of the survey data, one-on-one interviews were scheduled with eight volunteers. Each interview was recorded on a secure device and submitted to Simon Says, an online service, for transcription. The transcribed interviews were reviewed and edited to limit conversational interjections that could impact the readability of the transcription. A copy of the transcribed interview was provided to the respective interviewee so the transcript could be reviewed for accuracy and edited as necessary; however, no changes were requested.

The interview transcripts were coded a priori to identify and relate responses to the interview questions. The research questions provided the framework for data analysis and identification of key codes and patterns. As recommended by Creswell (1994), simultaneous data collection and analysis was completed to generate categories of information. Following transcription, each interview was read multiple times to identify initial codes, organize the data, and identify emerging themes. As each new transcribed interview was available, the previously coded transcriptions were reviewed to make connections across the data set. The research questions and survey data were regularly referenced for a comprehensive analysis.

Thematic Analysis

Through the lens of the research questions, three major themes were identified and form the framework for the discussion of the interview data.

Table 16

Major Themes by Research Question

Research Question	Major Themes	Subthemes
1	Multiple measures to identify struggling learners	Observation Communication Everyday Math resources
2	Assessment tools and strategies	Flexible groupings Games and activities Computation practice Student engagement
3	Meeting teachers' needs regarding intervening and supporting students	Purposeful approach to groupings Use of curriculum and related resources Challenges

Theme 1: Multiple Measures to Identify Struggling Learners

The first major theme focused on the identification of specific needs that students present with in a mathematics classroom. Consistent with the survey data, interview participants

emphasized that they utilize a range of formal and informal assessments to track progress towards stated learning objectives. Participants noted the wide range of challenges their students face as well as the challenges associated with identifying specific difficulties. All participants identified that their students experience a variety of challenges, with particular difficulties in the areas of number sense, basic computations, and fact fluency. Most teachers noted their ability to identify if students are experiencing a wide range of student difficulties in the classroom. Three subthemes emerged in the category of assessment tools and strategies, which included ongoing observation, communication, and use of curriculum resources (Table 14).

Assessment Tools and Strategies

Participants were asked about the procedures they follow to assess and track student progress. All participants described the need for continuous supervision of students, particularly when they presented new content. Participant 1 recognized the need to build a strong foundation and noted that "we have to start at the beginning because it's a disservice if we don't teach them everything". Most participants discussed the importance of developing foundational math skills so students can build on their knowledge in upcoming grades. Participant 4 shared that students are practicing things that are "going to be building blocks for a lesson down the road". All participants discussed the importance of ongoing supervision, use of multiple measures, and a combination of informal and formal assessment.

Observation. Participants emphasized their desire to monitor students in the moment rather than solely rely on unit tests, school wide benchmark data, or formal assessments. The data confirmed consistent routines of observing students while they are working and recording notes about the processes and strategies students use during a math lesson. All participants explained that they take time to circulate around the room while students play games so they can

ask clarifying questions and monitor students' progress. Participants used questions to assess conceptual understanding of learned skills and identify if students needed additional support to complete the assigned task. Specifically, Participant 8 noted that she prompts her students to think about numbers and follow patterns while they play counting games because "it's all about building on what they know".

In addition to making observations during class activities, two participants explained that they give students whiteboards and ask them to solve problems by showing their work. All teachers relayed a desire to not only see a correct answer, but also identify if a student could explain the process and show the strategies they used to calculate an answer. Participants were focused on monitoring students and providing feedback in the moment. Participant 3 explained that she often utilizes a whole-class format so she can circulate around the room and observe students working. She emphasized the importance of quickly identifying if kids were making mistakes so she could intervene and set the student up for success. All participants emphasized their daily observations as a primary source of data regarding student performance.

Areas of concern related to observing students' progress were reported. As previously indicated in the survey data, participants emphasized that they utilize a range of instructional models during a math lesson. As a result, there are periods of time during which students are working independently or with a small group of students. Participants noted the challenges regarding closely observing and documenting progress of students who are not working directly with a teacher. Participant 8 discussed the importance of using strategies and noted that the student accountability is challenging because "If they're playing a game and there's no score sheet, how do I know that they are playing the game?".

Communication. While discussing the use of resources to assess students and problem-solve through issues related to student performance, all participants referenced collaborating with other teachers. All participants expressed an appreciation for their grade-level team and noted that they collaborate, share resources, and discuss issues as they arise. In addition to recognizing the support of grade-level teachers, most teachers identified the Response to Intervention (RTI) teacher as a valuable resource who provided support and insight into students' difficulties.

When discussing the use of district collected benchmark data, Participants 6 and 7 reported that they value the collaboration that occurs during data meetings to discuss students' performance across settings. Participant 6 noted that the formal data does not always accurately reflect what she sees in the classroom, so discussion is an important part of the process. One area of concern that was noted was the use of timed tests for RTI benchmark data collection. Of note, two participants mentioned that they communicate with students' previous teachers; however, there was limited discussion about collaboration regarding vertical alignment of strategies or consistent use of supplemental resources used to support students. Participant 7 summarized the participants' comments about collaboration when she said, "It's a team effort".

Beyond the school-based collaboration, many teachers discussed their routines for communicating with parents. In addition to sending home math materials, two participants shared that they actively elicit feedback from parents about the progress they are seeing with mathematics skills. Participant 4 shared that she created a checklist and sends it home at the start of the school year to collect information about strengths and areas of needs related to mathematics. In addition to eliciting feedback from parents, she also works to "get a lot of information of the beginning of the year from assessments from other people who have worked with the students". Parent communication about homework was noted to be an area that some

participants found helpful, particularly when parents watch their child complete homework and share concerns with the teacher if they arise.

Curriculum. Everyday Math, a comprehensive K-6 math curriculum, is the program used across the general education classrooms district-wide. All participants confirmed the use of Everyday Math (EM) as the primary curriculum and noted their overall satisfaction with the available resources. Participant 7 shared her appreciation for the range of resources available that allowed teachers to provide instruction and support students. All participants utilized resources from Everyday Math, but there was inconsistency regarding the extent to which they used journal pages or homework to assess student performance. Half of the participants used homework as an evaluative tool, but the other half saw completing homework as an opportunity to promote independence and encourage additional practice rather than as an assessment tool. Participant 2 stated that the EM home link assignments, in addition to the unit tests, are an important assessment tool because they "can be an important part of the process of identifying that a student is struggling".

Although Everyday Math provides an online tool to track student progress, none of the participants reported to be currently using it because of the time required to continuously input student data. Along with the unit tests from Everyday Math, most participants reported that they use supplemental resources to assess computation and fluency skills. A few participants discussed the use of timed assessments with some hesitancy, but they used a range of timed tests of 1-3 minutes throughout the year to document student progress. Participant 2 shared that she likes to do quick fact checks with the students and have the students play games that "help me identify who's still weak with math facts".

Range of Student Challenges

Mathematics is a content area that requires the development and utilization of skills beyond computation. Participants were asked about the common challenges their students faced, and all participants explained that poor computation skills are a primary area of difficulty. Most followed up and noted that it is difficult to clearly identify the particular challenge, especially early in the school year. Participant 5 noted that she takes time at the start of the year to see how students are performing and purposefully create her instructional groups because initially, "I didn't know who my small group was going to be". Across the interviews, participants shared a strategic approach to creating small groups rather than a randomized approach.

Participants all noted the wide range of challenges that students face in mathematics as well as the tendency for students' difficulties to vary from unit to unit, and sometimes day to day. Participant 2 noted that "someone can be really good at math and really struggle with reading". Across the interviews, participants discussed their responsibility for identifying challenges and relayed a desire to get more help in the classroom to closely monitor and track students' performance.

While discussing students' challenges, participants acknowledged that challenges are multi-faceted and can be a complex problem to identify. Participant 7 shared that in her experience, if students are given additional support but continue to struggle, "It's not just math". that is causing the student to have difficulty, and noted that a bigger learning issue might need to be investigated. Across the data, primary areas of difficulty were noted to be related to specific math skills (e.g., basic computations and fact fluency), executive functions, and literacy skills. As reported in the interviews, areas of challenge were primarily related to computation skills rather than behavior challenges, math anxiety, or general domains such as processing speed.

Numeracy. Numeracy skills, which include using strategies to solve problems, practicing fact fluency, and developing an understanding of numerical patterns, is a primary instructional area in elementary school. According to the Common Core Standards (2019), second grade students should be working on developing addition and subtraction facts within 100 and third grade students should be developing an understanding of multiplication and division within 100. According to study participants, computation skills are an important part of their regular instruction. All participants shared their routines for practicing number sense activities and developing fact fluency; however, several teachers noted the continued difficulty that students experience with fact fluency and automaticity. Participant 5 acknowledged the difficulties she sees with fact fluency and hypothesized that students "might not be ready for the skills" when they were first presented.

Executive functions. Executive functions are broadly defined as the "domain general control processes important for managing goal-directed behaviors" (Cirio and Willcurr, 2017, n.p.). In the context of mathematics, executive functions skills are necessary for students to manage the material, problem solve, and maintain focus on the task at hand. Along with the computation difficulties reported, participants also noted the challenges some students exhibit with executive functions. Several participants noted that some students have a hard time organizing materials, sustaining attention, and using tools and resources as instructed. Maintaining attention for an extended period of time was also a commonly shared concern, with all participants noting that many students have difficulty working independently.

