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Early Grade Teacher Perspectives of Struggling Learners and Later Mathematics Achievement

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This is to certify that the doctoral study by

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Walden University
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Abstract

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Crystal Cuyler

EdS, Walden University, 2014

MA, Walden University, 2011

BS, Georgia Southern University, 2005

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Students who were not identified with a learning disability or significant developmental delay (SDD) in prekindergarten, but may have undiscovered learning issues are often among the lowest performing students in mathematics when they reach upper grades. The purpose of this qualitative study was to understand kindergarten, first, and second grade teacher perspectives of early indicators of later difficulties in mathematics among children not identified as having learning disabilities or SDD in prekindergarten. A retrospective study was conducted in which the remembrances of early grade teachers were used to explore the difficulties children who were struggling with mathematics as fourth and fifth graders had in their early years. The conceptual framework for this study was Kahneman and Tversky's theory of prediction and decision-making, which suggests that intuitive predictions often follow a judgmental heuristic. Three research questions guided inquiry into early grade teachers' perspectives of current and past students who struggled with mathematics. Data from 10 interviews, with teachers identified through purposeful sampling, were analyzed using thematic analysis. Results suggested teachers have the same information about students as they had previously, and difficulty in mathematics is not uncommon. Teachers believed they were able to predict in early learners their poor mathematics scoring in later grades, but felt they lacked agency to resolve early mathematics struggles to avoid later struggles. The results of this study bring attention to this perceived lack of agency and may lead to positive social change if early grade teachers are inspired to develop and successfully implement practices dedicated to increasing student success.

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Dedication

I first dedicate this doctoral study to my God and Savior who I asked in the very beginning to guide me along this uncharted journey and he never left me nor forsook me. To my amazing parents, Cleve and Laura Phillips, who instilled the importance of education and supported me along the way. No matter what I needed, no questions were asked. Last, but not least, I dedicate this study to my wonderful husband, Sean Cuyler, who encouraged me to go back to school, picked up my slack on days when I was too tired to cook or clean, and always had my back. I love you, Maceo!

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First, I would like to say thank you to my very close friend, Cassondra Walker, who started this going back to school journey with me in 2009 when we decided it was time to get our master's degree and in 2011 when we began working on our specialist's degree. I remember in 2014 when we talked ourselves into going on to work on our doctorate because it was only one more degree, so why not? You were with me along the way, and I appreciate every moment of it.

Thank you to my brother, Cleve. Although we do not talk every day, whenever you came to see me, you would always be sure to ask how school was going and if I needed anything. Thank you.

A very special thank you to my chair, Dr. Patricia Anderson, who pushed me every step of the way. There were times when I felt that quitting would be easier than finishing this study, but you always checked on me when I was missing for a while and let me know you were here to help. I remember your exact words and I repeated them quite often, "I can work with you, but I cannot work on nothing!" Dr. Anderson, without you, this study would not exist.

Lastly, thank you to everyone who supported me throughout this study and contributed in some way. Your cooperation and support were much needed and I am forever grateful. Thank you.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

Although school systems put into place programs or assessments to identify children early who will struggle later with mathematics, often those efforts do not catch all children (Harris & Bourne, 2017; Van de Walle et al., 2015). With the guidance of three research questions, in this study I examined kindergarten, first, and second grade teachers' recollections of early indicators of difficulties in mathematics that surfaced among fourth and fifth grade children who were not identified in prekindergarten screening as having learning disabilities or significant developmental delays (SDD) but later struggled in mathematics. I begin this section by providing background research related to the problem and an introduction to the conceptual framework for the study. Next, I present background information about the focus of this study, drawn from current literature, and establish the gap that exists involving what was known about some children's unanticipated struggles with mathematics. I conclude this chapter by discussing the significance of this study and implications it could have for the field of early childhood mathematics as well as the development and learning of young children. In this qualitative study, I sought to better understand early indicators of later difficulties in mathematics for young children.

Background

In 2015, two of the three elementary schools in the school system that was the focus of this study were placed on the Focus Schools list in their state. Being a Focus School meant there was a major gap in achievement between the highest and lowest performing students in a subject area and an urgent need to close that gap, according to a

2018 report by the department of education in the target state. As a result of being placed on the Focus Schools list, the elementary school administrators and district leaders decided that their initial focus would be closing the achievement gap in the area of mathematics, as reported in 2018 by the board of governors of the school system in the target county.

Difficulties with mathematics develop early in young children and persist throughout schooling if these difficulties are not addressed early (Nguyen et al., 2016; Shanley et al., 2017). Similarly, later achievement and success in life are dependent upon the development of early foundational skills in mathematics (Shanley et al., 2017; Stevens et al., 2015). Because of the cumulative nature of mathematics and the fact that new skills often require foundational knowledge, the early years are critical to later mathematics learning and skill development (Conoyer et al., 2016).

The ability to predict which students in early grades will struggle in mathematics in later grades is a challenge for early childhood educators and constitutes a major gap in practice. Stevens et al. (2015) reported that difficulties in identifying early in children's school careers who will later struggle in mathematics is a nationwide problem. Efforts to reform mathematics education in the United States have often fallen short in terms of closing the achievement gap between proficient students and those who struggle in mathematics (Stevens et al., 2015). Aunio and Rasanen (2016) said that mathematics assessment screeners used in the early grades usually do not accurately measure students' abilities and skills, and those assessments that do accurately measure students' skills are limited in current research, which makes it harder for early educators to determine which students later will struggle in mathematics. Harris and Bourne (2017) found that despite no obvious early indicators, some students in upper grades underperform in mathematics. Kindergarten, first, and second grade teachers may provide insights into identifying mathematics problems independent of formal assessments, which was the focus of this study.

Problem Statement

The problem that was the focus of this study was poor scoring in mathematics among fourth and fifth grade students who were not identified in prekindergarten as having learning disabilities or SDD. Each year, teachers in the school system administer the Prekindergarten Readiness Assessment to identify early students who may be at risk for future academic failure, as reported in 2016 by the target county school system. According to the county, despite this early attempt to identify at-risk learners, more often than expected, students identified as not having a learning disability or SDD were among the lowest performing students in the mathematics classroom, as indicated by response to intervention (RtI) data. This issue was evident in upper grades 3 to 5 when these same students began taking end-of-grade assessments and did not demonstrate proficiency at their current grade level, as reported by the target state department of education. From 2014 to 2016, the number of fourth grade students at one of the elementary schools that were the focus of this study who still performed at Level 1-Beginning Learner had always been greater than the number of students identified as having a learning disability or SDD. Level 1-Beginning Learners are students identified as not yet demonstrating proficiency at their current grade level and require substantial academic support for them to be prepared for the next grade level.

In the spring of 2014, there were 36 fourth graders at this school; of these, 14 scored at Level 1-Beginning Learner, but only five had been identified as having a learning disability or SDD, according to the state department of education. In the spring of 2015, there were 22 fourth graders, two of whom scored at Level 1, but neither of whom had been identified as having a learning disability. In the spring of 2016, there were 36 fourth graders, 18 of whom scored at a Level 1 despite the fact that only five had been identified as having a learning disability or SDD, as reported by the state department of education (see Table 1).

Table 1

Fourth Grade Students Performing at Level 1-Beginning Learner 2014-2016

Year	Total # of Students	Level 1-Beginning Learners	Students with Learning Disability or SDD
2014	36	14	5
2015	22	2	0
2016	36	18	5

This problem involving later grades mathematics failure among children not identified as having special needs that was unanticipated based on early grades assessments was not limited to the local school. Goldstein et al. (2017) addressed the validity of kindergarten readiness assessments and student achievement on a third grade summative assessment and found that lack of early identification of academic risk constitutes a nationwide issue.

Russo et al. (2019) examined performance-based assessments and teacher rating scales and raised concerns about the readiness assessments' ability to accurately measure children's abilities. Difficulties with mathematics develop early in young children and persist throughout schooling if these difficulties are not addressed early (Nguyen et al., 2016; Shanley et al., 2017). Additionally, later achievement and success in life are dependent upon the development of early foundational skills in mathematics (Shanley et al., 2017; Stevens et al., 2015). The need to better understand early indicators of later difficulties in mathematics was the problem that formed the basis of this study.

Purpose of the Study

The purpose of this study was to understand early grade teacher awareness of early indicators of poor scoring in mathematics among fourth and fifth grade students who were not identified in prekindergarten as having learning disabilities or SDD. Although there was extensive research addressing causes of mathematics failure for children with learning disabilities, little was known about what causes struggles with mathematics among students not identified as having learning disabilities. To address this issue, I conducted a retrospective qualitative study in which the remembrances of early grade teachers were used to determine difficulties that children who struggle with mathematics as fourth and fifth graders had in their early years. I conducted interviews to develop an understanding of the early warning signs that might have been exhibited by students who score poorly in mathematics in later grades. Insights gained from interviews could possibly help to determine if teachers could predict which students will later struggle in mathematics.

Research Questions

The research questions that guided this study were informed by Kahneman and Tversky's theory of prediction and decision-making. These questions were designed to first address the struggles of students currently enrolled in kindergarten, first, and second grade, the information with which teachers might predict students' future mathematics success, and teachers' perceived abilities to make such predictions. The questions were intended to lead to insights regarding the phenomenon of poor scores in mathematics among fourth and fifth grade students, despite the fact that they were not identified as having learning disabilities or SDD in prekindergarten. The research questions that guided this study were:

RQ1: How do early grade teachers describe mathematics learning they see in their currently enrolled students not identified in prekindergarten as having a learning disability or SDD as representative of mathematics learning they recall among undiagnosed students now in fourth and fifth grade who score poorly in mathematics?

RQ2: How do early grade teachers describe the availability of information regarding mathematics learning of their currently enrolled students not identified in prekindergarten as having a learning disability or SDD in comparison to the availability of information they recall having regarding mathematics learning among undiagnosed students now in fourth and fifth grade who score poorly in mathematics?

RQ3: How do early grade teachers describe their ability to predict poor mathematics scores in fourth and fifth grades for their currently enrolled students not identified in prekindergarten as having a learning disability or SDD?

Answers to these questions could possibly determine how early grade teacher awareness of mathematics learning in current and former students could be used to help teachers predict which early grade students may later struggle in mathematics.

Conceptual Framework

The conceptual framework for this study was Kahneman and Tversky's theory of prediction and decision-making. Kahneman and Tversky (1973) said intuitive predictions often follow a judgmental heuristic. In this sense, predictions are made based upon outcomes that appear to be most representative of evidence (Kahneman & Tversky, 1973). According to Kahneman and Tversky (1974), three heuristics are employed when judgments are made in situations of uncertainty: representativeness, availability of instances or scenarios, and adjustment from an anchor. Heuristics in judgments and decision making are mental cues people often use to inform their judgments and make decisions (Kahneman & Tversky, 1974). Representativeness is usually employed when judging the probability of an object or event being categorized or related to another object or event. Availability of instances or scenarios is a heuristic that relies on the ease with which an event can be recalled (Kahneman & Tversky, 1974). These concepts and how they relate to this study are discussed further in Chapter 2. Because this study was about the ability of teachers of early grades to observe mathematics difficulty and predict future success or failure of learners, application of Kahneman and Tversky's theory in this study could help determine if teachers can identify early students who will struggle in mathematics in the later grades.

Nature of the Study

The nature of this study was qualitative because qualitative research was consistent with building retrospectively a portrait of children who were struggling with mathematics as fourth and fifth graders, based on teacher remembrances of their early years. Qualitative studies are used to gain a better understanding of problems, whereas quantitative studies involve measurable data to quantify a problem (Merriam, 2009). This was a basic qualitative study using interviews, and I used teacher interviews to gain insights into the phenomenon of children scoring poorly in mathematics despite the fact that they were not identified as having a learning disability or SDD in prekindergarten. To develop a deeper understanding of early indicators of later difficulties in mathematics, teacher recollections and perspectives of learners when they were in kindergarten, first, and second grade were examined using interviews.

As a means of acquiring a representative sample, kindergarten, first, and second grade mathematics teachers in the school system that was the focus of this study were invited to participate. There were five kindergarten, five first grade, and six second grade teachers at the two schools of focus; therefore, it was estimated that 16 teachers would participate in the study.

Through the process of coding as a heuristic tool and inductive reasoning, intellectual interpretations could arise from discoveries found in data and themes that emerged in kindergarten, first, and second grade teachers' recollections. Codes could be used to rationalize what was happening and make discoveries about deeper realities that emerged from the data. This thematic analysis may address early warning signs of struggle that learners will experience in later grades and possibly validate early grade teachers' intuitions as a means by which to support young students in mathematics. The nature of the study is discussed in further detail in the methodology section of Chapter 3.

Allen and Casbergue (1997) examined the accuracy and thoroughness of teacher recall and found that teachers' ability to recall their students' learning behaviors was contingent upon the interactions the teachers previously had with the learners. Expert teachers were more likely to accurately remember their students' behaviors than novice teachers. Teachers' ability to recall student learning was important because their insights about student learning could ultimately guide and improve instruction (Thiede et al., 2015). This aspect of early childhood education is addressed in further detail in the literature review section of Chapter 2.

Definition of Terms

At-risk learner: A student with a higher probability of academic failure or limited success based upon social, biological, or environmental factors (Morgan et al., 2016).

Early indicators of later difficulties: Early signs of struggle exhibited by young learners that can be viewed as predictors of mathematics struggle in later grades (Conoyer et al., 2016).