In addition to the challenges with organization and attention, a few participants discussed their experiences working with students who have processing speed or working memory challenges. Participants 7 and 8 noted that they have worked with specific students who have a

hard time holding numbers in their mind while solving problems. Participant 6 noted that she has students who both work slowly and exhibit slow processing abilities. Although she noted that the slow processing abilities are evident during math instruction, they also impact the child throughout the school day. Participant 1 discussed the use of RtI to support students' ability to fluently identify numbers and count and stated, "I have mixed feelings about it because some kids are never going to be fast on those tests". As previously noted, identifying that a student is having difficulty with rapidly identifying numbers is separate from identifying a targeted intervention to support the child's continued progress.

Literacy skills. Similar to feedback about executive function difficulties, participants also noted the challenges some students face with foundational literacy skills. Beyond the need to complete problems that involve number and math symbols, students are required to decode text, comprehend word problems, and utilize content-specific vocabulary. As previously noted, participants expressed concerns about the amount of language in the Everyday Math program. Participant 5 noted that the reading and writing is particularly challenging for some students, which impacts their ability to work independently.

In addition to the difficulty some students face with reading math curriculum materials, writing expectations are also an area of challenge. Participants identified that some students experience difficulty with number and letter reversals, keeping up with the pace of writing during a lesson, and composing sentences to explain their work.

Additional areas of difficulty. As previously noted, mathematics is a complex content area that requires skills both specific to math and related to broader academic tasks. Participants identified that in addition to the common challenges, there are sometimes additional learning issues (e.g., developmental delays, social-emotional challenges) that can impact student

performance. Particularly when students are working independently, participants noted that some students struggle to complete assigned tasks. Participant 5 shared that she has worked with students who exhibit low confidence in math class and has had students state that math is their worst subject. She reported that some of her students were “afraid of math” and possibly had math anxiety.

Because mathematics is cumulative and lessons build upon learned skills, participants discussed the need to periodically review previously learned skills. Participants noted that some students have difficulty remembering how to solve problems from previous units and generalizing skills from one lesson to the next. Participant 8 shared that “kids don’t remember how to solve a problem they haven’t done in a while”. With regards to behavior, participants did not identify issues with students disrupting the lesson; however, a few participants noted that some students report that they are bored or tired during lessons.

Theme 2: Use of Targeted Interventions to Support Students

The second main theme that emerged was that participants use a range of interventions to support struggling students. Participants reported a high level of comfort using curriculum tools and making decisions to meet the students in their current classroom. All participants discussed the importance of targeting instruction to meet student needs and tailoring interventions to address specific areas of challenge. Similar to the identified areas of challenge, participants discussed using targeted interventions that were primarily related to creating instructional groups, providing computation and fact practice, and engaging students in the lesson. Interview data reflects a strong use of interventions related to supporting early numeracy skills, encouraging use of strategies for tracking work, and following directions to complete a task. Although many teachers discussed their work to promote computation skill development, they

also noted that students' challenges often vary from unit to unit. Participants discussed the need for ongoing monitoring of student performance in order to make informed decisions about the interventions they provide from lesson to lesson.

Flexible groupings. Participants discussed preferences for small or whole group instruction; however, their preferences were connected to their students' profiles. Participant 3 expressed a preference for whole group instruction and noted that "I can find more 1:1 time for struggling students". Although most participants expressed their preference for small group instruction, they noted the importance of being flexible and making sure the students' needs were being met. One example of the flexibility of the participants was related to the creation of homogeneous and heterogeneous groupings. Participant 4 explained that she uses mixed ability, heterogeneous groups for game stations and homogeneous groups for the small-group teacher station. Participant 4 further elaborated on her reasons for the variable groupings and noted that she also uses learning partners so "They are working with somebody who is going to be their helper or partner".

Some participants shared their routines for creating groups, with half of the participants identifying that their groups change regularly and are designed to provide students with opportunities to be academically and socially successful. Participant 4 shared a preference for a small group format and stated, "I can look more closely at kids on a day to day basis, and I often use that to change the next day's mental math". Participant 8 echoed the sentiment that student needs change and stated that, "I might see that somebody who I thought was at a practice level needs to go back and have it retaught. Or someone who I thought really had it does not". Continuous observation and informal data collection routines were mentioned when participants

discussed the creation of their student groups. In addition, participants emphasized the difficulties associated with managing multiple stations during a math period.

Creating flexible learning groups was discussed by each participant; however, the frequency with which the groups were changed varied. Participant 1 reported that she has arranged groups that are consistent for most of the year, but she occasionally changes groups to "let them have a different experience". Most mentioned that groups are formed by ability level, but several participants noted that sometimes the students who are a good match for one unit might not be an appropriate group for a subsequent unit. Participant 6 discussed the challenges related to creating instructional groups and noted that "Math-wise a group might be fine, but if the behavior is going to prevent us from getting there, I make changes".

Games and activities. Participants shared a range of games and activities that they use to provide students with opportunities to practice skills and review previously learned content. Although some participants emphasized the need to spend time learning how to play a game or use a tool, the primary focus of playing games was on developing number skills, practicing basic computations, and improving fact fluency. Many teachers noted the importance of promoting peer interactions, and Participant 6 identified the need to create "a community of learners that are supporting one another".

Using games and activities in the classroom was noted to be an opportunity for students to practice new content and have time to develop some independent work habits. Participant 4 shared that the use of mixed-ability groupings allows the students to "benefit from peer support and have a chance to show what they know". To provide struggling students with appropriate opportunities to engage in class activities, participants noted that they frequently differentiate lessons. Participant 4 emphasized the importance of correcting papers, giving corrective

feedback, and not giving busy work to students who are working in a math game station. Participant 2 shared that she creates a color-coded chart that students can reference during center rotations so they can see where they need to be.

Participants noted difficulties with creating the schedule of rotations and actively supervising the variety of activities that are happening during one math period. Participant 1 noted that "I do feel a little spread thin. I know I can't be everywhere". In addition to discussing the challenges with constantly monitoring their students, participants also noted the difficulties related to developing a schedule. As previously discussed, each participant shared that some students attend an RtI group during the math period. Although participants all appreciated the opportunity for the program, they shared some challenges with regards to fitting all of the necessary groupings into the daily routine. Participant 7 noted that although she would like to change her groups more often, she typically changes them 3-4 times a year because "It's hard to change. There are so many pieces in the puzzle".

Computation practice. All participants expressed overall positive feelings about the Everyday Math curriculum, but many also noted the need to supplement the lessons with computation and fact practice resources. Most participants noted that they regularly use manipulatives and tools; however, some participants questioned whether the volume of manipulatives is overwhelming for some of their students. Participant 7 recognizes the importance of providing a range of interventions and offers students different choices when they are using manipulatives. Most teachers noted the need to meet kids where they are and provide more time for students to practice skills, particularly computation. With regards to numeracy skill practice, all participants discussed the importance of computation practice, but only two participants commented on specifically practicing counting skills during their interview.

While providing students with opportunities to practice computation skills, participants discussed the importance of differentiating instruction to build on current skills. Across the data, participants noted the challenges some students face with writing numbers, showing work, and explaining their answers. Participant 4 discussed the use of time during small group rotations to teach and reteach skills that are posing problems for some students. She noted that "The younger students have shorter problems to solve, so I can do a few in the time it might take a student to do one problem in an upper grade". As previously noted, the interventions that work for one classroom or individual are not universal; however, they are grounded in a foundation of strong pedagogical skills and teaching strategies.

Student engagement. In addition to the use of tools and resources for building number sense and developing fact fluency, participants noted the use of activities and routines to promote student participation. Most participants referenced the use of guided questions and prompts that require students to elaborate on ideas and explain their thinking processes. Participant 6 noted her tendency to ask students specific questions (e.g., "Try this one", or "Can you circle the digit in the tens place?"). While discussing the use of games and activities to promote student involvement in the lesson, participants frequently commented on the use of number grids, hundreds charts, and manipulatives. Although most noted that manipulatives were helpful, Participant 8 noted that "They don't work for everyone". Additional strategies for engaging students included drawing pictures, using number lines, and collaborating with peers.

In addition to using strategies to support students' access to the curriculum, participants noted the need to target interventions. Across the data, participants reinforced the use of tools and resources to engage students and promote computation and fluency skill development. Participant 4 noted that sometimes the teacher needs to "peel away some of the layers of

difficulty so that they can free their minds up for the math portion" and noted that sometimes "The barriers are not necessarily important to understanding the concept". A few participants shared additional strategies including building opportunities for choice, providing movement breaks, and making lessons fun for the students. Participant 3 discussed the use of hands on activities and the need to "home in on what works for them" when selecting specific tools, vocabulary words, or strategies for solving a problem. Individualizing instruction to meet specific student needs was a regularly occurring discussion point during the interviews.