Learning disability: Underlying condition which causes difficulty in acquiring knowledge, developing skills, or processing information (Marita & Hord, 2017).

Significant developmental delay (SDD): Learning constraint that limits motor skills, socio-emotional development, adaptive behavior, communication, or cognition (Raab et al., 2016).

Assumptions

Throughout the study, I made several assumptions. The first assumption was that kindergarten, first, and second grade teachers were open and honest in terms of their recollections about students' learning behaviors when answering interview questions. A second assumption was that the children's prekindergarten assessment that indicated no learning disability or SDD was accurate, so indicators of their later struggle with mathematics remained to be discovered. Finally, I assumed that the instruction that children who struggle with mathematics in fourth and fifth grades received in prior years was equivalent to that received by children who did not struggle, and that instruction was appropriate in terms of their achievement level at the time and unaffected by bias of any kind.

Scope and Delimitations

The identified research problem was chosen to better understand kindergarten, first, and second grade teachers' perspectives of early indicators of later difficulties in mathematics among children not identified as having learning disabilities or SDD in prekindergarten. In this qualitative study, I used interviews of three kindergarten, four first grade, and three second grade teachers to explore their recollections of possible indicators in young students of later mathematics failure that were evident in present day fourth and fifth grade students. This study was delimited to kindergarten, first, and second grade teachers in two elementary schools in the school system under focus. Participants were teachers who taught current fourth and fifth grade students when they were in kindergarten, first, and second grade. Third grade teachers were excluded from the study because the intended purpose of the study was to identify early students who later struggle in mathematics, and third grade was not considered early enough. Analysis may help to address early warning signs of struggle that learners experience in later grades and possibly validate early grade teachers' intuitions as a means by which to support young students in mathematics.

Limitations

One limitation of the study was that it was conducted in a school system within a specific geographic location. My use of a small number of participants from this specific location limited generalizability of the results. However, themes that emerged from data and qualitative analysis may result in contributions to understanding unanticipated mathematics failure. Another limitation of the study was that it relied on self-reported teacher recollections that were gathered from interviews. Teacher recollections may be limited by hindsight bias (Bernstein et al., 2011), a possibility that is examined more closely in Chapter 3. A longitudinal study design was impractical and may be subject to expectancy bias, and so was rejected as a study design. A qualitative research design was chosen because qualitative studies are used to gain a better understanding of problems. To control for possible biases, interview questions were open-ended to avoid soliciting responses that were not consistent with other data sources. Despite these limitations, the qualitative nature of the study justified conducting in-depth interviews, a limited geographic location, and a limited number of participants. I used peer reviews to ensure that the interview questions as instrumentation addressed what they were intended to inquire about. A reasonable measure to address the limitation of using a limited geographic location and a limited number of participants was to establish transferability of the data by providing evidence that the findings of the study could be applicable to other situations and contexts (Merriam, 2009).

Significance

This study addressed the local problem by focusing on the early warning signs exhibited by students in kindergarten, first, and second grade who struggled in mathematics in later elementary grades. This study was unique because it involved addressing an area of early childhood mathematics that has been previously understudied in research. The results of this study may provide insights for the school system under focus by providing a deeper understanding of early indicators of later difficulties in mathematics through teacher recollections and perspectives that were provided through interviews with teachers at the kindergarten, first, and second grade levels. A study of this sort could provide valuable insights to the field of early childhood mathematics and significantly affect development and learning for young children, leading to positive social change. If teachers are provided with a deeper understanding of early indicators of later difficulties in mathematics, they will be better equipped to identify struggling learners early on and become more proactive in terms of their methods used to teach young children.

Summary

It is uncertain why some children struggle with mathematics when they have no prior history or diagnosis to support their struggles. In the problem statement, I addressed how teachers attempt to identify at-risk learners in prekindergarten. Despite these efforts, RtI data at the school system that was the focus of this study indicated that sometimes students identified as not having a learning disability or SDD were among the lowest performing students in the mathematics classroom, as reported in 2016 by the county. Throughout my initial search for literature, I found several articles that addressed mathematics difficulties among students with learning disabilities; however, the literature that addressed struggling students who were not identified as having a learning disability or underlying cause was limited.

In this chapter, I identified research questions this study would attempt to answer and conceptual framework that the study was based upon. After identifying the nature of the study as being qualitative based on teacher interviews, I provided a definition of terms, assumptions, limitations, and scope and delimitations of the study. I concluded this section by identifying potential contributions of the study and implications for positive social change. The conceptual framework identified in Chapter 1 will be discussed in further detail in Chapter 2 to articulate how this study will be grounded in seminal theories. Throughout the literature review, I attempted to provide descriptions about what was known about the phenomenon that was taking place in mathematics classrooms and identified what remained to be investigated further.

Chapter 2: Literature Review

Despite early efforts to identify at risk learners, RtI data at the school system that was the focus of this study often indicated that students identified as not having a learning disability or SDD were among the lowest performing students according to a 2016 report by the county school system. The purpose of this study was to understand kindergarten, first, and second grade teachers' perspectives of early indicators of later difficulties in mathematics among children not identified as having learning disabilities or SDD in prekindergarten. I begin this section by describing strategies used to search for literature and identifying the conceptual framework on which the study was based. Next, I present a review of literature related to early childhood mathematics curriculum and discuss learning expectations for young children as early as 0- to 12 months of age to grade 5. I also examine mathematics struggles among students in kindergarten and primary grades and mathematics failure among fourth and fifth grade students based upon their performance on state testing. I conclude this section by discussing teachers' ability to predict future achievement of learners while also relating predictions to the conceptual framework.

Literature Search Strategy

The search for literature was conducted using many databases found in Walden University's online library. Databases searched include: Academic Search Complete, Child Care and Early Education Research Connections, Education Research Starters, Education Source, and ERIC. Throughout the search, the following keywords were used: *at risk learner*, *early childhood mathematics*, *early indicators*, *learning disability*, *mathematics difficulty*, *mathematics learning disability*, *mathematics screener*, *predictions, teacher intuition*, *teacher judgment*, *teacher perspective*, *teacher recall*, *teacher reflection*, *significant developmental delay*, *struggling learner*, and *undiagnosed disability*. Several keywords were also searched using Google Scholar to find peer-reviewed articles; however, when the articles found on Google Scholar required a membership or subscription, the online journal search at Walden University Library was used to find the journal in which the article could be found. A portion of the literature review is dedicated to explaining early childhood mathematics curriculum and expectations for the teaching and learning of mathematics as it relates to young children. Resources used for that portion were obtained from the National Association for the Education of Young Children (NAEYC), the National Council of Teachers of Mathematics (NCTM), and the national and state standards that were utilized in the school system that was the focus of this study.

Conceptual Framework

The conceptual framework for this study included Kahneman and Tversky's theory of prediction and decision-making. Kahneman and Tversky (1973) found that predictions are instinctively made based upon outcomes that appear to be most representative of evidence and often follow a judgmental heuristic. According to Kahneman and Tversky (1974), three heuristics are employed when judgments are made in situations involving uncertainty: representativeness, availability of instances or scenarios, and adjustment from an anchor. Heuristics in judgments and decision making are mental cues people often use to inform their judgments and make decisions

(Kahneman & Tversky, 1974). Representativeness is usually employed when judging the probability of an object or event being categorized or related to another object or event. Availability of instances or scenarios is often employed when assessing the plausibility of developments. Adjustment from anchor is a heuristic commonly employed in numerical predictions based upon the availability of relevant values, thus making these values quantitative in nature (Kahneman & Tversky, 1974). Adjustment from anchor was unrelated to the current study, but in the following paragraphs, I elaborate more on how representativeness and availability of instances relate to this study.

Kahneman and Tversky (1974) defined representativeness as the degree to which an object or individual can be categorized as a prototype of another category. The key determinant of representativeness is similarity. When decisions are made based upon representativeness, people often pay attention to similarities that exist between the new event and an existing category (Kahneman & Tversky, 1974). This concept as it relates to the current study suggests that the ability of teachers to predict which students will later struggle with mathematics in upper grades is dependent upon teachers' understanding of their students' current struggles in lower grades and how those struggles relate to past learners. Teacher recollections of student learning and what teachers believe to have been early indicators of later difficulties were critical to this study, because there was no other specific evidence available at the time to determine why students not identified as having a learning disability or SDD in prekindergarten end up struggling in upper grades.

Availability of instances or scenarios is a heuristic that relies on the ease with which an event can be recalled (Kahneman & Tversky, 1974). This heuristic supports the proposition that judgments are made about the frequency of an event based upon the number of similar instances that come to mind (Kahneman & Tversky, 1974). This concept applied to the current study suggests that teachers may be able to predict which students in early grades will later struggle in mathematics as the frequency of a student's early grades struggles causes them to be more apparent and easily recalled. As teachers frequently observe signs of struggle in early grades, they are more likely to make accurate judgments about students' success or failure in upper grades.

Kahneman and Tversky's theory has been used extensively in education and economics because it addressed how intuitive predictions are made or can be derived from tests and outcomes. Bordalo et al. (2016) used Kahneman and Tversky's theory to present a model in which stereotypes were determined to be dependent upon the context in which they were presented. Bazerman and Sezer (2016) used Kahneman and Tversky's theory to develop an understanding of unethical behaviors and the predictability of individuals in business and management positions. Application of Kahneman and Tversky's theory in this study could help to determine if early grade teachers can observe mathematics difficulty and predict future success or failure of learners by identifying early students who will later struggle in mathematics.

In the remainder of this chapter, I present current literature related to the issue under consideration in this study. Although there was extensive research addressing causes of mathematics failure for children with learning disabilities, very little was known about what causes struggles with mathematics among students not identified as having learning disabilities. I begin with an in-depth description of the mathematics curriculum widely taught in early childhood. I continue with literature related to mathematics struggles in early grades, mathematics curriculum in the upper elementary grades, and mathematics failure among children in the upper elementary grades. I conclude the literature review with evidence that teachers may be able to anticipate upper elementary grade mathematics failure based on what they know about children's mathematics performance in early childhood.

Mathematics Curriculum in Preschool and Primary Grades

Mathematics instruction begins as soon as a child enters group care. Curriculum in the early years provides age-appropriate standards that define what students should know and be able to do at their current stage of development (Common Core State Standards Initiative, 2018). According to the National Association for the Education of Young Children (NAEYC, 2002), beginning in the first year of life and continuing through the preschool years, there are age-appropriate early learning and development standards that identify what young children should be experiencing in the area of mathematics. These standards for mathematics instruction in the preschool years, kindergarten, and primary grades form the foundation for mathematics success in fourth and fifth grade (Rittle-Johnson et al., 2019; Watts et al., 2018).

Preschool Mathematics Curriculum

Head Start and Early Head Start programs were initially developed to promote school readiness of infants and toddlers and support pregnant women (U.S Department of Health & Human Services [DHHS], 2017). However, all children do not qualify for Head Start and must be entered into other programs provided by childcare centers (DHHS, 2017). Whatever path parents take, there are age-appropriate early learning and development standards that identify what young children should experience in mathematics (NAEYC, 2002). Although standards for 0- to 12-month-old babies focus on providing children with opportunities for observing the world and objects around them, these standards form the foundation for what young children will learn once they enter primary school (NAEYC, 2002). Other mathematics standards for infants include exposure to numerals in pictures and books, participation in simple counting of objects with the help of an adult, and play with different sizes and shapes of objects and toys (NAEYC, 2002).

With an increase in age to 1 to 2 years comes an increase in children's experience with mathematics. According to the NAEYC (2002) and the Department of Early Care and Learning in the state that was the focus of this study, young children should be encouraged to imitate rote counting, sing simple number songs, attach meaning to names for numbers with the help of an adult, have a sense of awareness of the concept of amount, and count groups of objects with adult support. These activities form the number and quantity curriculum strand of mathematics. In the measurement and comparison strand, children 1 to 2 years of age should begin appropriately using words related to size, such as light or heavy, short or tall, and big or small, explore use of measurement tools, and sort, order, and classify objects based on their characteristics (NAEYC, 2002). In the strands of geometry and spatial thinking, 1- to 2-year-olds should begin exploring concepts of direction, such as up, down, above, under, and around, begin sliding, flipping, and rotating objects to make them fit into a space, and begin to recognize and match identical shapes (NAEYC, 2002).

Similar to early learning and development standards for 1- to 2-year olds, standards for children 2 to 3 years of age require an adequate amount of adult guidance (NAEYC, 2002). However, at this stage, young children begin to exhibit more of an active role in terms of their own understanding of numbers (Anders & Rossbach, 2015). In the number and quantity strand, 2- to 3-year olds begin to recite numbers in sequence up to 5, recognize numerals in the world around them, and understand that a given number of objects can be represented by a printed numeral (NAEYC, 2002). According to the National Council of Teachers of Mathematics (NCTM, 2000), number and operation standards are the most critical content standards for young children to develop early an understanding of mathematical concepts. It is in the numbers and operations strand where preschool children begin to understand quantification and one-to-one correspondence (NCTM, 2000). In the measurement and comparison strand, 2- to 3-year olds begin using trial and error to arrange and order objects based on one or more characteristics (NAEYC, 2002). At this age, young children begin to differentiate between objects more independently and require less adult guidance (Anders & Rossbach, 2015). Other critical standards that do require adult guidance include young children participating in the creation of simple pictorial graphs, recognizing and naming two-dimensional shapes, and practicing appropriate use of mathematics vocabulary (NAEYC, 2002). These concepts form the strands of measurement and comparison and geometry and spatial thinking.

Today, 80% of children served by school-based Head Start programs in the U.S. are 3- to 4-year olds (DHHS, 2017). Although many of the concepts 3- to 4-year olds learn are similar to concepts identified for 2- to -3-year olds, the greatest difference is that children 3 to 4 years of age exhibit more independence in terms of their understanding of mathematical concepts (Anders & Rossbach, 2015). In the number and quantity strand, 3- to 4-year olds recite numbers in sequence up to 10, match sets of objects to numerals 0-5, recognize and name up to three items in a set, and count to five using one-to-one correspondence (NAEYC, 2002). As young children learn to count, they learn the importance of stable number order, cardinality, and one-to-one correspondence (NCTM, 2000). In the measurement and comparison strand, 3- to 4-year olds begin using standard and nonstandard tools to measure attributes of objects with adult guidance and sorting objects based on size, shape, and color (NAEYC, 2002). Standards for geometry and spatial thinking require 3- to 4-year olds to follow simple directions to demonstrate an understanding of direction and the position of objects (NAEYC, 2002). At this stage, young children also independently recognize basic two-dimensional shapes in the environment (NAEYC, 2002).

School-based prekindergarten programs across the U.S. are government-funded and provided to eligible 4-year olds, while there are a few districts that provide programs for 3-year olds (DHHS, 2017). Similar to Head Start programs, parents of young children who do not qualify for prekindergarten have to find other programs that offer childcare (DHHS, 2017). Early learning and development standards for 4- to 5-year olds require little adult assistance, as young children at this stage have usually acquired the necessary skills to navigate mathematical concepts in the world around them (Anders & Rossbach, 2015). During the prekindergarten years, young children can recite numbers up to 20, count up to 10 objects using one-to-one correspondence, identify numbers that come before and after a number up to 10, and describe sets as being less, more, or equal (NCTM, 2000;). These concepts form the number and quantity strand. In the measurement and comparison strand, 4-year olds begin using a variety of techniques to measure and compare length, capacity, and weight using standard and nonstandard units (NCTM, 2000). 4-year olds can also associate the passage of time with actual events and create and extend simple and repeating patterns (NCTM, 2000). As for geometry and spatial thinking, 4-year olds can appropriately use directional language to indicate direction, position, and order of objects in their environment, recognize and name common two- and three-dimensional shapes, and combine simple shapes to form new shapes (NCTM, 2000).

Kindergarten Mathematics Curriculum

In most states, young children must be 5 years of age prior to the month of September for them to be entered into kindergarten (National Center for Education Statistics, 2018). Since the beginning of the 2010 Common Core State Standards Initiative, 42 states have adopted the English language arts and mathematics common core standards (Common Core State Standards Initiative, 2018). Common Core standards identify mathematics content that should be covered at each grade level from kindergarten through high school; however, states are given the freedom to organize the content in any way they wish (Common Core State Standards Initiative, 2018). The school district that was the focus of this study uses state mathematics standards that are based upon common core state standards.

Instructional time in kindergarten should focus primarily on number recognition, counting, and cardinality (Common Core State Standards Initiative, 2018; NCTM, 2000). The foundation on which to build a sound understanding of place value entails giving young children in kindergarten multiple opportunities to work with the whole numbers 11-19 (Common Core State Standards Initiative, 2018; NCTM, 2000). In the strand of operations and algebraic thinking, kindergarten learners are expected to explore addition as adding to or putting together and subtraction as taking from or taking apart (Common Core State Standards Initiative, 2018). Geometry, measurement, and data standards in kindergarten call for young learners to compare and be able to describe measurable attributes, classify and count the number of objects in a category, identify and describe the properties of shapes, and create, compose, compare, and analyze shapes (Common Core State Standards Initiative, 2018).

Primary Grade Mathematics Curriculum

In grade 1, there are four critical areas of focus for mathematics instruction: the development of addition and subtraction strategies, place value and whole number relationships, iterating linear lengths of measurement, and composing and decomposing geometric shapes (Common Core State Standards Initiative, 2018; NCTM, 2000). Standards in the strand of number and operations in base-ten describe how first graders will extend the counting sequence and place value concepts up to 100 through activities that build students' understanding of the relative magnitude of numbers (Common Core

State Standards Initiative, 2018). In the strand of operations and algebraic thinking, students in grade 1 use properties of operations, equations, and solution strategies to develop their understanding of the relationship between addition and subtraction (Common Core State Standards Initiative, 2018). Many of the geometry, measurement, and data concepts introduced to students in kindergarten are expanded upon in first grade, with the addition of indirectly measuring and iterating units of length, telling and writing time, and representing and interpreting data (Common Core State Standards Initiative, 2018).

The primary focus of second grade mathematics instruction is to build upon first grade concepts by extending students' understanding of base-ten notation and building students' fluency with addition and subtraction within 100 (Common Core State Standards Initiative, 2018; NCTM, 2000). In the number and operations strand, second grade students work with multi-digit whole numbers up to 1000; this includes reading, writing, comparing, adding, and subtracting whole numbers using strategies based on place value relationships (Common Core State Standards Initiative, 2018). It is in the second-grade strand of operations and algebraic thinking when students begin to explore concepts of multiplication through working with even and odd numbers, equal groups, rectangular arrays, and learning to skip count by 5, 10, and 100 (Common Core State Standards Initiative, 2018). It is also in second grade when students begin to recognize the need for standard units of measurement; therefore, it is critical for teachers to provide students with multiple opportunities to explore lengths of objects using various tools such as rulers, measuring tapes, and meter and yard sticks. (Common Core State Standards

Initiative, 2018). Other standards included in the strand of geometry, measurement, and data include students working with time and money, representing and interpreting data using graphs, partitioning shapes into halves, thirds, and fourths, and analyzing the sides and angles of shapes to identify and describe them (Common Core State Standards Initiative, 2018).

Students in the school system that was the focus of this study begin taking end-of-grade assessments in third grade as mandated by the state department of education. These assessments are designed to measure students' knowledge and understanding of skills outlined in the state-adopted common core-based content standards. Mathematics content in third grade begins to present students with a variety of new concepts. In the strand of numbers and operations in base-ten, students are introduced to rounding for the first time and must round whole numbers to the nearest 10 and 100 (Common Core State Standards Initiative, 2018). Students must also be able to perform multi-digit arithmetic fluently with addition and subtraction within 1000 (Common Core State Standards Initiative, 2018). In the strand of numbers and operations with fractions, third graders begin to develop an understanding of fractions as numbers by representing them on a number line as unit fractions. Standards in the strand of operations and algebraic thinking require third graders to learn multiplication and division facts within 100 and understand the relationship between multiplication and division through exploration with equal-sized groups, arrays, and area models (Common Core State Standards Initiative, 2018). All other new concepts are presented in the geometry, measurement, and data strand and require third graders to measure elapsed time, distinguish between perimeter and area, solve problems involving liquid volume and masses of objects, create line plots with whole, half, and quarter intervals, and understand the different categories of shapes (Common Core State Standards Initiative, 2018). Mathematics understanding established in the primary grades form the foundation for mathematics achievement in fourth and fifth grades.

Mathematics Struggles among Students in Early Grades

It is not uncommon for young children to struggle with mathematics and often those struggles are not signs of disabilities or deficits (Morgan et al., 2019). Over the years, mathematicians have identified five primary disciplines of mathematics, which include number sense, algebra, geometry, measurement, and data analysis and probability (Engel et al. 2016). These disciplines form the foundation on which early mathematics teaching and learning are built (Powell & Nelson, 2017). Research has shown that most difficulties in early mathematics stem from an inadequate sense of numbers as well as underdeveloped spatial skills (Bassok et al., 2016; Morgan et al., 2019; Mulligan et al., 2018). As earlier mentioned, the primary focus of mathematics instruction in kindergarten is on number recognition, counting, and cardinality; while the primary focus in first grade is on the development of addition and subtraction strategies, place value and whole number relationships, iterating linear lengths of measurement, and composing and decomposing geometric shapes (Common Core State Standards Initiative, 2018; NCTM, 2000). These concepts rely heavily on students' spatial reasoning and their ability to understand numbers, relationships, and patterns (Mulligan et al., 2018; Rittle-Johnson et al., 2016). An inadequate sense of numbers affects students' ability to recognize relationships between single items or groups of items; grasp concepts like more, less, larger, and smaller; make number comparisons; understand symbols that represent quantities; and understand ordinal numbers (Bassok et al., 2016; Morgan et al., 2019; Mulligan et al., 2018). Students with underdeveloped spatial skills have trouble understanding prepositional terms; identifying patterns and relationships; sorting and categorizing objects; making comparisons; and understanding measurable attributes and properties of two- and three-dimensional figures (Clements & Sarama, 2018; Mulligan et al., 2018; Rittle-Johnson et al., 2019). To the extent that children in early childhood fail to master these basics may experience continuing struggles in grades 4 and 5.

Mathematics Expectations for Students in Grades 4 and 5

According to the NAEYC's Position Statement and the NCTM, mathematics education in the early years is the foundation for subsequent years of mathematics learning (NAEYC, 2002; NCTM, 2000). Likewise, expectations for fourth and fifth grade students deeply depend on students' understanding of mathematical concepts presented during the preschool and primary years (NAEYC, 2002; NCTM, 2000). Mathematics instruction in grade 4 begins with many of the concepts introduced in third grade: reading, writing, expanding, rounding, comparing, ordering, adding, and subtracting multi-digit whole numbers, all of which include students working within 1,000,000 to understand the relative size of numbers (Common Core State Standards Initiative, 2018). Fourth graders' ability to understand these concepts is dependent upon mathematics concepts introduced as early as preschool (Conoyer et al., 2016; NAEYC, 2002; Shanley et al., 2017; Stevens et al., 2015). The early learning and development standards that require 1- to 2-year-olds to develop a sense of awareness for the concept of amount, and that require 2- to 3-year-olds to understand quantification and one-to-one correspondence, are the very standards that mark the beginning of a long string of place value concepts to follow (NAEYC, 2002; Rittle-Johnson et al., 2016). In the primary grades, the activities that develop students' understanding of number recognition, counting, cardinality, adding as putting together, and subtraction as taking apart are the concepts needed for fourth graders to fully understand the magnitude of numbers and how to operate with them (Casey et al., 2017; Common Core State Standards Initiative, 2018).

It is in the fourth-grade strand of numbers and operations in base-ten when students are expected to multiply 4-digit by 1-digit numbers, 2-digit by 2-digit numbers, and divide up to 4-digit dividends by 1-digit divisors through the use of place value strategies and properties of operations (Common Core State Standards Initiative, 2018). It is essential for students to have developed an adequate understanding of place value prior to expecting them to be able to perform multi-digit operations with whole numbers using place value strategies (Burns et al., 2015; Casey et al., 2017). In the strand of numbers and operations-fractions, fourth grade students are expected to understand equivalent fractions and use the concept of equivalence to compare and order fractions (Common Core State Standards Initiative, 2018). Fourth graders are also expected to understand decimal notation for fractions with denominators of 10 and 100 and be able to compare tenths to hundredths using the equivalence between the two (Common Core State Standards Initiative, 2018). Fourth grade students' understanding of fractional amounts and equivalence is developed as early as prekindergarten with activities that require prekindergartners to count sets and groups of objects and describe sets are being less, more, or equal; kindergarten, first, and second grade activities that allow young learners to compose and decompose shapes; and first and second grade activities that require students to partition shapes into halves, thirds, and fourths (Clements & Sarama, 2018; Common Core State Standards Initiative, 2018). Fourth graders' understanding of decimal concepts depends on their understanding of money amounts and coins as being a part of the whole, which is introduced in first grade and elaborated on further in second grade (Common Core State Standards Initiative, 2018).

The only other major concept that is introduced in the fourth-grade strand of geometry, measurement, and data is understanding angle measures and using a protractor to measure them (Common Core State Standards Initiative, 2018). Fourth grade students' understanding of angle measures depends on the foundational skills introduced in preschool and primary grades that require young children to explore attributes of shapes, appropriately use measurement tools, understand the concept of measurement through the use of standard and nonstandard units of measure, and partition circles into equal shares such as quarters creating four equivalent parts, which can later be expressed as generating four 90 degree angles (Common Core State Standards Initiative, 2018; Mulligan et al., 2018).

Instructional time in fifth grade is centered around three critical areas: operations with fractions and decimals, decimal place value and powers of 10, and volume of three-dimensional figures (Common Core State Standards Initiative, 2018). Students' ability to understand fraction and decimal operations in grade 5 is dependent upon their understanding of place value and the properties of operations, their ability to perform multi-digit arithmetic, and their understanding of fraction and decimal concepts that were developed throughout preschool, primary grades, and fourth grade (Common Core State Standards Initiative, 2018; Merkley & Ansari, 2016).