Despite the range of interventions used by the experienced participants of this study, participants noted that some students continue to experience difficulty accessing the mathematics curriculum. Difficulties beyond the commonly observed number skills and literacy skills were noted to be related to organization, memory, and processing speed. Participant 3 noted that she has students who have difficulty with sustained attention that "got in the way of them being able to hit those [math] standards". While discussing the added challenges related to developmental readiness, Participant 3 discussed the need to front end instruction about using basic tools such as a ruler. When she notices that students struggle with a skill later in the year, she will use an earlier tool to provide a familiar context for the student. Participant 3 elaborated on her use of explicit instruction in the classroom and explained, "I might go back to a number line and try to explore the same concept with a tool that they're a lot more familiar with. And then we can use it as a bridge".

Theme 3: Meeting Teachers' Needs Regarding Intervening and Supporting Students

As previously noted, teachers reported a flexible and student-centered approach to instruction. Although preferences for particular groupings were noted, all participants identified that their instructional practices shift to meet the needs of their class. Participant responses

reflected a strong desire to focus on individual needs and address learning objectives that provide a strong foundation for learning. Participant 3 discussed her routines for tracking students that need extra help and said, “If I see a kid struggling with a certain concept, I write their name down and keep that list. And then whenever I get a chance to pull a 15-minute group, I pull the kids for that skill”. All participants shared their comfort with teaching math and desire to take initiative to develop pedagogical skills to reach struggling learners.

Purposeful approach to teaching math. Teachers noted that they utilize a range of strong pedagogical skills in the classroom and discussed their habits of varying instruction to meet the needs of students in a group. Small groups were a predominant method of instruction, as many noted that it provides an opportunity to see the kids completing problems. Overall, teachers were more interested in seeing the process, rather than checking work for accuracy. Participants all recognized the need to use a range of tools and strategies, but they also reported that they continue to see students struggle to achieve stated learning expectations. Mathematics is not a one-size-fits-all content area.

Participants recognized their strengths as instructors, but they also noted the challenges related to identifying exact interventions to support students with difficulties beyond numeracy, executive functions, and attention. Despite strong pedagogical skills and access to comprehensive curriculum resources, participants acknowledged that there are students who continue to struggle.

Curriculum and related resources. All participants reported that they utilize the district curriculum as their primary source for mathematics lessons, although a few mentioned the need to find supplementary resources. Participants noted that they are primarily focused on locating a range of resources for developing computation abilities and promoting fact fluency.

Environment. Participants addressed the positive climate of the classroom, but they also shared concerns about the time they have with each student, which many participants connected to the need for additional teacher support in the classroom. Related to the tendency for small group instruction, participants noted that it is difficult to monitor the different groups of students in the room, with some groups receiving more attention than others. Participant 8 discussed the challenges with tracking data while kids are working independently and noted that "I can make observations if they are at the table with me, but it's difficult to know if they are independently playing a game". Participant 2 noted that supervising the rotations during a math workshop period is challenging and that she will notice that "This child is really not coming up with an original idea". Participants discussed the use of routines, clear expectations, and frequent check-ins during a math period; however, they also noted that is challenging to reach everyone during a period without additional support.

Scheduling. Teachers mentioned that they have limited ability to alter their schedules to meet newly identified needs. There are groups that happen at certain times, and staffing was noted to be a particular area of need. Teachers discussed the use of assessment periods to adjust student groupings; however, they noted that student behavior can impact the effective formation of groups. Participants emphasized their focus on tailoring instruction to meet the students' needs. Multiple teachers reported that they find it difficult to schedule all of the small groups, with Participant 1 noting that she feels "spread thin" at times.

Need for support. Difficulties associated with clearly identifying specific needs were shared by most participants. While discussing the range of tools available to identify students' specific challenges, Participant 5 reported that she did not have the tools to figure out specific needs. Other participants identified spending time with each student as an area of challenge.

Professional Development. Teachers discussed the frequency with which professional development was offered as well as the specific content of the presentations. Data analysis indicates that teachers recognize the range of resources available in the Everyday Math program, but they also noted that they would like to attend workshops focused on interventions. Participants acknowledged that the district has provided program based professional development; however, they also noted that professional development focused on targeted interventions was lacking. Several participants noted that they take initiative to review math curriculum resources, and Participant 4 noted that she will typically "seek out math related professional development on my own".

Summary of Chapter 4

This chapter presented the main findings that emerged from the survey and interview data. Data was organized by research question in order to address each question as completely as possible. Through the exploration of teachers' experiences in the classroom regarding supporting struggling math students, information about assessment tools and strategies, resources for intervention, and perceptions about access to necessary professional development were documented. Survey and interview data were analyzed together since the findings from each data source reflected similar beliefs and strategies for supporting elementary school students who are struggling in mathematics class.

The first research question focused on the assessment and identification of students who are demonstrating difficulty in math class. Survey and interview participants indicated that the students with whom they work exhibit a wide range of difficulties that impact their performance in math class. To identify specific needs, teachers primarily rely on a district-wide math curriculum, but they also use supplemental resources to provide extended practice for the

students. All interview participants reported that they actively monitor their students during class lessons and use a range of tools and resources to identify the specific needs of their students. Although all fourteen participants noted that they can identify students who are demonstrating difficulty with number sense skills, only 11/14 noted that they can identify working memory difficulties, and 9/14 indicated that they feel capable of identifying specific needs related to processing speed.

The second research question focused on the identification of specific tools and strategies to meet a range of students' needs. Participants indicated that they collaborate with building-based professionals when they identify that a student is struggling. Survey participants noted that they typically meet with grade-level teachers (13/14) and special education teachers (12/14), and several interview participants indicated that they work closely with their grade-level team to discuss students who are having difficulty, share resources, and create materials. Although collaboration was regularly discussed, participants indicated that they work with grade-level teams rather than with a cluster of teachers (e.g., K-3). With regards to identifying targeted interventions, 13/14 participants reported a level of comfort with number sense interventions, but only 5/14 participants reported to feel comfortable when the students' difficulties were related to working memory or processing speed.

The final research question focused on the extent to which teachers feel prepared to effectively intervene and support their struggling students. Teachers indicated that they value the collaboration and support within the district and recognize the wealth of resources that are available through the Everyday Math program. Participants noted that they have had trainings related to the math program and have ongoing access to professional support as needed. Despite the curriculum-based resources and time to collaborate with grade-level teams, participants

indicated that they do not have ongoing access to intervention-based professional development. Participants indicated that they typically seek out workshops on their own but would prefer to have district-based professional development.

CHAPTER 5

DISCUSSION, SUMMARY, AND CONCLUSIONS

The purpose of this phenomenological study was to explore K-3 teachers' perceptions regarding reaching struggling learners in an elementary school mathematics classroom. According to Feifer, (2017) between 6% and 14% of school age-children experience difficulty with mathematics despite appropriate instruction (p. 14). Within an elementary school mathematics classroom, students can present with a wide-range of difficulties that require targeted interventions focused on developing specific skills. The researcher documented how teachers determine what instructional practices and interventions they use, what resources are available to them, and how prepared they feel to meet the needs of struggling learners in a K-3 mathematics classroom. This chapter presents a summary of the study and shares conclusions drawn from the two data sets presented in Chapter 4: survey data and interview data. It also includes implications for action and recommendations for additional research related to the identification and support of struggling elementary school math students.

Review of Research Questions and Summary of Responses

To develop an understanding of how teachers can support struggling learners, research questions were designed to focus on the instructional practices that teachers utilize to identify and meet the needs of students in an early elementary (K-3) mathematics classroom. In addition, teachers were asked about their beliefs regarding access to the necessary tools and resources to effectively intervene and support their struggling students. In response to the proposed research questions, findings indicate that teachers utilize a range of tools to identify students' specific needs and target interventions to address students' areas of difficulty. While teachers discussed a

range of difficulties that they can readily identify and provide intervention, there were areas that teachers noted to be more difficult to target.

Use of Tools and Strategies to Identify Students' Areas of Difficulty

Feifer (2017) discussed the range of difficulties that potentially impact students' performance in a math classroom and noted that "there can be a multitude of reasons, both inherent within the child or relative to the curriculum itself, why students may have difficulty in mathematics" (p. 25). In this research study, teachers echoed Feifer's belief that a variety of factors impact students and discussed the range of difficulties that their students face in the classroom. Participants noted that students experience difficulty with content-based skills (e.g., number sense and computations), literacy skills (e.g., reading and writing), and executive function skills such as attention, working memory, and organization. The survey and interview questions were designed to gather information about the teachers' perspectives and identify what teachers experience in the classroom on a routine basis.

Survey participants noted that their students exhibit a range of challenges that include both content specific and domain general skills. In addition to the previously identified difficulties, participants noted that the Everyday Math program is challenging for struggling readers because of the high volume of language embedded throughout the curriculum materials. Participants noted that they utilize a range of tools and strategies to identify students' current performance levels across a range of tasks. Although teachers reported they utilize the district-wide math program as their primary curriculum, there was variability with regard to the use of curriculum-based homework materials and supplemental resources as assessment tools. All participants indicated that they collaborate with their colleagues and request feedback and support to identify their students' areas of need.

Interview participants were asked open-ended questions to address topics related to the survey questions and literature review. Across the interview data, participants noted that they have access to a strong math program with time allocated to provide math instruction throughout the week. Participants discussed the use of curriculum resources and supplements to track student progress, including homework, unit tests, and fact checks; however, they emphasized the use of "in the moment" observation to monitor student progress. As a group, the participants relied on their strong pedagogical skills to create instructional groups, provide explicit instruction, and prompt students to explain their thinking. It was evident that participants were keenly focused on observing the processes their students followed to solve a problem rather than simply checking students' work for correct answers.

When discussing the use of strategies to monitor student progress, participants indicated that their students demonstrate a wide range of skills and abilities. Teachers noted that they prefer to arrange their student groupings to maximize the time they can spend with small groups or struggling learners. Although they noted that students' needs can be identified, they noted that some areas of need are more easily identified than others. All participants shared that they regularly note computation difficulties, but they identify executive function difficulties and math anxiety less often. Participants noted the inconsistencies of some students, and shared that some students' performance levels vary from math unit to unit.

Similar to teachers' reports, the literature review documented a primary focus on development of basic numeracy skills. Despite the wealth of information about the importance of developing foundational math skills, researchers have identified that there are a variety of challenges that impact students' performance. Particularly because of the range of difficulties

that have been identified by researchers as well as teachers in this study, it is important for teachers to assess and identify particular difficulties that students experience in math class.

Researchers agree that working memory, number sense, attention, and visual integration skills can impact students' performance in the mathematics classroom (Feifer, 2017; Mazzocco, 2007). Askenazi and Henik (2012) posed a question about how to identify if a student's difficulty is related to an executive function issue, lack of attention, or math disability. Researchers noted the overlap between the difficulties that teachers observe, which can complicate the process of specifically identifying an area of need for a particular student. Because of the potential for different issues to overlap for a particular student, Mammarella (2015) discussed the need to explore the relationship between working memory, anxiety, and math achievement.

Researchers are working to identify the underlying abilities that impact math performance and recognize the importance of identifying specific needs so interventions can be targeted to address the actual issue. Geary (2012) discussed the range of difficulties that students face and asked, "Where is the line between a math disability and a fact recall difficulty?" (p. 23).

In Massachusetts, 50% of all public school 3rd grade students scored in the partially meeting or not meeting expectations on the 2018 Next Generation MCAS (DESE, 2018). In order for students who are experiencing difficulty in mathematics to be provided with targeted interventions, teachers must be able to actively observe their students and identify specific areas of need. Mazzocco (2007) noted that "astute observation serves an important role" in the assessment of students (p. 47). As previously noted, the participants in this study emphasized the extent to which they actively monitor and observe their students during a math period. Although all participants utilized unit tests and assignments to document progress, they heavily relied on their day to day observations.

Identification of Interventions to Support Struggling Learners

Survey participants indicated that they use a range of pedagogical skills and strategies to target interventions to meet individual students' needs. Although 13/14 participants noted that they *strongly agree* or *agree* with the statement that they can identify strategies to support students with number sense difficulties, only 5/14 indicated that they *strongly agree* or *agree* that they can identify strategies to support students with working memory or processing speed difficulties. Similarly, 6/14 participants noted that they *strongly agree* or *agree* that they can identify strategies to support students with executive function challenges or math anxiety. One participant noted that the Everyday Math program moves quickly and believes that some students need more time to practice the presented skills. In addition, one participant questioned if some of her students were developmentally ready for the curriculum. With regards to utilization of additional resources, the majority of participants noted that they use activities, games, and technology, but only 1/14 participants indicated that she used volunteers in the classroom.

Interview participants noted that when they identify that a student is demonstrating difficulty, they focus on determining the cause so they can implement an appropriate intervention. Participants shared that the identification of a specific strategy to address some particular needs can be difficult. Most noted a strong level of comfort with supporting students experiencing difficulty with computations or organization, but few participants reported similar confidence when students were experiencing difficulty with working memory, processing speed, or math anxiety. Many participants noted the difficulties they have with regards to checking in with each student during a class and discussed their use of flexible groupings to maximize their student interactions throughout a lesson. Participants also highlighted extensive use of strategies

to highlight important skills, eliminate unnecessary language, and encourage use of tools and resources to solve problems.

Literature strongly supports the importance of targeting instruction to meet specific needs. Feifer (2017) discussed the importance of precise assessment so "interventions can be directed in a more specific and targeted manner to better meet the needs of individual children" (p. 53). Managing a classroom of learners is multi-faceted, and effective instruction is based on individual needs. Gordon et. al. (2014) noted the need to "target specific needs" (p. 88) and individualize interventions for struggling students. Particularly in mathematics, there are skills beyond the computational abilities that impact performance. Ramirez (2013) studied the relationship between working memory skills and math anxiety, noting that students with low working memory were less impacted by math anxiety than students with high working memory. The provision of an appropriate intervention requires specific information about a student's needs rather than a broader intervention or assessment.

Teachers' Perceptions Regarding Access to Tools and Resources

The focus of this study was to gather information from the teachers' perspective regarding strategies and routines for identifying and supporting students who are struggling in mathematics. Survey participants were asked if they have the tools and resources they need to effectively intervene and support their students, and although most (8/14) reported to *strongly agree* or *agree*, 5 participants reported neutral feelings, and 1 *disagreed*. One participant noted that she would like to see more systematic intervention in math across the district, and two participants noted that literacy intervention often takes priority over math intervention. In addition to the variable responses regarding access to tools and resources, participants also shared a desire for additional instructor support in the classroom and shared that they do not have

enough time to check in with each student during a period. As previously noted, teachers believe that actively observing students, providing feedback in the moment, and asking questions to assess students' thinking are critically important components of an effective math lesson.

Interview participants discussed the wealth of resources available to them and noted the strong collaborative mindset of colleagues and support personnel. The data indicates that teachers regularly collaborate with their grade-level teams and special education teachers to create resources and review students' progress. Participants indicated that they work to create schedules that meet a range of needs; however, they noted that it is challenging to fit everything into the day. Participants shared their appreciation for the district-wide curriculum, Everyday Math, and noted that it provides a range of tools and resources to create engaging lessons for their students. Despite access to the structured curriculum and program-based professional development, participants expressed a desire for professional development that is focused on targeted interventions.

Study participants recognized the importance of using strong instructional methodologies to reach the range of students in their classrooms. Jankvist and Niss (2018) studied targeting instruction to "pave the way for satisfactory learning" through differentiated instruction (p. 15). In order to select the effective interventions, teachers must have experience, knowledge, and access to tools and resources. The DESE (2018b) explained that educators' content knowledge is necessary (p. 11), which related to the study data that identified the need for targeted and ongoing professional development. It is important to evaluate if there is a connection between the research being done and the path by which that information reaches teachers in the classroom. Mazzocco, Feigenson, and Halberda (2011) studied students' abilities to approximate numbers and noted the relationship between abilities and persistent difficulty with mathematics

achievement. Classroom teachers might identify that a student is struggling, but the real challenge can be in identifying the best route for intervention.

Implications and Recommendations for Action

The purpose of this study was to document the tools and strategies elementary school teachers use to identify and support struggling students in a math classroom. This study focused on teachers' perspectives in order to document teachers' experiences related to the identification of difficulties and implementation of interventions. Through a study focused on teachers' experiences, the gap between research that is focused on intervention strategies and the application of the strategies in the classroom can be targeted. By identifying the difficulties educators face in a math classroom, stakeholders can work collaboratively to address specific areas of need faced by teachers and students. Based on the data collected and analyzed, the researcher recommends the following action steps.

Research Question 1 Recommendations: Student Assessment

Format for collecting observation notes. The researcher recommends that teachers work to develop a consistent format for collecting and recording informal observations about students' performance in mathematics. The researcher recognizes the strong pedagogical skills and extensive years of experience that the participant teachers possess, but without a clear way to document student progress, the data is not accessible for ongoing review. The data indicates that teachers use observation skills as a primary method to gather information about students' performance. Although all participants acknowledged the importance of collecting informal data during a math period, participants did not indicate that there is a process for sharing data with previous or future teachers. To promote the effective and efficient allocation of services in an elementary math classroom, teachers should be collecting data that provides the most specific

and descriptive information as possible. In order for teachers to easily share student data, a consistent format for recording notes should be created and shared with teachers across the district.

Format for documenting student progress. The researcher also recommends that district stakeholders explore options for tracking students' computation abilities under untimed conditions. In this study, teachers noted that timed tests are difficult for some kids, so it is important to separate if students are having difficulty with math computations or simply need additional time to complete the assigned task. Teachers in this study reported that computation skills were a common area of need, but there was limited discussion about why a student was having difficulty with fact fluency. As a result, further exploring the *why* behind a student's difficulty mastering basic fact skills is a worthwhile endeavor for teachers across grades K-3.

In addition to gathering feedback about computation skills, teachers should also consider options for eliciting feedback from students about their personal performance. Because the students are in grades K-3, it will be important for the questions and response options to be developmentally appropriate for the population of students. Teachers noted the considerable amount of time they use to monitor and observe students during a math lesson, so interviewing students about their perceptions could provide important information about what they think they need to succeed.