Although fractions and decimals are the major areas of focus, it is in fifth grade when students are introduced to a variety of new concepts that rely heavily on the mathematical foundations built in the lower grades (Casey et al., 2017; Rittle-Johnson et al., 2019; Van de Walle et al., 2015). The first instructional unit in the strand of operations and algebraic thinking requires fifth grade students to develop an understanding of the order of operations and use that understanding to write and interpret numerical expressions and analyze patterns and relationships (Common Core State Standards Initiative, 2018). Fifth graders' understanding of numerical expressions is linked to the foundational standards that require first and second graders to work with addition and subtraction equations, the third and fourth grade standards that focus on multiplication and division equations, and the primary grade standards that require students to explain patterns in arithmetic and develop an understanding of the properties of operations (Casey et al., 2017; Common Core State Standards Initiative, 2018). Prekindergarten standards that allow young learners to create and extend simple repeating patterns and fourth grade standards that require students to generate shape and number patterns that follow a given rule are essential to fifth graders' understanding of patterns as they relate to the coordinate plane (Clements & Sarama, 2018; Common Core State

Standards Initiative, 2018). In grade 5, students are expected to generate two numerical patterns in a function table, identify relationships between the patterns, and use the table to graph ordered pairs on a coordinate plane, which requires directional language and spatial thinking, concepts that were developed early during the preschool years (Common Core State Standards Initiative, 2018; Watts et al., 2018).

As previously mentioned, another critical area of focus in the fifth-grade strand of measurement and data is volume of three-dimensional figures. Fifth grade students are expected to understand the concept of volume as it relates to cubes and rectangular prisms. An adequate understanding of volume requires students to use their previous understanding of addition and multiplication to measure volume (Common Core State Standards Initiative, 2018). Previously taught concepts of perimeter and area also help to enhance fifth graders' understanding of volume (Common Core State Standards Initiative, 2018; Mulligan et al., 2018).

Mathematics Failure among Students in Grades 4 and 5

Understanding mathematics failure among students in grades 4 and 5 requires further explanation of the achievement levels identified by the target state's Milestones Assessment System that describes student mastery of content and command of the knowledge and skills outlined in state. According to the target state's department of education, achievement levels provide meaning and context to scale scores by describing a student's level of mastery and the knowledge and skills a student must demonstrate to be successful at each level. The Milestones Assessment System has four achievement levels: Level 1-Beginning Learner, Level 2-Developing Learner, Level 3-Proficient

Learner, and Level 4-Distinguished Learner. Level 1-Beginning Learners are students identified as not yet demonstrating proficiency at their current grade level and require substantial academic support for them to be prepared for the next grade level. Students performing at Level 1-Beginning Learner in grades 3 and 4 are not required to achieve grade level proficiency or retest in the area of mathematics; however, these students are considered for retention in their current grade based upon promotion criteria set by the local board of education. Level 2-Developing Learners are students identified as partially demonstrating proficiency at their current grade level and require some additional academic support for success at the next grade level. Students in grade 5 must achieve Level 2-Developing Learner in the area of mathematics in order for them to be considered for promotion to the next grade level; therefore, fifth grade students performing at Level 1-Beginning Learner are provided with remediation and given the opportunity to retest. Level 3-Proficient Learners are students identified as demonstrating proficiency in the knowledge and skills needed for their current grade level and are prepared for the next grade level. The highest level of achievement is Level 4-Distinguished Learner. Students performing at Level 4 demonstrate advanced proficiency at their current grade level and are considered well prepared for the next grade level as well as on path for college and career readiness; thus, indicating that Level 3 and Level 4 are the desired levels of achievement.

Despite efforts to increase student achievement in the area of mathematics, each year well over 50% of students in grades 4 and 5 in both schools that were the focus of this study perform at Level 1-Beginning Learner or Level 2-Developing Learner. In the spring of 2016, according to the target state's department of education, there were 36 fourth graders at one of the schools; of these, 18 scored at Level 1-Beginning Learner and 13 scored at Level 2-Developing Learner for a total of 86.1%. That same year, there were 23 fifth graders, 6 of whom scored at Level 1 and 9 of whom scored at Level 2, totaling 65.2%. In the spring of 2017, there were 31 fourth graders; of these, 4 scored at Level 1 and 17 scored at Level 2 for a total of 67.7%. In fifth grade that year, there were 36 students, 15 of whom scored at Level 1 and 16 students scored at Level 2 for a total of 86.1%. In the spring of 2018, there were 28 fourth graders, 4 of whom scored at Level 1 and 11 of whom scored at Level 2 for a total of 53.6%. In fifth grade, there were 32 students; of these, 8 scored at Level 1 and 17 students scored at Level 2 for a total of 78.1%. Table 2 shows the percentage of students in fourth and fifth grade performing at Level 1-Beginning Learner and Level 2-Developing Learner from 2016 to 2018. According to Stevens et al. (2015), as long as fourth and fifth grade students continue to struggle with mathematics content and perform at the lower achievement levels on assessments, efforts to improve student achievement in the area of mathematics will continue to fall short. These data are illustrated by Table 2.

Table 2

Students Performing at Level 1-Beginning and Level 2-Developing Learner

Year	Total # of Students	Level 1-Beginning Learners	Level 2-Developing Learners	Percentage at Level 1 and Level 2
	4th Grade			
2016	36	18	13	86.1
2017	31	4	17	67.7
2018	28	4	11	53.6
	5th Grade			
2016	23	6	9	65.2
2017	36	15	16	86.1
2018	32	8	17	78.1

Teachers' Ability to Predict Future Achievement

When students enter upper grades, it is hard for teachers to pinpoint exactly when their struggles with mathematics began, especially if they were never diagnosed with having significant development delays (SDD) or a learning disability (Harris & Bourne, 2017; Nguyen et al., 2016). Despite this issue, current research has shown that it is possible for early grade teachers to predict future achievement of learners in certain instances, given the right conditions (Nguyen et al., 2016; Thiede et al., 2015; Virinkoski et al., 2018). Factors such as years of teaching experience, teacher knowledge of content, and teaching practices all play a part in teachers' ability to accurately predict performance (Thiede et al., 2015). According to Thiede et al. (2015), teachers make judgments based upon inferences drawn from available cues and the accuracy of these judgments continually improves when cues are diagnostic and focused on students' thinking and understanding of content. Teacher judgment is important because judgments about student learning can ultimately guide and improve instruction by helping to identify struggling learners, influence teachers' expectations about students' abilities, and influence students' academic self-concept (Mannikko & Husu, 2019; Thiede et al., 2015). Virinkoski et al. (2018) found that teacher judgments are more beneficial when coupled with relatively accurate universal screeners. Although this study addressed using teacher judgment and screening tests to detect reading difficulties in first graders, similar efforts can be employed to detect early students who will later struggle with mathematics (Virinkoski et al., 2018).

Teachers' ability to predict future achievement of learners formed the foundation of this study. As previously mentioned in the conceptual framework, predictions are instinctively made based upon outcomes that appear to be most representative of the evidence and often follow a judgmental heuristic (Kahneman & Tversky, 1973). In this sense, teacher judgments are made based upon what is being perceived and the context of the situation (Johnson, 1987). This process, as it relates to the current study, suggests that teacher recollections and perspectives can be analyzed and used to gain insights into the issue of children struggling in mathematics even though they were not identified as having a learning disability or SDD in prekindergarten. Similar to the findings of Virinkoski et al. (2018), in this study I attempted to determine if kindergarten, first, and second grade teachers could use their knowledge of their students and observations to predict future success or failure of learners by identifying early students who will later struggle in mathematics.

Summary and Conclusions

In this chapter, I presented literature supportive of my purpose of understanding kindergarten, first, and second grade teachers' perspectives of early indicators of later difficulties in mathematics among children not identified as having learning disabilities or SDD in prekindergarten. Included in this literature review was a description of early grades curriculum in hopes of better understanding the connection between early mathematics learning and later mathematics struggle. Through the use of curriculum data retrieved from sources such as NAEYC and NCTM, I began the literature review by explaining early childhood mathematics curriculum and the expectations for the teaching of young children. After explaining the importance of early grades mathematics as it relates to fourth and fifth grade mathematics, I went on to discuss mathematics failure among students in grades 4 and 5. During the process of finding research related to teachers' ability to make predictions about students' future achievement, I found very few articles that touched on the topic. However, the work of Kahneman and Tversky's (1973), which formed the framework of this study, indicated that teachers may be able to predict student achievement in later grades based on their observations in the early grades. Although research has shown that teachers can predict future achievement of learners given the right circumstances, there was still a need to determine if early grade teachers could observe mathematics difficulty and predict future success or failure of learners by identifying early students who will later struggle in mathematics. In Chapter 3, I describe the research design and methodology for this study.

Chapter 3: Research Method

The purpose of this study was to understand kindergarten, first, and second grade teachers' perspectives of early indicators of later difficulties in mathematics among children not identified as having learning disabilities or significant developmental delays in prekindergarten. To accomplish this goal, I employed a qualitative research design with a retrospective study approach. Qualitative research was consistent with building retrospectively a portrait of children who were currently struggling with fourth and fifth grade mathematics, based on teacher remembrances of students in their early years. I begin this section by providing a rationale for choosing a qualitative research design, identifying the role of the researcher, and describing who was selected as participants. Next, I discuss the methodology of the study, where I provide procedures for participant recruitment and discuss the plan for data collection and analysis. I conclude this section by addressing ethical procedures, providing methods of maintaining trustworthiness, and discussing ways in which I planned to obtain permissions and participant consent.

Research Design and Rationale

The research questions that guided this study were:

RQ1: How do early grade teachers describe mathematics learning they see in their currently enrolled students not identified in prekindergarten as having a learning disability or SDD as representative of mathematics learning they recall among similarly undiagnosed students now in fourth and fifth grade who score poorly in mathematics?

RQ2: How do early grade teachers describe the availability of information regarding mathematics learning of their currently enrolled students not identified in prekindergarten as having a learning disability or SDD in comparison to the availability of information they recall having regarding mathematics learning among similarly undiagnosed students now in fourth and fifth grade who score poorly in mathematics?

RQ3: How do early grade teachers describe their ability to predict poor mathematics scoring in fourth and fifth grades for their currently enrolled students not identified in prekindergarten as having a learning disability or SDD?

These questions were intended to determine if any of the struggles teachers see among their current students were also present when current fourth and fifth graders were in lower grades. To address these questions, I conducted a qualitative retrospective study in which remembrances of early grade teachers was used to determine the difficulties that children who were struggling with mathematics as fourth and fifth graders had in their early years. Teacher recollections and perspectives of these learners when they were in kindergarten, first, and second grade were examined through the use of interviews. The conceptual framework for this study was Kahneman and Tversky's theory of prediction and decision-making, which informed the study as data collected from interviews were analyzed and used to gain insights into the phenomenon of children struggling in mathematics despite the fact that they were not identified as having a learning disability or SDD in prekindergarten.

Qualitative studies are used to gain a better understanding of problems, whereas quantitative studies use measurable data to quantify a problem (Merriam, 2009). I chose a retrospective design as opposed to other qualitative methods such as case study, phenomenology, or grounded theory because retrospection was better suited to answer the research questions. Although case study research designs often involve open-ended interview questions to gather data, case studies require investigations to occur in natural settings (Yin, 2009). Since the purpose of this study was to better understand events that have already occurred, a case study design would not suffice. Interviews are also conducted throughout phenomenology and grounded theory research studies; however, these methods involve understanding lived experiences among participants in certain instances (Starks & Trinidad, 2007). In phenomenology, the phenomenon is known, and the purpose is to describe and attach meaning to participants' lived experiences (Ravitch & Carl, 2016). Similarly, with grounded theory the phenomenon is also known; however, its purpose is to describe and ascribe meaning to lived experiences of participants who experienced the phenomenon under different circumstances (Ravitch & Carl, 2016). Since the purpose of this study was to better understand the struggles teachers see among their current students and possibly relate them to previous learners, phenomenology and grounded theory designs did not suffice.

Role of the Researcher

As an early childhood mathematics teacher for 16 years, I am passionate about how young children learn and understand mathematics. I was employed as the fourth and fifth grade mathematics teacher at one of the focus schools, so I acted as an observer. As the researcher, I acknowledged that I was employed at the school in which the study was conducted; however, my only interest was in teachers' perspectives of struggling learners currently in kindergarten, first, and second grade who were not identified in prekindergarten as having a learning disability or SDD and how those struggles were possibly related to teachers' recollections of current fourth and fifth grade students' struggles when they were in early grades. Although I was employed in the school system that was the focus of this study, I was not in any supervisory position and had no authority over participants in the study.

Since the school system was small, I had a positive relationship with administration and staff members of each school and felt that teachers would agree to participate since the school system was concerned with closing the achievement gap in the area of mathematics. I was an insider, not only as a teacher of mathematics but also as a colleague of participating teachers. My insider status provided me with credibility and a feeling of collegiality from participants, but it also opened the study to bias. As a mathematics teacher, possibilities for bias stemmed from my own personal opinions about how children learn and understand mathematics, and ultimately, my selection of interview data that I felt to be most pertinent. To guard against this possible bias and control my own intrusive thoughts, I used the process of interviewee transcript review (ITR) and asked participants to review their interview transcripts for accuracy prior to my analysis of the data. To further guard against bias, I used the process of member-checking and provided each participant with a one-page draft of the findings after analysis. This allowed participants to review the results again after themes and patterns had emerged from the data to further validate findings. Prior to conducting interviews, I used the process of peer review and had someone with a doctorate degree check over interview questions and examine data after analysis. One final way I minimized bias was through purposefully withholding my comments during interviews and asking questions to clarify understanding of what was said by participants. My role as the researcher was only to collect data throughout the study in hopes of better understanding the struggles students were experiencing in the mathematics classroom.