Research Question 2 Recommendations: Interventions

Inventory the tools and manipulatives being used. All teachers discussed their use of a range of manipulatives, but some expressed concerns about the number of options, and a few wondered if the variety was confusing for some students. Curriculum-based and supplemental resources should be catalogued across the elementary school so teachers can purposefully select

tools that are developmentally appropriate and are relevant to the content being presented. The Everyday Math program identifies specific tools for each grade level; however, supplemental resources should be streamlined so that students have access to familiar tools and are not unnecessarily using new tools each year.

Promote vertical collaboration. The data reflect that teachers have a strong desire to collaborate and share resources, primarily within a grade-level team. To promote continuity across the grades, district stakeholders should build in time for teachers to share resources vertically. The use of targeted interventions will, and should, vary from classroom to classroom. Despite this, it is important to create a system for sharing information about strategies and interventions so teachers have important information about their students. The focus should not be to create a step-by-step approach to instruction, but rather provide teachers with the information they need to build on the work of their colleagues and support students from the first day of school. The vertical collaboration will promote communication about foundational skills for different students and will provide teachers with information that could help them scaffold lessons and differentiate instruction from the start of the school year.

Research Question 3 Recommendations: Teacher Resources

Professional development.Teachers who participated in this study are experienced, flexible, and observant professionals who seek out opportunities for professional development. Future professional development should be focused on interventions beyond the Everyday Math curriculum, and teachers should be surveyed to gather information about the topics they think would be of value. During future scheduled workshops, specific areas of challenge that teachers identified (e.g., working memory, executive functions, processing speed) should be addressed,

with follow-up sessions for continued discussion and opportunities for teachers to receive individualized support, as necessary.

Instructional support. Teachers indicated that although they are actively monitoring the students in their class, they find it difficult to manage the range of activities in a period. To address this challenge, considering a co-teaching model is recommended; however, stakeholders should also consider how streamlining resources and scaffolding lessons could be implemented. Managing the presentation of the curriculum and adapting materials to meet individual needs could promote student independence and allow students to develop their own work habits rather than require a teacher to be close by at all times. If poor reading ability is hindering a student's access to the math lesson, they often need a teacher close by. If a student is struggling to track the lesson, they often need frequent feedback and redirection. If a child has difficulty working on timed assessments, they might need to work well after the other kids are finished. Through intervention-focused professional development workshops and time for teachers to collaborate and share strategies, additional routines can be developed to promote students' success and independence.

Recommendations for Further Study

There is a broad scope of challenges that students face when working to develop 21st century mathematics skills (Feifer, 2017 and Mazzocco, 2007). Consequently, it is imperative for teachers to be well-versed in both the content of mathematics, the range difficulties that students can face, and the related interventions. To make this connection, teachers require access to resources beyond an elementary math curriculum to meet the diverse needs of students. In order to further identify efficient strategies for assessing and supporting struggling math students, future studies are recommended.

It would be beneficial to explore strategies for supporting students with working memory difficulties in the classroom, with an emphasis on specific strategies for limiting practices that overload students' working memory. Much research has been conducted in the area of timed math assessments, but additional studies that investigate the connection between working memory and fluency challenges is recommended. Also, in order to provide teachers with the necessary professional development they need to support their students, additional studies about the research to classroom connection should be considered. Specifically, studies related to the underpinnings of math anxiety and the early indications that differentiate it from computation difficulties or working memory challenges should be conducted.

Conclusion

The purpose of this study was to document the instructional practices and interventions teachers use, the resources available to them, and how prepared they feel to meet the needs of struggling learners in a K-3 mathematics classroom. Results indicate that teachers identify a range of student difficulties that can vary as the curriculum changes throughout the school year. Common challenges in a K-3 mathematics classroom include difficulties with content specific skills (e.g., numeracy, counting, fact fluency), literacy skills, general domain skills (e.g., processing speed), math anxiety, and executive functions (e.g., working memory and attention). To provide targeted interventions that address individual needs, teachers utilize a range of tools and strategies. Results indicate that teachers actively observe their students, intervene in the moment to address areas of difficulty, and collaborate with grade-level teams to discuss curriculum and share resources to support struggling students. Despite their strong pedagogical skills and years of experience, teachers discussed the challenges associated with meeting the wide range of needs in their mathematics classrooms.

Study participants discussed the use of resources and emphasized the collaborative nature of their colleagues, availability of mathematics manipulatives, and access to a comprehensive mathematics curriculum. Participants noted that they have been trained in the Everyday Math Program; however, they noted a need for professional development that is focused on interventions for struggling students. Based on the data collected in this study, participants are interested in exploring supplemental materials for supporting struggling students and identifying specific interventions that match the challenges their students are facing.

Although access to a comprehensive curriculum was noted to be a strength, teachers indicated that they find it challenging to meet the needs of each student during a math period. In order to explore options that would support both teachers and students, district stakeholders should consider expanding the professional development topics to include intervention strategies, cataloging the range of math tools and manipulatives used across the district, and providing opportunities for vertical collaboration and sharing of student data across grade-level teams (e.g., K-1; 2-3). Mathematics instruction builds upon previously constructed knowledge, so it is imperative for early elementary teachers to identify specific areas of need and provide targeted interventions that promote the development of problem solving and computation skills.

References

Ashkenazi, S., Mark-Zigdon, N., & Henik, A. (2009). Numerical distance effect in developmental dyscalculia. *Cognitive Development, 24*(4), 387-400. doi:10.1016/j.cogdev.2009.09.006.

Ashkenazi, S., & Henik, A. (2010). Attentional networks in developmental dyscalculia. *Behavioral and Brain Functions, 6*(1), 2. doi:10.1186/1744-9081-6-2.

Bloomberg, L. & Volpe, M. (2016). *Completing your qualitative dissertation*. (2nd ed.) SAGE Publications.

Bruner, J. S. (1966). *Toward a theory of instruction*. Cambridge, Mass.: Belkapp Press.

Bugden, S., & Ansari, D. (2011). Individual differences in children's mathematical competence are related to the intentional but not automatic processing of Arabic numerals. *Cognition, 118*(1), 35-47. doi:10.1016/j.cognition.2010.09.005.

Creswell, J. W. (2015). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. (5th ed.) Boston, MA: Pearson.

Decker, S. L., & Roberts, A. M. (2015). Specific cognitive predictors of early math problem solving. *Psychology in the Schools, 52*(5), 477-488. doi:10.1002/pits.21837

de Freitas. E., & Walshaw, M. (2016). *Alternative theoretical frameworks for mathematics education research: Theory meets data*. Retrieved from https://ebookcentral.proquest.com.

Dehn, Milton J. (2015). *Essentials of working memory assessment and intervention.* Hoboken, New Jersey: John Wiley & Sons, Inc.

Desoete, A., Ceulemans, A., Roeyers, H., & Huylebroeck, A. (2009). Subitizing or counting as possible screening variables for learning disabilities in mathematics education or learning? *Educational Research Review, 4*(1), 55-66. doi:10.1016/j.edurev.2008.11.003.

Eccles, J. (1983). Expectancies, values, and academic behaviors. In J.T. Spence (ed.), *Achievement and achievement motives: Psychological and sociological approaches* (p. 75–146). San Francisco: W. H. Freeman.

Everingham, Y. L., Gyuris, E., & Connolly, S. R. (2017). Enhancing student engagement to positively impact mathematics anxiety, confidence and achievement for interdisciplinary science subjects. *International Journal of Mathematical Education in Science and Technology, 48*(8), 1153. doi:10.1080/0020739X.2017.1305130.

Fani, T., & Ghaemi, F. (2011). Implications of Vygotsky's zone of proximal development (ZPD) in teacher education: ZPTD and self-scaffolding. *Procedia - Social and Behavioral Sciences. 29* 1549-1554. doi:10.1016/j.sbspro.2011.11.396.

Feifer, S. G. (2017). *The neuropsychology of mathematics: An introduction to the fam*. Middletown, MD: School Neuropsych Press, LLC.

Geary, D. C., Hoard, M. K., & Byrd-craven, J. (2008). Developmental neuropsychology development of number line representations in children with mathematical learning disability. *Developmental Neuropsychology, 33*(3), 277-299. doi: 10.1080/87565640801982361.

Geary, D. C., Hoard, M. K., & Bailey, D. H. (2012). Fact retrieval deficits in low achieving children and children with mathematical learning disability. *Journal of Learning Disabilities, 45*(4), 291-307. doi:10.1177/0022219410392046.

Goldfarb, L. & Levy, S. (2013). Counting within the subitizing range: The effect of number of distractors on the perception of subset items. *PLoS One, 8*(9), e74152. doi:10.1371/journal.pone.0074152.

Gordon, D., Meyer, A., & Rose, D. (2014). *Universal design for learning: Theory and practice* (e-book). Peabody: CAST Professional Publishing. Retrieved from https://ebookcentral.proquest.com.

Henik, A., Rubinsten, O., & Ashkenazi, S. (2011). The "Where" and "What" in developmental dyscalculia. *The Clinical Neuropsychologist, 25*(6), 989-1008. doi:10.1080/13854046.2011.599820.