Methodology

As previously mentioned, this qualitative study was used to gain insights into the phenomenon of children struggling with mathematics in upper grades despite the fact that they were not identified as having a learning disability or SDD in prekindergarten. To develop a deeper understanding of early indicators of later difficulties in mathematics, teacher recollections and perspectives of fourth and fifth grade students when they were in kindergarten, first, and second grade were examined via interviews. Interviews were then coded to make discoveries about deeper realities that emerged from the data. This qualitative analysis may be used to pinpoint the early warning signs of struggle that learners experience in later grades and possibly validate early grade teachers' intuitions as a means by which to support young students in mathematics.

Participant Selection

Purposeful sampling was used to acquire a representative sample for the study. Purposeful sampling allows the inquirer to select sites and individuals who will purposefully provide a better understanding of the central phenomenon (Creswell, 2009). The purposeful sample that was used in the study included kindergarten, first, and second grade mathematics teachers at the two schools under focus. Teachers were invited to participate in this study via email. At the time of this study, there were five kindergarten, five first grade, and six second grade teachers at the schools of focus; therefore, I estimated that 16 teachers would participate in the study. With such a small number of participants, it was my hope that all teachers would be willing to participate, or at least three or four teachers from each grade. In a retrospective study of this sort, a small number of participants is adequate to explore patterns and connections among responses as themes emerge from the data (Creswell, 2009; Merriam, 2009).

Instrumentation

I used two instruments to gather data for this study: the interview questions (see Appendix D) involving teachers' perspectives of struggling mathematics learners, and myself as the interviewer. Creswell (2009) recommended that interview questions are kept to a minimum number of open-ended questions; therefore, three interview questions were created with a subset of followup questions for each. Interview questions were developed to first inquire about kindergarten, first, and second grade teachers' current students who were struggling with mathematics although they were not identified as having a learning disability or SDD in prekindergarten. Teachers were asked to identify some of the common signs of struggle that they have observed among their current students and provide specific examples of these struggles. The second interview question was about current fourth and fifth grade students whom they previously taught and had no diagnosis of a learning disability or developmental delay in prekindergarten. If teachers were able to recall past learners, I then asked about signs of struggle teachers recall students exhibited when they were in kindergarten, first, and second grade. I asked teachers to think of both groups of learners, current and past kindergarten, first, and second grade students, and similarities or differences they observed between the two.

Teachers were then asked to predict how the children they currently teach, both those who struggle and did not seem to struggle, would do in math when they were in fourth and fifth grade. Lastly, teachers were asked how their ability to predict mathematics outcomes for current learners was based upon what they knew about how children have struggled in the past. Content validity was established through the process of peer review to ensure that interview questions reflected intended research questions. Validity of interview questions was confirmed by a fifth grade mathematics and science teacher of 24 years who held a doctorate in education. Due to her experience of writing a dissertation on effective teaching strategies for mathematics teachers of upper elementary African American students, this teacher was knowledgeable in her review of the interview questions. In her review, she offered suggestions on how to improve the structure of the interview questions and made certain that questions were worded to not make assumptions about interviewee responses.

My role as interviewer and research instrument required me to remain objective throughout the interviews as well as during data analysis. To remain objective throughout the interview process, I purposefully withheld my comments and only asked questions to clarify understanding of what was said by participants. As previously mentioned, my role as the researcher was only to collect data throughout the study in hopes of better understanding the struggles students were experiencing in the mathematics classroom and remain objective throughout the process.

Procedures for Recruitment, Participation, and Data Collection

After Walden's Internal Review Board (IRB) approved my study (approval #06-05-20-0195343), I began the data collection process by using the school system's public employee contact link to send an email invitation to kindergarten, first, and second grade mathematics teachers. The email invitation explained the purpose of the study, procedures, and significance of a study of this sort. The consent form was then emailed to participants who contacted me to express interest in the study. The consent form explained that participation in the study was completely voluntary, and participants could withdraw at any time. I further explained that I planned to maintain confidentiality and anonymity by safeguarding all data collected from individual participants throughout the study. Once participants gave consent to participate, I followed up with each of them via email to schedule a date and time to conduct interviews. Participants were able to select either telephone or video conferencing. A convenient date and time was set by each individual participant in a private setting where they felt comfortable and quiet enough for interviews to be audio recorded for transcription. I also explained that interviews should last approximately 30 to 60 minutes and participants would receive a copy of the interview transcript later via email for ITR.

During the interviews, I asked a series of open-ended questions (see Appendix A) to elicit teachers' perspectives of struggling learners currently in kindergarten, first, and second grade and the current fourth and fifth grade students who they previously taught. Although I planned to keep my comments limited throughout the interview, I asked probing followup questions in order for interviewees to elaborate on their responses and provide more details.

Data Analysis Plan

As previously mentioned, after Walden's IRB approval, I began the data collection process by first sending participants an invitation email followed by obtaining participant consent. Interviews were audio recorded with the aid of professional transcription services provided by Otter.ai Voice Notes. Transcripts were carefully examined to look for emerging patterns and themes in the data. According to Thomas (2006), it helps to read and then reread transcripts for meaning and understanding to determine which data holds the most value. Through the process of coding as a heuristic tool and inductive reasoning, intellectual interpretations could arise from discoveries found in data and themes that emerged in kindergarten, first, and second grade teachers' recollections of fourth and fifth grade students. For this study, I created a framework that was used to categorize and define the data, an explanatory framework that was guided by the research questions and interview data. I coded the data twice on two separate occasions; two coding sessions helped to ensure that I had consistently and accurately categorized content across codes. Since codes were not predefined, I examined qualitative data to derive patterns that were used to create a code list and then placed them in table format outlining what each code was and what it covered (Thomas, 2006). These codes were then mapped to the key components of this study and the conceptual framework on which it was built upon. According to Saldana (2015), the process of coding requires examining relationships between codes and then linking data to the conceptual framework. Codes were used to rationalize what was happening in order to better understand early indicators of later difficulties and determine the extent to which teachers could predict early those students who will later struggle in the area of mathematics.

Prior to my data analysis, I asked participants to review their interview transcripts for accuracy. In the event a participant found inaccuracies in transcripts, necessary changes would have been made to make certain participants' responses were accurately presented. Once data were coded and organized in the framework, I made connections, identified relationships, and attempted to attach meaning and significance to the framework. The initial step of the coding process required me to read the interview transcripts several times while journaling my thoughts, ideas, and questions throughout the process. After initial codes were created, I used a concept map to group codes into categories. Lastly, categories were combined based upon recurring themes, language, beliefs, and opinions. During the reporting phase, I presented themes in a cohesive manner, consistent with the research questions, conceptual framework, and identified purpose of the study.

Any discrepant cases that caused a lack of agreement or balance in the data I would also address and factor these into the data analysis (Merriam, 2009). Discrepant data in a study with interviews often occurs when the researcher finds inconsistencies in the data after the interview is over; usually when a person says one thing at one point and then the opposite of that later in the interview (Merriam, 2009). If this had occurred, I would have used the participant transcript review as an opportunity to ask the participant to clarify any discrepancy I noticed in their interview responses.

Trustworthiness

Credibility of a qualitative research study is one of the key components to establishing trustworthiness. According to Merriam (2009), credibility refers to the ways in which a researcher establishes internal validity and ensures that their study will actually measure or test what it is intended to measure. Credibility of the study was established through the use of member checking. Member checking acts as a method of quality assurance allowing participants to examine the accuracy of the researcher's interpretations by providing them with a one-page draft of the findings (Creswell, 2009). Member checking allowed participants to clarify comments and intentions, correct errors, and provide additional information if necessary (Creswell, 2009). Content validity also was established through the process of peer-review to ensure that the interview questions as instrumentation inquired about what they were intended to inquire about. The validity of the interview questions was confirmed by a fifth-grade mathematics and science teacher of 24 years who held a doctorate in education.

Transferability is established when the researcher provides readers with evidence that the findings of the research study could be applicable to other situations, contexts, populations, and times (Merriam, 2009). Since the nature of this qualitative study was specific to a particular environment, it was very difficult to demonstrate that the findings were applicable to other situations (Johnson & Christensen, 2008). To establish transferability, I used thick description. According to Johnson and Christensen (2008), thick description is a research technique used when qualitative researchers provide a very detailed account of their experiences during data collection. This process includes strategies such as talking about where the interviews occurred and other aspects of data collection process that help to provide the reader with a better understanding of the research setting (Johnson & Christensen, 2008). Providing sufficient contextual information enables the reader to make a transfer of findings from the current study to other situations or contexts (Johnson & Christensen, 2008).

Dependability of a study is established by employing techniques to demonstrate that if the study was repeated, with the same participants in the same context, similar results would be obtained (Merriam, 2009). To establish dependability, I used the process of reflexivity to consciously acknowledge and examine the preconceptions I brought to the study as a mathematics teacher (Merriam, 2009). Keeping a reflective journal throughout data collection and analysis phase helped to evaluate the overall effectiveness of the research study (Johnson & Christensen, 2008).

Confirmability is usually established using instruments that are not dependent on human perception (Creswell, 2009). However, in a qualitative study, the risk of researcher bias is inevitable (Johnson & Christensen, 2008). As a mathematics teacher in the school system that was the focus of this study, I was aware that I brought biases and assumptions to the study related to how I felt children learn and understand mathematics. Confirmability was established by ensuring the data reflected participant’s perspectives of the mathematics struggles students face and not my own. One way to achieve this was to purposefully withhold my comments and only ask questions to clarify understanding of what was said by participants throughout the interview process (Creswell, 2009). As the creator of the interview questions and serving as the interviewer presented the study with bias. To guard against this bias and control my own intrusive thoughts, I asked participants to review interview transcripts for accuracy prior to my analysis of the data. Having only one coder presented the study with yet another potential weakness. To address this issue and establish intra-coder reliability, I coded the data twice on two separate occasions. Two coding sessions helped to ensure that I had consistently and accurately categorize content across codes (Johnson & Christensen, 2008).

Ethical Procedures

Prior to conducting research, I sought approval from Walden’s IRB. IRB approval helped to ensure that any foreseen ethical issues were addressed prior to the research for participant protection. After obtaining IRB approval, I emailed prospective participants an invitation to participate in the study. The email to participants described the purpose of the research study and procedures that would be followed to collect data. Once teachers agreed to participate, I emailed them a consent form, explaining their role as a participant in this study, and that participation in the study was completely voluntary and they could withdraw at any time.

Since the wellbeing of participants was a priority, participants were ensured of confidentiality and anonymity throughout the study. Participants’ identities were protected using a pseudonym for each participant, data were stored in a locked cabinet that was safeguarded, and digital data files were stored on a password protected computer and accessed only by me. Following the completion of the study, I would store data for five years in a locked cabinet that would be safeguarded and accessed only by me. After five years, paper documents would be shredded, and digital files would be securely removed using Windows Wipe Disk.

Summary

In Chapter 3, I discussed the research methodology by first presenting a rationale for the research design and then describing my role as the researcher. Since the purpose of this study was to better understand kindergarten, first, and second grade teachers' perspectives of struggling learners in the mathematics classroom, early grade teachers were identified as the intended participants and the process for their recruitment was explained. I went on to explain how interview data was collected and analyzed during the coding process, while being certain to remain objective throughout data analysis. I concluded this chapter by explaining strategies to establish trustworthiness and addressing ethical concerns. In the remaining chapters, I present the results of the data collection and analysis in Chapter 4 and summarize the findings, discuss recommendations, and describe potential implications in Chapter 5.

Chapter 4: Results

The purpose of this study was to examine kindergarten, first, and second grade teachers' recollections of early indicators of difficulties in mathematics that surfaced among fourth and fifth grade children who were not identified in prekindergarten screening as having learning disabilities or SDD. Three research questions guided inquiry into early grade teachers' perspectives of current and past students who struggled with mathematics, as well as their ability to predict mathematics difficulty based on available information. I begin this section by describing the setting and conditions at the time of the study and presenting demographics and characteristics of participants that are relevant to the study and may affect interpretation of the study's results. Next, I describe in detail the data collection process and how I used a concept map to first group codes into categories and then combined categories based upon recurring themes during data analysis. I conclude this section by discussing results of the data analysis as it relates to the research questions and provide evidence of trustworthiness.

Setting

The data collection process took place during the COVID-19 pandemic, which precluded my ability to conduct face-to-face interviews with participants as I originally planned. Like many schools around the nation, schools in the system that was the focus of this study had been closed for several months at the time of data collection. Therefore, interviews were done via telephone or teleconference links, accessed from individual locations such as my home office as well as homes or similar private locations chosen by each participant. Participants selected a preferred interview method of telephone or video conferencing; seven of the teachers decided to do a video conference and the other three interviews were conducted over the phone. Prior to each interview, participants were asked to find a private setting within the comfort of their home that would be quiet enough for interviews to be audio recorded for transcription. Several participants were interviewed in their dens or family rooms while spouses were away, and children were napping or busy playing. Other participants answered interview questions outside on their patio or in their bedroom. As the researcher, all interviews were conducted in the privacy of my home office.

Data Collection

I collected interview data from 10 early grade teachers, including eight women and two men. Three were kindergarten teachers, one of whom had been teaching for 4 years, and the other two had been teaching 5 years or more. Four first grade teachers participated, one of whom had been teaching for 3 years and another had been teaching for 4 years; the other two teachers had been teaching for 5 years or more. Three second grade teachers took part in the study, all of whom had been teaching for 5 years or more (see Table 3).