Jankvist, U., & Niss, M. (2018). Counteracting destructive student misconceptions of mathematics. *Education Sciences, 8*(2), 53. doi:10.3390/educsci8020053.

Jansen, B. R. J., Louwerse, J., Straatemeier, M., van der Ven, S H G, Klinkenberg, S., & van der Maas, H L J. (2013). The influence of experiencing success in math on math anxiety, perceived math competence, and math performance. *Learning and Individual Differences, 24*, 190-197. doi:10.1016/j.lindif.2012.12.014.

Jordan, N. C., & Hanich, L. B. (2003). Characteristics of children with moderate mathematics deficiencies: A longitudinal perspective. *Learning Disabilities Research & Practice, 18*(4), 213-221. doi:10.1111/1540-5826.00076

Kanter, P., & Leinwand, S. (2018). *Making numbers, facts, and computation meaningful: Developing numerical fluency*. Portsmouth, NH. Heinemann.

Krasa, N., & Shunkwiler, S. (2009). *Number sense and number nonsense: Understanding the challenges of learning math*. Baltimore, MD: Paul H. Brookes Publishing Co.

Lafay, A., St-Pierre, M., & Macoir, J. (2017). The mental number line in dyscalculia: Impaired number sense or access from symbolic numbers? *Journal of Learning Disabilities, 50*(6), 672-683. doi:10.1177/0022219416640783.

Lee, J., Kotsopoulos, D., Tumber, A., & Makosz, S. (2015). Gesturing about number sense. *Journal of Early Childhood Research, 13*(3), 263-279. doi:10.1177/1476718X13510914

Maloney, E. A., & Beilock, S. L. (2012). Math anxiety: Who has it, why it develops, and how to guard against it. *Trends in Cognitive Sciences, 16*(8), 404-406. doi:10.1016/j.tics.2012.06.008.

Mammarella, I. C., Hill, F., Devine, A., Caviola, S., & Szűcs, D. (2015). Math anxiety and developmental dyscalculia: A study on working memory processes. *Journal of Clinical and Experimental Neuropsychology, 37*(8), 878-887. doi:10.1080/13803395.2015.1066759.

Massachusetts Department of Elementary and Secondary Education (DESE) (2018a). 2018 MCAS technical report. Retrieved from http://www.doe.mass.edu/mcas/results.html

Massachusetts Department of Elementary and Secondary Education (DESE) (2018b). *ESSA State Plan*. Retrieved from http://www.doe.mass.edu/federalgrants/essa/stateplan/

Massachusetts Department of Elementary and Secondary Education (DESE) (2018c). *Curriculum Frameworks*. Retrieved from http://www.doe.mass.edu/frameworks/current.html

Mazzocco, M. M. (2007). Early predictors of mathematical learning difficulties: Variations in children's difficulties with math. *Exchange*, *151*, 40-47. Retrieved from https://pdfs.semanticscholar.org/0e0a/cccc1b33ae1d01fe2ff7575df92bb96f2135.pdf.

Mazzocco, M.M. Feigenson, L., & Halberda, J. (2011). Preschoolers' precision of the approximate number system predicts later school mathematics performance. *PLoS One, 6*(9), e23749. doi:10.1371/journal.pone.0023749

McCaskey, U., Von Aster, M., Kucian, K., Tuura, R. O., Maurer, U., & Martin, E. (2018). Longitudinal brain development of numerical skills in typically developing children and children with developmental dyscalculia. *Frontiers in Human Neuroscience, 11* doi:10.3389/fnhum.2017.00629.

McLean, J. F., & Rusconi, E. (2014). Mathematical difficulties as decoupling of expectation and developmental trajectories. *Frontiers in Human Neuroscience, 8*, 44. doi:10.3389/fnhum.2014.00044

National Center for Education Statistics (NCES). (2013). *Inclusion of Students with Disabilities*. Retrieved from https://nces.ed.gov/fastfacts/display.asp?id=59.

Nguyen, H.N., Laski, E.V., Thomson, D.L., Bronson, M.B., & Casey, B.M. (2017). More than counting: Learning to label quantities in preschool. *YC Young Children, 72*(3), 22. Retrieved from https://search.proquest.com/docview/1917905225.

Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2013). Math anxiety, working memory, and math achievement in early elementary school. *Journal of Cognition and Development, 14*(2), 187-202. doi:10.1080/15248372.2012.664593.

Stock, P., Desoete, A., & Roeyers, H. (2009). Screening for mathematical disabilities in kindergarten. *Developmental Neurorehabilitation, 12*(6), 389-396. doi:10.3109/17518420903046752.

Vukovic, R. K., Kieffer, M. J., Bailey, S. P., & Harari, R. R. (2013). Mathematics anxiety in young children: Concurrent and longitudinal associations with mathematical

performance. *Contemporary Educational Psychology, 38*(1), 1-10. doi:10.1016/j.cedpsych.2012.09.001.

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

Appendix A

Research Site Approval Request

April 18, 2019

Dear Superintendent of Schools,

I am writing to request your permission to conduct a research study at your institution. I am currently a student in the Doctor of Education in Transformative Leadership program at the University of New England and am in the process of writing my dissertation.

I am conducting a research study designed to investigate how elementary school mathematics teachers determine what instructional practices and interventions they use, what resources are available to them, and how prepared they feel to meet the needs of struggling learners in a K-3 mathematics classroom. Through a study focused on identifying teachers' use of targeted strategies to identify and support struggling students, insights regarding effective instructional practices can be documented.

Method of Study
The primary method for data collection will be a qualitative phenomenological study. Surveys and semi-structured interviews will be conducted with certified K-3 teachers and will provide data to address the proposed questions related to providing targeted mathematics instruction to elementary students. There will be no student involvement in this research project.

Benefits to the school or district
Though there are no direct benefits to the Participating School District for participating in this research, it is my hope that the findings of my study will provide insight that will help teachers improve instructional practices to support struggling learners in an elementary mathematics classroom.

Proposed Project Period
The research proposed research period is from May 15, 2019 through July 15, 2019.

Participation
Informed consent will be obtained prior to completing the survey and participating in the interview. The researcher will explain the purpose of the research and expected duration of the interview. Interview participants will be informed that their participation is voluntary and will be advised that they can withdraw from the study or decline to answer any questions at any time. Each interview will be recorded and submitted to an outside company for transcription; a copy of the transcribed interview will be provided to the respective interviewee for review.

Confidentiality of participants will be maintained through the use of pseudonyms and coding of any identifiable information. Interviews will be recorded and sent to a transcription service that securely stores and encrypts files. Following receipt of a transcribed interview, the researcher

will delete the audio recording from the recording device. The transcribed interview will be stored in a file on a password protected computer for three years. At the end of three years, the file will be deleted securely through a military grade scrubbing procedure.

Information obtained from research will not include names of interviewees, schools, districts, or personal information.

Your approval to conduct this study will be greatly appreciated. If you agree to proceed with this study, please submit a signed letter of permission on your institution's letterhead acknowledging your consent. Please contact me at ckelleher@une.edu or 978-500-1788 with any questions or concerns about the study.

Sincerely,

Colleen Kelleher
Doctoral Candidate, Educational Leadership
University of New England

Appendix B

Invitation to Participate Email

From: Colleen Kelleher
Sent: Sunday, June 2, 2019 8:20 PM
Subject: Invitation to Participate in a Research Study

Dear Colleagues,

I would like to invite you to participate in a research study titled: *Teachers' Perceptions Regarding Reaching Struggling Learners in an Elementary School Mathematics Classroom*. I am currently a student in the Doctor of Education in Transformative Leadership program at the University of New England and am in the process of writing my dissertation.

The purpose of this research study is to document how teachers determine what instructional practices and interventions they use, what resources are available to them, and how prepared they feel to meet the needs of struggling learners in a K-3 mathematics classroom. Through a study focused on identifying teachers' use of targeted strategies to identify and support struggling students, insights regarding effective instructional practices can be documented.

This study involves a survey with the possibility of participating in a follow-up interview. If you agree to participate in this project, please use the link below to access the electronic survey. The survey should take less than fifteen minutes to complete. If you have any questions or concerns, please contact me at (978)500-1788 or ckelleher@une.edu. Your participation is appreciated!

Survey Link:
https://redcap.une.edu/redcap/surveys/?s=73XNJK3TCH

Sincerely,

Colleen Kelleher
Doctoral Candidate, Educational Leadership
University of New England

Appendix C

Email Follow-up to Perspective Participants

Hi Everyone,

Thank you so much to those who were able to complete my survey! I know this is a busy time of year, and I truly appreciate your help with my research study.

If you haven't had a chance to respond yet, please consider taking a few minutes to answer the survey questions. It should take less than 15 minutes (likely just 10 minutes!). I'm hoping to collect data over the next week so I'm ready to write over the summer!

Looking forward to gathering more data!

Survey Link: https://redcap.une.edu/redcap/surveys/?s=73XNJK3TCH

Thanks again,
Colleen

Appendix D

Consent to Participate

UNIVERSITY OF NEW ENGLAND
CONSENT FOR PARTCIPATION IN RESEARCH

Project Title: Teachers' Perceptions Regarding Reaching Struggling Learners in an Elementary School Mathematics Classroom
Principal Investigator(s): Colleen Kelleher
Introduction:

- Please read this form. You may also request that the form is read to you. The purpose of this form is to give you information about this research study, and if you choose to participate, document that choice.
- You are encouraged to ask any questions that you may have about this study, now, during or after the project is complete. You can take as much time as you need to decide whether or not you want to participate. Your participation is voluntary.

Why is this research study being done?
The purpose of this qualitative phenomenological research study is to document the practices used by teachers and the types of services they provide to support struggling students in a K-3 mathematics classroom.

Who will be in this study?
Participants for this study will be Massachusetts licensed teachers who are currently teaching full-time in a K-3 public school classroom located in Massachusetts.

What will I be asked to do?
You will be asked to participate in an online survey that is focused on gathering information about your teaching experience and strategies for identifying and supporting struggling math students. You may volunteer to participate in a semi-structured 1:1 interview. Interviewees will be selected from a pool of volunteers. During the interview, you will be asked open-ended questions focused on pedagogy and resources related to supporting struggling math students. Following the interview, you will receive a copy of the transcribed interview to review for accuracy.

What are the possible risks of taking part in this study?
There are no predictable risks for taking part in this study.

What are the possible benefits of taking part in this study?
There are no direct benefits to you participating in this study.

What will it cost me?
There are no costs to participate in this survey.

How will my privacy be protected?

Confidentiality of participants will be maintained through the use of pseudonyms and coding of any identifiable information. Survey data will be collected through a secure web-based program. The survey is anonymous unless the participant wishes to complete a follow up interview. If a participant volunteers for a 1:1 interview, an email address will be requested. Data collected during the interview will be kept confidential, and your identity will not be disclosed. The researcher, the researcher's committee members, and the University of New England's Institutional Review Board (IRB) will have access to the survey data. During the interview, participants will be identified by number (e.g., Participant 1, Participant 2). All references to participants will follow that naming structure throughout the remainder of the study.

How will my data be kept confidential?

Confidentiality will be maintained through the use of pseudonyms to represent each participant. Interviews will be recorded and sent to a transcription service that securely stores and encrypts files. Following receipt of a transcribed interview, the researcher will delete the audio recording from the recording device. The transcribed interview will be stored in a file on a password protected computer for three years. At the end of three years, the file will be deleted securely through a military grade scrubbing procedure.

What are my rights as a research participant?

- Your participation is voluntary. Your decision to participate or not will have no impact on your relationship with your employer/school district.
- You may skip or refuse to answer any question for any reason.
- If you choose not to participate there is no penalty to you and you will not lose any benefits that you are otherwise entitled to receive.
- You are free to withdraw from this research study at any time, for any reason.
    - If you choose to withdraw from the research study, there will be no penalty to you and you will not lose any benefits that you are otherwise entitled to receive.
- You will be informed of any significant findings developed during the course of the research that may affect your willingness to participate in the research.
- If you sustain an injury while participating in this study, your participation may be ended.

What other options do I have?

- You may choose not to participate.

Whom may I contact with questions?

- The researcher conducting this study is Colleen Kelleher.
    - For more information regarding this study, please contact Colleen Kelleher.

☐ If you choose to participate in this research study and believe you may have suffered a research related injury, please contact Dr. Michelle Collay via email at mcollay@une.edu.

☐ If you have any questions or concerns about your rights as a research subject, you may call Mary Bachman DeSilva, Sc.D., Chair of the UNE Institutional Review Board at (207) 221-4567 or irb@une.edu.

Will I receive a copy of this consent form?
You will be given a copy of this consent form.

Participant's Statement

I understand the above description of this research and the risks and benefits associated with my participation as a research subject. I agree to take part in the research and do so voluntarily.

Participant's signature or Legally authorized representative — Date

Printed name

Researcher's Statement
The participant named above had sufficient time to consider the information, had an opportunity to ask questions, and voluntarily agreed to be in this study.

Researcher's signature — Date

Colleen Kelleher
Printed name

Appendix E

Survey

Participation is anonymous and voluntary
Do you give your consent to participate in this survey?

- ☐ yes
- ☐ no

Part I. Certification and Education

1. Are you currently a licensed educator teaching in a K-3 public school general education classroom? If yes, please share your certification (e.g., 1-6 General Education, or K-2 Early Childhood).
   - ☐ yes _____
   - ☐ no

2. How many years have you been teaching in Massachusetts as a K-3 certified teacher?
   0-1 1-5 5-10 10-15 >15
3. What was your undergraduate major of study in college?

4. Do you have a master's degree? If so, what was your degree focus?
   - ☐ Yes _____
   - ☐ I do not have a master's degree

Part II. Instructional Practices

5. Do you use a specific math curriculum or textbook? If yes, please specify.
   - ☐ yes _____
   - ☐ no

6. What, if any, resources or tools do you use in your mathematics classroom?

7. How many minutes of math instruction do you have each week? How long is each math period?

Part III. Student Assessment

8. Based on your experiences in a K-3 mathematics classroom, which areas have you identified to impact student performance? Check all that apply.

- ☐ Number sense
- ☐ Comprehension
- ☐ Working memory
- ☐ Processing speed
- ☐ Executive functions (planning, organizing, follow-through)
- ☐ Math anxiety
- ☐ Reading skills
- ☐ Student groupings
- ☐ Other (please specify) _____

9. How do you assess your students' progress towards meeting stated math goals and objectives? Check all that apply.

- ☐ review of work samples
- ☐ formal assessments (please specify) _____
- ☐ chapter / unit tests
- ☐ classroom observations
- ☐ school-wide benchmarks (please specify) _____
- ☐ projects
- ☐ homework
- ☐ other (please specify) _____

10. Does your school have an RtI (Response to Intervention) program? If yes, how many of your students, if any, are receiving Tier II or Tier III support?

- ☐ yes _____
- ☐ no

11. How many students, if any, have you referred for a mathematics special education evaluation in the past school year?

0-1 2-4 5-7 8-10 >10

12. Do you collaborate with other professionals when you identify that a student is experiencing difficulty in math? If yes, please check all that apply.

- ☐ grade-level teacher
- ☐ special education teacher
- ☐ math intervention specialist/ math coach
- ☐ principal
- ☐ paraprofessional / teaching assistant
- ☐ parents/guardians
- ☐ other (please specify) _____

Part IV. Professional Development

13. I feel qualified to identify the particular needs of a struggling math student.

- ☐ strongly agree
- ☐ agree
- ☐ neutral / neither agree nor disagree
- ☐ disagree
- ☐ strongly disagree

14. I feel qualified to identify targeted interventions to address specific students' needs in mathematics.

- ☐ strongly agree
- ☐ agree
- ☐ neutral / neither agree nor disagree
- ☐ disagree
- ☐ strongly disagree

15. I have the curriculum tools and supplemental resources I need to meet the range of learners in my mathematics classroom.

- ☐ strongly agree
- ☐ agree
- ☐ neutral / neither agree nor disagree
- ☐ disagree
- ☐ strongly disagree

Professional Development

16. Does your school provide regular professional development specifically focused on supporting all learners in the mathematics classroom? If yes, how often?

17. Have you completed workshops or graduate-level courses focused on elementary mathematics or mathematics pedagogy? If so, when?

18. Does your school provide regular time to grade-level teams to collaborate and plan math lessons?

19. Please include any additional comments you have regarding supporting struggling math students in the classroom.

Are you interested in participating in a 1:1 interview focused on interventions and supports for struggling math students?

- ☐ yes
- ☐ no

Appendix F

Interview

Interview Questions

The following research questions will guide the study:

1) How do early elementary school teachers (K-3) identify and evaluate individual students regarding the potential areas of difficulty in mathematics (e.g., counting, subitizing, comparing numbers, and completing basic computations)?
2) What tools and resources do early elementary school teachers utilize to intervene and support elementary school students who are demonstrating difficulty in mathematics class?
3) To what extent do early elementary school teachers feel prepared to effectively intervene and support students who are experiencing difficulty in math class?

Opening Statement: I appreciate your willingness to meet with me to discuss interventions and assessments to support struggling math students. my Doctorate in Educational Leadership. In your role as an elementary school teacher, I am interested in learning about your experiences with identifying, supporting, and instructing students experiencing difficulty in mathematics. With your permission, I would like to record and transcribe our interview.

Teaching Experience

1. Years teaching / Current grade

2. Can you describe the typical model you follow during your math periods? (For example, small group, whole class, center rotations, etc). Which is/are your preferred model (2)? How do you create instructional groups?

Identifying students' specific math needs

3. What tools do you use to monitor progress? What are your measurable learning targets?

4. What are the **common** difficulties that you have seen your students face in your math class?

Supporting students in the mathematics classroom

5. What targeted interventions have used to support struggling math students in your classroom.

6. Discuss the resources **you** utilize when developing plans to support your students.

7. How do you create instructional groups or pair students during group work?

Professional Development

8. Can you tell me about your professional development experiences in your current school?

Closing remarks: Are there any additional points you would like to share? Thank you for sharing such specific examples and stories. I truly appreciate you taking the time to meet with me and discuss your experiences and thoughts about supporting students in a mathematics classroom.