Table 3

Participant Demographic Data

Participant #	Gender	Grade Level	Years of Teaching Experience
1	Male	Second	7
2	Female	Second	5
3	Female	First	3
4	Female	Second	12
5	Female	Kindergarten	18
6	Female	First	4
7	Female	Kindergarten	30
8	Male	First	15
9	Female	First	21
10	Female	Kindergarten	4

I conducted seven interviews using Google Meet and three interviews via cellular phone. Each interview lasted approximately 30 minutes and was audio recorded with the aid of Otter.ai Voice Notes. During the first interview, I realized after about a minute into the interview that Otter.ai Voice Notes was not recording on my computer, and I had to restart the interview. Fortunately, the participant had just begun talking when this occurred, so I just had to read the first interview question over again. Two connections were dropped, once during the third interview and again during the eighth interview. The first dropped connection occurred as a result of a thunderstorm and the interview had to be continued the next day because of a power outage. The second dropped connection was a result of the participant's battery going dead in their tablet and they had to reconnect via laptop. The only other minor interruption occurred when a toddler came into the participant's room, but he was quickly escorted back out by his older sibling.

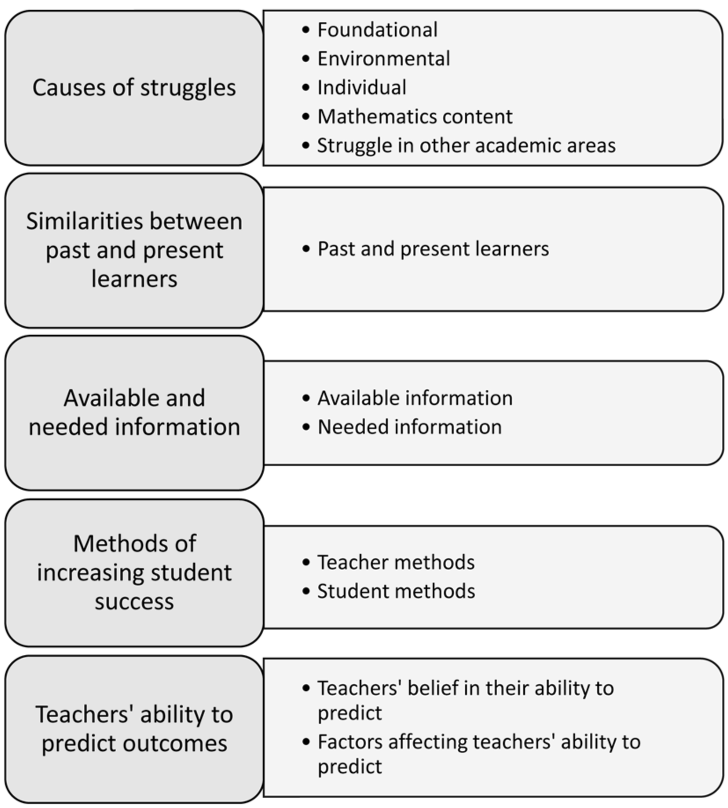
After each interview, I downloaded the transcription provided by Voice Notes and reviewed it to correct errors by comparing the transcription to the audio file of each interview. Once I was satisfied that a transcription was correct, I emailed it to the appropriate participant to check the accuracy of the data. Participants were asked to get back to me with any changes they believed were necessary. No changes were requested by any participant, so I used my final transcription files as the basis for data analysis.

Data Analysis

For this study, I created a framework that was used to categorize and define the data, an explanatory framework that was guided by the research questions and interview data. I began the data analysis process by using transcription files from participant interviews to identify codes within the files. According to Saldana (2015), the process of coding requires examining relationships between codes and then linking the data to the conceptual framework. To ensure accuracy of the data, files were coded twice on two separate occasions, both of which yielded 98 codes (see Appendix B). Once codes were identified, I grouped and organized them based upon similarities. Similarities found among the coded units led to the development of 12 categories: foundational, environmental, and individual causes of struggle, math content causing struggle, struggle in other academic areas, past and present learners, available information, needed information, teacher methods of increasing success, student methods of increasing success, teachers' ability to predict outcomes, and factors affecting teachers' ability to predict. The 12 categories then led to the development of five themes: causes of struggles, similarities among past and present learners, available and needed information, methods of increasing student success, and teachers' ability to predict outcomes (see Figure 1).

Figure 1

Themes and Associated Categories



Themes that developed as a result of data analysis seemed to suggest that there are numerous factors causing students to struggle with mathematics from year to year.

Interviews indicated that participants were consistent in terms of their perspectives of struggling learners and their belief in their ability to predict outcomes. There were no discrepant cases found. I next present the results with verbatim quotations from participant interviews.

Results

Results for RQ1

RQ1 was: How do early grade teachers describe mathematics learning they see in their currently enrolled students not identified in prekindergarten as having a learning disability or SDD as representative of mathematics learning they recall among similarly undiagnosed students now in fourth and fifth grade who score poorly in mathematics? To answer this question, I used participant responses from interview questions 1 and 2. Themes that applied to this question include causes of struggles and similarities among past and present learners.

The first idea that emerged with regard to RQ1 is that several factors contribute to struggles students past and present face in mathematics. According to several participants, the earliest signs of struggle stem from foundational and environmental causes. P1 stated, “Often times the child is on the younger end of the age requirement, has not had a strong preschool experience, and is not supported academically at home.” P3 said, “The students who usually struggle are impoverished and children who come from homes that do not have a strong support system.” In addition, P6 said, “The students who lack a solid background and are weak in previously taught skills are the ones who struggle early on.” P8 stated, “Some of the students come from homes where the parents are uneducated or struggled themselves in school, so they do not seem to feel able to help their children learn or seem to not value learning."

Another contributing factor to the struggles students face in mathematics derived from the personal attributes of individual learners. According to P4, "Common signs portrayed by students who do not have an identified learning disability are poor attention span, lack of confidence, and they are usually unmotivated." Similarly, P3 said, "Sometimes you find students who lack desire to complete work or learn new things." P2 stated, "Many times students have behavior problems, possibly to cover up the fact that they do not know the content." P9 added, "Many students believe that if they cannot understand something right away then they will never understand it, even with more practice."

All participants felt that some specific mathematics content caused some students to struggle almost every year. Kindergarten and first grade teachers identified struggle with early concepts such as counting, number recognition, and one-to-one correspondence. P3 stated, "Number reversals, inability to count and identify numbers, relying heavily on counting all things from one rather than counting on are the concepts these learners often struggle with." Similarly, P10 said, "Most of the struggles I see are inability to count and number recognition." P8 went on to add, "Often students struggle to make the connection between the objects and numbers and understanding what the numbers actually mean." Second grade teachers felt that concepts such as basic facts, addition and subtraction with regrouping, and math story problems were common causes of struggles. P4 stated, "Many of the students that I have taught lacked foundational skills like knowing their basic addition and subtraction facts, so when they get to second grade they struggle with new concepts like regrouping." P2 added, "Concepts such as addition, subtraction, and math story problems commonly cause students to struggle in second grade."

The second idea that emerged with regard to RQ1 is that struggles seen among students' past and present have been consistent over the years. When asked about the similarities between past and present learners, P5 stated, "I have seen the same struggle from year to year. A common struggle is being able to explain thinking. They can show you but cannot always explain why." Similarly, P6 stated, "The struggles are basically the same each year. Many struggle to learn mathematics when it comes to really understanding the concept. Most are able to mimic what you model, but whether they understand it is not always the case." P9 stated, "There are many similarities between them. Number reversals are seen each year, as well as the inability to retain and comprehend what is being said or modeled during small and whole group instruction." P7 went on to add, "I have been a teacher for 30 years and have seen many of the same struggles over the years. My experience has been that students who struggle with math in kindergarten also struggle in other academic areas."

The purpose of RQ1 was to determine how early grade teachers describe mathematics learning they see in their currently enrolled students not identified in prekindergarten as having a learning disability or SDD as representative of mathematics learning they recall among similarly undiagnosed students now in fourth and fifth grade who score poorly in mathematics. As a result of the data analysis, I found that the struggles seen among student’s past and present have been consistent over the years. The earliest signs of struggle commonly develop from foundational and environmental causes, personal attributes of individual learners, and specific mathematics content causing difficulty such as counting, number recognition, one-to-one correspondence, basic facts, addition and subtraction with regrouping, and math story problems.

Results for RQ2

RQ2 was: How do early grade teachers describe the availability of information regarding mathematics learning of their currently enrolled students not identified in prekindergarten as having a learning disability or SDD in comparison to the availability of information they recall having regarding mathematics learning among similarly undiagnosed students now in fourth and fifth grade who score poorly in mathematics? To answer this question, I used participant responses from interview question 3. Themes that applied to this question include available and needed information and methods of increasing student success.

The first idea that emerged with regard to RQ2 is that the availability of information regarding mathematics learning is the same now as it has been in the past. P10 stated, “The information available today is similar to what was available when I first started teaching. Students learn best through hands on activities that maintain students’ interest.” To add to that, P1 stated, “The information I have today is the same as in the past since we know that students learn better when given hands on meaningful experiences and not drill and practice worksheets.” P5 hinted that teacher experience contributes to the perception of information available, stating, “I have more information now that I have more experience. I have also been able to use a variety of curriculum which has helped me plan more appropriately for the common struggles I see every year." P8 said, "After many years of teaching, experience allows you to understand what students need and the next steps to take. Formative assessments also help to guide instruction."

The second idea that emerged regarding RQ2 is that the availability of information regarding mathematics learning helped teachers identify methods of increasing student success in mathematics. P1 stated, "I use baseline assessing at the start of the year and formative assessments throughout the year. My formative assessments drive my reteaching, interventions, and next steps." P7 stated, "With the help of number talks, we help students to verbalize their math thinking and when a teacher can understand how a child is thinking about numbers and math, they can better teach them what they need next." P5 stated, "When students are struggling in kindergarten, I immerse them in hands on tools and provide small group or one-on-one intervention in the areas needed." Similarly, P6 stated, "We encourage students to use counters or to draw their math answers to show how they came up with the answer. It tells the teacher a great deal about what steps to take next for each individual child." P8 went on to add, "It is important to make sure there are no gaps in learning. Students should be able to explain their thinking. That is when the teacher is able to catch any misunderstandings."

The purpose of RQ2 was to determine how early grade teachers describe the availability of information regarding mathematics learning of their currently enrolled students not identified in prekindergarten as having a learning disability or SDD in comparison to the availability of information they recall having regarding mathematics learning among similarly undiagnosed students now in fourth and fifth grade who score poorly in mathematics. I found participants believed that the availability of information regarding mathematics learning is the same now as it was in the past. Also, teachers in this study felt that the availability of information regarding mathematics learning has helped them with identifying methods of increasing student success in mathematics, such as using one-on-one interventions and hands on tools.

Results for RQ3

RQ3 was: How do early grade teachers describe their ability to predict poor mathematics scoring in fourth and fifth grades for their currently enrolled students not identified in prekindergarten as having a learning disability or SDD? To answer this question, I used participant responses from interview question 4. Themes that applied to this question include available and needed information and teachers' ability to predict outcomes.

The idea that emerged with regard to RQ3 is teachers felt that there are several factors impacting their ability to predict poor mathematics scoring in later grades for students currently enrolled in early grades. I begin here with the reasons teachers felt that they could predict outcomes for learners. P9 stated, "I think that after a few years a pattern develops and when students fall behind, they struggle to catch up with their grade level and often times they never catch up." Similar to that, P4 stated, "Students who struggle in lower grades with foundational skills will continue to struggle unless they receive really effective remediation or tutoring." P7 stated, "In my past experiences, students that struggled with math in kindergarten also ended up struggling in later grades. I have been moved around quite a bit, so one year I taught former kindergarten students later again in third grade." P5 stated, "I think my ability to predict math outcomes for children is accurate because I am seeing the same trends amongst the demographics of students I teach every year." P6 added, "I think I could predict only somewhat because it is quite possible or even likely they will continue to struggle depending on the reasons they are struggling now."

Contrary to those responses, some teachers felt that it would be difficult to predict mathematics outcomes for learners. P2 stated, "I do not think I can predict because sometimes even a child on grade level can move on to the next grade and not get the support, instruction, or experiences needed to continue mastering grade level material." Similarly, P3 stated, "It is hard to predict with certainty because even if a child is struggling in lower grades, given the right amount of support, they can turn things around and make tremendous growth." P10 said, "It is difficult to predict mathematics outcomes because students and situations can change. Some students may develop an interest once teachers have found a method of instruction that works and does not frustrate learners."

The purpose of RQ3 was to determine how early grade teachers describe their ability to predict poor mathematics scoring in fourth and fifth grades for their currently enrolled students not identified in prekindergarten as having a learning disability or SDD. I found that teachers' ability to predict poor mathematics scoring in later grades for students currently enrolled in early grades was dependent upon teachers' past experiences with struggling learners. Teachers who felt they could predict mathematics outcomes based their ability to predict on learning trends and the notion that students currently struggling in lower grades would likely continue to struggle in upper grades. Teachers who felt they could not predict mathematics outcomes based their inability to predict on their belief that students and learning situations could eventually change.