Appendix G

School Approval Letter

SCHOOL DISTRICT

Office of the Superintendent

P.O. Box

Tel. (

Fax:

SUPERINTENDENT OF SCHOOLS

May 29, 2019

RE: Request to Conduct Research

To Whom It May Concern:

The purpose of this letter is to inform you that I give Colleen Kelleher permission to conduct the research project titled, *Teachers' Perceptions Regarding Reaching Struggling Learners in an Elementary School Mathematics Classroom,* for her program at the University of New England. This also serves as assurance that the School District complies with requirements of the Family Educational Rights and Privacy Act (FERPA) and the Protection of Pupil Rights Amendment (PPRA) and will ensure that these requirements are followed in the conduct of this research.

Sincerely,

Superintendent

Appendix H

Coding Map: Research Question 1

Research Question #1

First Iteration:

1.1 Formal and informal assessment

- attention to struggling learners
- card and dice activities
- challenging - skills can change daily
- computation sheets
- Everyday Math resources
- fact tests - timed - regular basis
- games - computation and counting
- guided questions
- homework - data point
- in the moment - see who is getting it
- individual check ins
- informal - probing questions
- informal observation
- instruction - diagnostic
- mental math
- observation
- progress monitoring – schoolwide
- recording data and notes
- summative
- teacher created tools and rubrics
- watch the process students use
- whiteboard problems

Second Iteration:

1a. All teachers use a range of strategies to track student progress.
1b. All teachers recognized that one assessment does not tell the full story of a student's needs.
1c. All teachers referenced multiple measures for gathering student data.
1d. Most teachers believed that observational data was the most beneficial way to track student progress.
1e. Many teachers believed that student performance varies from day to day and unit to unit.
1e. Many teachers used a teacher created tool or note taking system to organize data and track areas of challenge.
1f. Many teachers used timed fluency tests to track students' computation skills.

Third Iteration:

1A. Assessment: Teachers utilize a range of formal and informal assessments to collect data on an ongoing basis.

Code Mapping
Research Question #1

First Iteration:

1.1 Students struggle in math class

- attention
- behavior
- can't shift tasks
- computation errors
- developmentally not appropriate
- EM Program is language based
- executive functions
- fact fluency
- frustration and boredom
- global issue not necessarily math
- impulsivity
- kids master at different times
- lack of confidence
- limited practice with skills
- low independence
- low confidence
- low interest in lesson
- math anxiety
- maturity level
- memory - can't hold numbers
- miscounting
- needing extra time
- not independent
- number and letter reversals
- numbersense
- one to one correspondence
- pace too fast
- place value
- processing speed
- reading based
- social component of groups
- sustained attention
- tracking on a number line / grid
- using math tools
- using efficient strategies
- vocabulary
- writing skills
- writing quickly

Second Iteration:

1a. All teachers recognized difficulties with basic numeracy skills.
1b. All teachers believed that specific math skill deficits were impacting performance.
1c. All teachers believed that students' abilities varied across tasks and time.
1d. Most teachers identified executive function difficulties as commonly occurring.
1e. Most teachers believed that the language demands of the EM Program were difficult.
1f. Most teachers believed that struggling students had challenges in multiple areas.
1g. Most teachers recognized literacy skills as barriers to math performance.
1h. Some teachers identified engagement and interest in the lesson as a reason for difficulty.
1i. Some teachers addressed the different time that students need to complete tasks.
1j. A few teachers questioned if students were having difficulty with memory.
1k. A few teachers addressed issues related to selecting and utilizing efficient tools and strategies to solve problems.

Third Iteration:

1B. Student Challenges: All teachers expressed concerns about student performance across a range of skills, with primary difficulties in the areas of basic numeracy skills, executive functions, and literacy skills.

Appendix I

Coding Map: Research Question 2

Teachers use a range of strategies to meet student needs.

- break down directions and language
- build confidence from ground up
- build on current understanding
- close proximity
- conversations with students
- developmentally appropriate
- differentiation - different numbers
- drawing - teach kids step by step
- explicit instruction – step by step
- extra practice
- fact families
- fact fluency strategies
- fact practice - students track
- familiar context for new skills
- focus on what works for students
- games to review and apply content
- give choice - let kids pick the tool
- give feedback
- groups depend on class and staff
- guided questions
- helping kids 'see' numbers
- more time for struggling learners
- instruction about how to use tools
- instruction diagnostic and explicit
- intervention immediate feedback
- make math exciting
- mark papers
- meet kids where they are
- model with students' papers
- movement engage the kids
- multiple representations
- number grids and hands on
- number sense games
- parent communication
- peel away layers of difficulty
- peer assistance
- purposeful pairings
- recognize that choice is important
- manipulatives: number lines / grids
- reteaching
- small group skill based
- strategy wall for students
- visual schedule color coded

Second Iteration:

2a. All teachers utilize a range of tools and strategies.
2b. All teachers provide explicit instruction and value step-by-step directions.
2c. All teachers discussed specific interventions for developing computation skills.
2d. All teachers believed that instructional groups should be purposefully created.
2e. All teachers provided access to a range of math tools and manipulatives.
2f. All teachers believed in differentiating instruction and providing time for practicing new skills and concepts.
2g. Most teachers addressed the need for developmentally appropriate instruction that builds on current skills.
2h. Most teachers focused on engaging students in the learning process.
2i. Most teachers identified that struggling students get more of their time.
2j. A few teachers discussed providing visual models and having students draw diagrams.

Third Iteration:

2. Supporting Struggling Learners: Strong pedagogy skills drive instruction that meets a range of learners.

Appendix J

Coding Map: Research Question 3

To what extent do early elementary school teachers feel prepared to effectively intervene and support students who are experiencing difficulty in math class?

First Iteration:

3.1 Teachers experience challenges, but they maintain a problem-solving mindset to student needs

- developmental foundational skills basics
- have to front end lessons
- doesn't have time - 3-4 kids... divided attention
- getting to everyone wants a second teacher
- hard to see difficulties at start of the year
- keeping track while working independently
- kids have multiple levels need multiple levels
- limited time with high students
- literacy connections - library of math books
- need to closely monitor students in workshop model
- needs another teacher - hard to get to everyone
- needs to monitor and follow up
- scheduling groups and getting to see everyone
- scheduling with RTI
- teacher making the schedule
- time - not enough
- time - stretched thin
- transitioning takes up time
- trying to figure out where challenge is - what is the 'root' of the problem?
- vocabulary - need more exposure - relate to content
- wants more consistency within grade – accountability

Second Iteration:

3.1a. All teachers believed there are challenges that must be addressed in the classroom environment.
3.1b. All teachers believed that scheduling services is an area of challenge for teachers that impacts student instruction.
3.1c. Most teachers believed that staffing patterns impact their ability to give all students the attention they need.
3.1d. Most teachers noted that getting to the root of a student’s difficulty requires collaboration and professional support.
3.1e. Most teachers believed constant monitoring of students is necessary, but not manageable in a one teacher classroom

Third Iteration:

Teachers acknowledge the range of challenges they face to meet students’ needs, but they believe their strong pedagogical skills, positive mindset, access to resources, and open communication provide a strong foundation for supporting struggling learners

Research Question #3

To what extent do early elementary school teachers feel prepared to effectively intervene and support students who are experiencing difficulty in math class?

First Iteration:

Teachers appreciated the access to a comprehensive math program, but they noted that it is challenging for some students to navigate.

3.2 Teachers access resources to meet students' needs.

- a ton of language on every page"
- collaborate - with teachers to find new activities
- collaborate with pervious teachers
- collaborate with staff - team effort
- collaborate with teachers - plan and ask for help
- communicate with RTI teacher
- doesn't build mastery before moving on
- goes quickly - pace of lesson
- introduces and reviews
- language heavy"
- lots of differentiation resources
- lots of ideas in the teachers' manual
- love the program / too many ways to solve problems
- moves quickly for some
- no PD for active board
- limited PD / not as much PD as I would like
- not enough fact practice
- not related to math
- online is too time consuming
- pace is fast
- plenty of resources
- RTI - teacher support is great
- reading a book about strategies
- seek out my own PD
- self-directed - math workshop
- so much - little room for extras
- specific PD to EDM
- take finding PD upon myself
- wants 'teaching strategies' not more EDM PD
- would like PD on intervention

Second Iteration:

3.2a. Teachers believed they must invest planning time to prepare lessons so they can modify the available resources. Professional development was an area of need that teachers want to increase.

3.2a..Teachers believe they have a rich supply of math materials – curriculum, tools, resources.

3.2b. Teachers appreciate the EM support, but recognize the need for more intervention based professional development.

3.2c. Teachers reported self-directed professional development and utilization of tools and resources they find on their own.

3.3d. Teachers believe that the community of professionals provide strong support for meeting struggling learners, but they expressed a desire for additional instructional support and access to a math coach/ specialist.

Third Iteration:

Teachers utilize the EM Program resources to present lessons, but they also need to supplement and modify lessons.