Additional Finding

In this study, I found that years of teaching experience impacted teachers' ability to predict poor mathematics scoring in later grades for students currently enrolled in early grade. The data analysis revealed that teachers with greater years of experience felt they could predict outcomes and teachers with fewer years of experience felt that they could not predict. The participants who felt they could predict mathematics outcomes for learners had been teaching 12, 18, 21, and 30 years, with the exception of Participant 6 who had only been teaching for four years and felt that she could only somewhat predict outcomes. Opposed to that, the participants who felt they could not predict mathematics outcomes had all been teaching five years or less. According to Thiede et al., (2015) factors such as years of teaching experience, teacher knowledge of content, and teaching practices all play a part in teachers' ability to accurately predict performance.

Summary of Results

The themes that developed as a result of the data analysis seemed to suggest numerous factors cause students to struggle with mathematics each year. The teachers' perspectives of past and present learners supported this claim as the participants felt that students have exhibited the same characteristics of struggle over the years and the information, they have available today about students' mathematics learning is the same as the information they had back when teaching past learners. A few teachers even felt that they have more information available now with having more years of teaching experience. Although the signs of struggle have been consistent over the years, teachers felt that the best approach to increasing student success in mathematics is through providing meaningful learning experiences and using interventions and remediation to help close learning gaps. The data analysis also revealed that teachers' ability to predict the mathematics outcomes for learners they currently teach is influenced by the notion that students can change, and their learning situations can also change, while a few participants felt that students will likely continue to struggle with mathematics in later grades if they are currently struggling in their early years. Years of teaching experience was also identified as being a factor in teachers' ability to predict mathematics outcomes.

Evidence of Trustworthiness

As stated in Chapter 3, credibility refers to the ways in which a researcher establishes internal validity and ensures that their study will actually measure or test what it is intended to measure (Merriam, 2009). Prior to data collection, I supported content validity through the process of peer-review to ensure that the interview questions inquired about what they were intended to ask. To establish credibility, participants were provided with a copy of their transcription file to review for accuracy. Participants felt that their transcription file accurately depicted their perspectives of struggling learners and later mathematics achievement.

Since the nature of this qualitative study was specific to a particular environment, it would be very difficult to demonstrate that the findings are applicable to other situations (see Johnson & Christensen, 2008). Therefore, to establish transferability I used thick description in describing how the interviews occurred and other specific aspects of the data collection process, thus enabling the reader to determine if my findings might apply to their situation or context. My reflective journal that I kept throughout the data collection and analysis process assisted with my presentation of thick descriptions.

To establish dependability, I used the process of reflexivity to consciously acknowledge and examine the preconceptions I brought to the study as a mathematics teacher (see Merriam, 2009). I kept a reflective journal throughout the data collection and analysis phase to help evaluate the overall effectiveness of the research study (see Johnson & Christensen, 2008). According to Merriam (2009), dependability of a study is established by employing techniques to demonstrate that if the study were repeated, with the same participants in the same context, similar results would be obtained. My plan was to establish consistency of results as I used the reflective journal.

To establish confirmability, I purposefully withheld my comments during interviews and only asked questions to clarify understanding of what was said by participants (see Creswell, 2009). After interviews, I asked participants to review their interview transcript for accuracy prior to my analysis of the data. To address the issue of having only one coder and to establish intra-coder reliability, I coded the data twice on two separate occasions. These two coding sessions took place two weeks apart to allow enough time to take a fresh look at the data the second time around. The results of both sessions were then compared to confirm consistency. While writing the results, I supported confirmability by using the interview transcripts and direct quotes from participants to accurately depict the early grade teachers' perspectives of struggling learners and later mathematics achievement.

Summary

In Chapter 4, I began by describing the setting and conditions at the time of the study and presented demographics and characteristics of participants that were relevant to the study. I described in detail the data collection process and how I used a concept map to first group codes into categories and then combined categories based upon recurring themes during data analysis. The similarities found among the coded units led to the development of 12 categories that subsequently led to the development of five themes: causes of struggles, similarities among past and present learners, available and needed information, methods of increasing student success, and teachers' ability to predict outcomes. I concluded this section by discussing the results of the data analysis as it related to the research questions and provided evidence of trustworthiness. In the remaining chapter, I summarize the findings, discuss recommendations, and describe the potential impact for positive social change.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this study was to understand kindergarten, first, and second grade teachers' perspectives of early indicators of later difficulties in mathematics among children not identified as having learning disabilities or SDD in prekindergarten. The nature of this study was qualitative because qualitative studies are used to gain a better understanding of problems, whereas quantitative studies use measurable data to quantify a problem (Merriam, 2009). I chose a retrospective design as opposed to other qualitative methods such as case study, phenomenology, or grounded theory because retrospection was better suited to answer the research questions. One key finding of the data analysis revealed that the struggles seen among student's past and present have been consistent over the years. Data analysis also revealed that teachers' ability to predict poor mathematics scoring in later grades for students currently enrolled in early grades was dependent upon their past experiences with struggling learners as well as their years of teaching experience. In this chapter, I interpret the findings, describe limitations of the study, make recommendations for further research, and discuss implications for practice and social change.

Interpretation of Findings

In this section, I interpret the findings of my study in relation to findings in prior literature. I organized this interpretation by the five themes that emerged in my study: early signs of struggle, similarities between past and present learners, availability of information, methods of increasing student success, and teachers' ability to predict outcomes.

Early Signs of Struggle

I found that teachers described the earliest signs of struggle commonly developed from foundational and environmental causes, personal attributes of individual learners, and specific mathematics content causing difficulty. Morgan et al. (2019) said it is not uncommon for young children to struggle with mathematics, and often those struggles are not signs of disabilities or deficits. The primary focus of mathematics instruction in early grades is number recognition, counting, and cardinality (Common Core State Standards Initiative, 2018; NCTM, 2000). Findings in my study revealed that specific mathematics content that caused difficulty early in students' academic career included concepts such as counting, number recognition, and one-to-one correspondence. These echoes prior research of Mulligan et al. (2018) that showed most difficulties in early mathematics stem from an inadequate sense of numbers and underdeveloped spatial skills. Although early grades mathematics primarily focuses on number recognition, counting, and cardinality (Common Core State Standards Initiative, 2018; NCTM, 2000), those were precisely the concepts identified as the areas causing the most difficulty in mathematics each year according to kindergarten and first grade teachers who participated in the study.

My finding that the earliest signs of struggle commonly develop from foundational and environmental causes, personal attributes of individual learners, and specific mathematics content causing difficulty disconfirmed the findings of Stevens et al. (2015). These authors found that although there was extensive research addressing the causes of mathematics failure for children with learning disabilities, very little was known about what causes struggles with mathematics among students not identified as having learning disabilities (Stevens et al., 2015). Data analysis in this study revealed that specific mathematics content causing difficulty where concepts such as counting, number recognition, one-to-one correspondence, basic facts, addition and subtraction with regrouping, and math story problems.

Similarities Among Past and Present Learners

Several participants explained that struggles seen among past and present learners have been consistent over the years. Kahneman and Tversky (1974) defined representativeness as the degree to which an object or individual can be categorized as a prototype of another category. The key determinant of representativeness is similarity. Teacher perspectives in this study that struggles seen among past and present learners were consistent over the years confirm the action of representativeness. When decisions are made based upon representativeness, people often pay attention to similarities that exist between the new event and an existing category (Kahneman & Tversky, 1974). This concept, as it relates to the study, suggests that the ability of teachers to predict which students will later struggle with mathematics in upper grades is dependent upon their understanding of their students' current struggles in lower grades and how those struggles relate to past learners. Teacher recollections of student learning and what they believe to have been early indicators of later difficulties were critical to this study, because there was no other specific evidence available at the time to determine why students not identified as having a learning disability or SDD in prekindergarten struggle with mathematics in upper grades.

Availability of Information

I found that participants believed that the availability of information regarding mathematics learning is the same now as it was in the past. According to Kahneman and Tversky (1974), availability of instances or scenarios is often employed when assessing the plausibility of developments. This heuristic supports the proposition that judgments are made about the frequency of an event based upon the number of similar instances that come to mind (Kahneman & Tversky, 1974). Teachers in this study also felt that the availability of information regarding mathematics learning has helped them with identifying methods of increasing student success in mathematics, such as using one-on-one interventions and hands on tools. These findings are similar to the findings of Thiede et al. (2015) that showed teachers make judgments based upon inferences drawn from available cues, and the accuracy of these judgments continually improves when cues are diagnostic and focused on students' thinking and understanding of content. Teacher judgment is important because judgments about student learning can ultimately guide and improve instruction by helping to identify struggling learners, influence teachers' expectations about students' abilities, and influence students' academic self-concept (Mannikko & Husu, 2019).

Methods of Increasing Student Success

After finding the availability of information regarding mathematics learning to be the same now as it was in the past, I also found that teachers in this study felt that the availability of information regarding mathematics learning helped them with identifying methods of increasing student success in mathematics. These methods not only included teacher methods for increasing student success, but also ways in which students can work to increase their own success. Student methods of increasing success included explaining their thinking, drawing pictures to demonstrate learning, reading questions out loud, and using manipulatives, while teacher methods of increasing success include providing one-to-one interventions and hands on experiences, using number talks so students can explain their thinking, making careful observations, and working to reduce learner frustration while maintaining interest. Teachers' ability to identify methods of increasing student success in mathematics reflects Kahneman and Tversky's (1974) heuristic of availability of instances or scenarios. Application of this heuristic to the current study suggests that teachers' frequent observations of struggle will likely lead them to make judgments about methods used to increase students' success.

Despite these identified methods of increasing student success, there seems to be some disconnect between methods teachers are using and what students are actually gaining from those methods. If struggles seen among past and present learners have been consistent over the years and the availability of information regarding mathematics learning is the same now as it was in the past, then identified methods of increasing success are insufficient or nonexistent at all. Students continuing to struggle year after year is inconsistent with what is suggested by the National Association for the Education of Young Children's (NAEYC) age appropriate early learning and development standards that identify what young children should be experiencing in the area of mathematics, as well as age appropriate standards that define what students should know and be able to do at their current stage of development as described by the Common Core State Standards

Initiative. Students' struggles become increasingly more evident in grades 3 to 5 when students do not demonstrate proficiency at their current grade level on end-of-grade assessments. Teachers cannot do what they have always done, continue to use the information they have always used and expect results. Changes have to be made and methods must be revised in early grade mathematics in order for students in upper grades to begin experiencing greater gains. As long as fourth and fifth grade students continue to struggle with mathematics content and perform at the lower achievement levels on assessments, efforts to improve student achievement in the area of mathematics will continue to be insufficient.

Teachers' Ability to Predict Outcomes

I found that teachers' ability to predict poor mathematics scoring in later grades for students currently enrolled in early grades was dependent upon their past experiences with struggling learners. Teachers who felt they could predict mathematics outcomes based their ability to predict on learning trends and the notion that students currently struggling in lower grades would likely continue to struggle in upper grades. Teachers who felt they could not predict mathematics outcomes based their inability to predict on their belief that students and learning situations could eventually change. Finding teachers' ability to predict poor mathematics scoring in later grades for students currently enrolled in early grades being dependent upon teachers' past experiences with struggling learners reflected the findings of Virinkoski et al. (2018). These authors said it is possible for early grade teachers to predict future achievement of learners in certain instances, given the right conditions (Virinkoski et al., 2018). Thiede et al. (2015) said factors such as years of teaching experience, teacher knowledge of content, and teaching practices all play a part in teachers' ability to accurately predict performance.

Being able to predict outcomes for struggling learners alone is not enough. There seems to be some complacency in terms of what early grade teachers are teaching and the experiences they are providing to young learners. As mentioned earlier, data analysis revealed that teachers felt the struggles seen between past and present learners have been consistent over the years, and availability of information regarding mathematics learning is the same now as it was in the past. This refutes NAEYC's Position Statement and the NCTM's belief that mathematics education in the early years is the foundation for subsequent years of mathematics learning. Mathematics understanding established in the primary grades form the foundation for mathematics achievement in fourth and fifth grades; therefore, once teachers predict students will likely struggle in later grades, steps must be taken early on to increase student success.

Summary of Interpretations

In general, the findings of this study confirm much of what was already known about mathematics struggles in early childhood, yet extend knowledge in the discipline. One key idea that emerged from my study that I did not find in prior literature was contributing factors to the struggles students past and present face in mathematics that were identified by participants in the study. Although there was extensive research addressing causes of mathematics failure for children with learning disabilities, very little was known about what causes struggles with mathematics among students not identified as having learning disabilities. My study helps to fill this gap in practice and further extends knowledge in the discipline by addressing earliest signs of struggle commonly developed from foundational and environmental causes, personal attributes of individual learners, and specific mathematics content causing difficulty such as counting, number recognition, one-to-one correspondence, basic facts, addition and subtraction with regrouping, and math story problems. If teachers are provided with a deeper understanding of early indicators of later difficulties in mathematics, they will be better equipped to identify struggling learners early on.

Although participants identified methods of increasing student success in the area of mathematics, there seems to be some disconnect between methods teachers are using and what students are actually gaining from those methods. Data analysis revealed that struggles seen among past and present learners have been consistent over the years and the availability of information regarding mathematics learning is the same now as it was in the past, thus indicating some complacency in early grade teaching. Teacher and student methods of increasing student success in mathematics extend knowledge in the discipline by providing specific ways in which teachers and students can work to improve mathematics learning in early grades. Once teachers begin using their past experiences with struggling learners to help them identify early students who will later struggle in mathematics, they will become more proactive in their methods used to teach young children, methods such as those identified by participants in this study as methods of increasing student success.

It was possible for early grade teachers to predict future achievement of learners in certain instances, given factors such as years of teaching experience, teacher knowledge of content, and teaching practices (Nguyen et al., 2016; Thiede et al., 2015; Virinkoski et al., 2018). My study helps to further extend this knowledge in the discipline by addressing poor mathematics scoring in later grades for students currently enrolled in early grades, which was dependent upon their past experiences with struggling learners as well as years of teaching experience. Teachers' ability to predict future mathematics achievement of learners formed the foundation of this study. This study revealed that teachers can use their knowledge of students and observations to predict future success or failure of learners by identifying early students who will later struggle in mathematics.

Limitations of the Study

The design of this study subjected it to possible limitations. As mentioned earlier, the data collection process took place during the COVID-19 pandemic, which precluded my ability to conduct face-to-face interviews and limited my access to participants as originally planned. Limited access to participants meant conducting interviews via telephone or a teleconference link. To address this issue, a reasonable measure taken prior to conducting interviews was to ask participants to find a private setting within the comfort of their home that would be quiet enough to be audio recorded for transcription. This potential limitation did not undermine my ability to answer the research questions or quality of the findings.

During data collection, a few situations occurred that might have limited trustworthiness for the study; however, reasonable measures were immediately taken to resolve these issues. Because participant interviews were conducted using video conferencing or cellular phone and audio recorded with transcription services provided by Otter.ai Voice Notes, the data collection process had minor interruptions. As mentioned earlier, during one interview, I realized Voice Notes was not recording on my computer, and connections were dropped during two other interviews that were held via video conference. To resolve these unanticipated issues, the interviews were reconnected as soon as possible and continued at the point where they had been interrupted. These minor occurrences had no effect on validity of results or usefulness of the data to readers.

Recommendations

It was discussed early in this study that very little was known about what causes struggle with mathematics among students not identified as having learning disabilities (Stevens et al., 2015) despite there being extensive research addressing the causes of mathematics failure for children with learning disabilities (Cirino et al., 2015; Lewis, 2016; Morgan et al., 2016). My analysis of the data found in this study revealed that specific mathematics content causes difficulty early on and persists into later grades, so further research into the early signs of mathematics struggle at each grade level could help pinpoint exactly what causes young learners to struggle year after year. Because of the cumulative nature of mathematics and the fact that new skills often require foundational knowledge, the early years are critical to later mathematics learning and skill development (Conoyer et al., 2016). In addition, further research into the identified methods of increasing student success could be beneficial to school systems attempting to decrease mathematics failure in later grades. Data analysis revealed that teachers in this study felt that the availability of information regarding mathematics learning has helped them with identifying methods of increasing student success in mathematics. I found that despite these identified methods of increasing student success, there seemed to be some disconnect between methods teachers are using and what students actually gain from those methods. Further research into methods of increasing student success and the possible effects they can have on student achievement may be critical to addressing the identified problem of later grades mathematics failure among children not identified as having a special need.

One additional avenue for further research could be to focus on teachers' feelings of self-efficacy and their ability to improve mathematics instruction. As earlier mentioned, the data analysis revealed that teachers felt the struggles seen among past and present learners have been consistent over the years and the availability of information regarding mathematics learning is the same now as it was in the past. This suggests some complacency in what early grade teachers are teaching and the experiences they are providing to young learners. It was determined that teachers cannot simply do what they have always done and expect results to improve. Further research into teachers' feelings of self-efficacy could potentially provide insights into why teachers have this fatalistic point of view that identifying methods of increasing student success alone will work to increase student achievement in the area of mathematics when it was determined in this study that students have continued to experience the same signs of struggle each year.

Implications

The intended audience for this study was early childhood teachers, administrators, district leaders, policy makers, and early childhood researchers. District leaders and policy makers can use the results found in this study to guide curriculum reform and develop strategies that are geared towards increasing student success in mathematics classrooms. Early grade teachers can use the results of this study to examine their own ability to predict mathematics outcomes for their current learners and become more proactive in their methods used to teach them. Subsequently, students performing at the lower levels of achievement in mathematics should receive appropriate interventions, hands on experiences, and other identified methods of increasing student success. According to the NCTM (2000), in schools where students' mathematics achievement is inadequate, a selective use of remediation, intervention programs, and multiple opportunities for acceleration are critical to maximizing student achievement.

The insights gained from my research indicated teachers felt that the availability of information regarding mathematics learning has been the same over the years and has helped in identifying methods of increasing student success in mathematics. In addition, teachers felt that students have been exhibiting the same signs of struggle each year. These findings indicate that teachers are not currently using what they know about increasing student success to make the best decisions about instructional practices. This could have implications for administrators, district leaders, and policy makers to create opportunities for preservice teacher training that addresses the critical areas of mathematics teaching and establish mentoring programs for novice teachers to engage in conversations with colleagues about implementing best practices in the mathematics classroom. Years of teaching experience had an impact in this study on teachers' ability to predict poor mathematics scoring in later grades for students currently enrolled in early grades. This finding supports the need for school systems to provide novice teachers with experienced mentors and a more formal structure for developing communities of practice with their colleagues. School systems should focus their attention on providing effective professional development to help novice teachers gain more experience in order to guide schools towards success. Because of the consistent struggles with mathematics, there seems to be some complacency in what early grade teachers are teaching and the experiences they are providing to young learners. This further indicates a need for experienced teachers to be provided with effective professional development to ensure they are adapting to the growing needs of their students and adjusting their teaching methods to readily meet those needs. These opportunities will help teachers become more reflective about their teaching practices and the methods they are using to increase student achievement.

Another implication for change resulting from the data analysis is for teachers to implement the identified methods of increasing success which included providing one-to-one interventions and hands on experiences, using number talks so students can explain their thinking, making careful observations, and working to reduce learner frustration while maintaining interest. Teachers should also encourage students to actively engage in their own learning by implementation of the identified student methods of increasing success. Methods such as explaining their thinking, drawing pictures to demonstrate learning, reading questions out loud, and using manipulatives. When students are given opportunities to actively take part in their learning, it helps them to become more accountable for their learning (Watts et al., 2018). As students talk about what they know and explain their thinking, teachers can catch misconceptions earlier in an attempt to minimize consistent struggles that have been present each year. In order to improve student performance in the mathematics classroom, teacher and student strategies should be structured and include activities that will promote the development of young learners. It is important to give students the opportunity to make connections with mathematics and the world around them (Common Core State Standards Initiative, 2018).

Based on data generated from my research, methodological suggestions for future researchers include further application of qualitative methods to continue exploring early childhood mathematics. If time permits, case study research into the identified methods of increasing student success and the possible effects they can have on student achievement may be beneficial to addressing the identified problem of later grades mathematics failure among children not identified as having a special need. Case study research designs will allow further investigations to occur in natural settings and open-ended interview questions to assist in data collection (Yin, 2009).

The school system that was the focus of this study was facing issues in the area of mathematics that needed to be addressed. The purpose of my study was to better understand early grade teachers' perspectives of early indicators of later difficulties in mathematics among children not identified as having learning disabilities or SDD in prekindergarten. The school system can use the results of this study as a starting point to begin implementing change that will not only help to eliminate some of the problems currently being faced, but will also help to guide the school system towards positive outcomes for young learners and the early childhood field. The results of this study can provide the school system of focus with valuable insights to understanding early indicators of later difficulties in mathematics through careful examination of teacher recollections and perspectives that were provided through interviews with early grade teachers. Results of my study provide valuable insights to the field of early childhood mathematics and have potential to significantly enhance the development and learning of young children, thus leading to positive social change.

Conclusion

This study addressed a gap in practice by focusing on early warning signs exhibited by students in kindergarten, first, and second grade who struggle with mathematics in later elementary grades. This study contributes to the field because it addressed an area of early childhood mathematics that had been previously understudied in research. The nature of this study was qualitative because qualitative research was consistent with building retrospectively a portrait of children who were struggling with mathematics as fourth and fifth graders, based on teacher remembrances of their early years. Very few prior studies focused on the causes of struggle with mathematics among students not identified as having learning disabilities, despite there being extensive research addressing the causes of mathematics failure for children with learning disabilities. This study attempted to address the need for further research into mathematics failure among students not identified as having a learning disability by examining teacher recollections of student learning and what teachers believed to have been early indicators of later difficulties. Themes that developed as a result of the data analysis seemed to suggest that numerous factors cause students to struggle with mathematics each year. The data analysis also revealed that teachers' ability to predict poor mathematics scoring in later grades for students currently enrolled in early grades was dependent upon teachers' past experiences with struggling learners and their years of teaching experience.

This study adds to the current literature and extends knowledge in the field by providing a clearer understanding of teachers' perspectives of early indicators of later success or failure in mathematics. One key idea that emerged from the findings that I did not find in prior literature was the contributing factors to struggles students past and present face in mathematics that were identified by participants in the study. Another key finding was that struggles seen among past and present learners have been consistent over the years and the availability of information regarding mathematics learning is the same now as it was in the past, thus indicating some complacency in early grade teaching and a disconnect between methods teachers are using and what students are actually gaining from those methods.

Implications for change suggest district leaders and policy makers guide curriculum reform and develop strategies that are geared towards increasing student success in the mathematics classroom. Recommendations for future research include further investigation into the early signs of mathematics struggle and the identified methods of increasing student success. Further investigations are critical to pinpointing exactly what continually causes young learners to struggle each year and to addressing the identified problem of later grades mathematics failure among children not identified as having a special need. Positive social change may result when early childhood advocates take a closer look at the causes of continued mathematics struggle and work to develop and successfully implement practices dedicated to increasing student success.

References

Allen, R. M., & Casbergue, R. M. (1997). Evolution of novice through expert teachers' recall: Implications for effective reflection on practice. *Teaching & Teacher Education, 12,* 741-755. https://doi.org/10.1016/S0742-051X(97)00018-8

Anders, Y., & Rossbach, H. G. (2015). Preschool teachers' sensitivity to mathematics in children's play: The influence of math-related school experiences, emotional attitudes, and pedagogical beliefs. *Journal of Research in Childhood Education, 29*(3), 305-322. https://doi.org/10.1080/02568543.2015.1040564

Aunio, P. & Rasanen, P. (2016). Core numerical skills for learning mathematics in children aged five to eight years – a working model for educators. *European Early Childhood Education Research Journal, 24*(5), 684-704. https://doi.org/10.1080/1350293X.2014.996424

Babad, E. Y. (1985). Some correlates of teachers' expectancy bias. *American Educational Research Journal, 22*(2), 175-183. https://doi.org/10.1.1.828.4543

Bassok, D., Latham, S., & Rorem, A. (2016). Is kindergarten the new first grade? *AERA Open, 1*(4), 1-31. https://doi.org/10.1177/2332858415616358

Bazerman, M. H., & Sezer, O. (2016). Bounded awareness: Implications for ethical decision making. *Organizational Behavior and Human Decision Processes, 136,* 95-105. https://doi.org/10.1016/j.obhdp.2015.11.004

Bernstein, D. M., Erdfelder, E., Meltzoff, A. N., Peria, W., & Loftus, G. R. (2011). Hindsight bias from 3 to 95 years of age. *Journal of Experimental Learning, Memory, and Cognition, 37*(2), 378-391. https://doi.org/10.1037/a0021971

Bordalo, P., Coffman, K., Gennaioli, N., & Shleifer, A. (2016). Stereotypes. *Quarterly Journal of Economics, 131*(4), 1753-1794. https://doi.org/10.1093/qje/qjw029

Burns, M. K., Walick, C., Simonson, G. R., Dominguez, L., Harelstad, L., Kincaid, A., & Nelson, G. S. (2015). Using a conceptual understanding and procedural fluency heuristic to target math interventions with students in early elementary. *Learning Disabilities Research & Practice, 30*(2), 52-60. https://doi.org/10.1111/ldrp.12056

Casey, B. M., Lombardi, C. M., Pollock, A., Fineman, B., & Pezaris, E. (2017). Girls' spatial skills and arithmetic strategies in first grade as predictors of fifth-grade analytical math reasoning. *Journal of Cognition and Development, 18*(5), 530-555. https://doi.org/10.1080/15248372.2017.1363044

Cirino, P. T., Fuchs, L. S., Elias, J. T., Powell, S. R., & Schumacher, R. F. (2015). Cognitive and mathematical profiles for different forms of learning difficulties. *Journal of Learning Disabilities, 48*(2), 156-175. https://doi.org/10.1177/0022219413494239

Clements, D. H., & Sarama, J. (2018). Myths of early math. *Education Sciences, 8*(2), 71. https://doi.org/10.3390/educsci8020071

Common Core State Standards Initiative. (2018). *Mathematics standards*. http://www.corestandards.org/math/

Conoyer, S. J., Foegen, A., & Lembke, E. S. (2016). Early numeracy indicators: Examining predictive utility across years and states. *Remedial and Special Education, 37*(3), 159-171. https://doi.org/10.1177/0741932515619758

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications.

Dwyer, S. C., & Buckle, J. L. (2009). The space between: On being an insider-outsider in qualitative research. *International Journal of Qualitative Methods, 8*(1), 54-63. https://journals.sagepub.com/doi/pdf/10.1177/160940690900800105

Engel, M., Claessens, A., Watts, T., Farkas, G. (2016). Mathematics content coverage and student learning in kindergarten. *Educational Researcher, 45*(5), 293-300. https://doi.org/10.3102/0013189X16656841

Galdas, P. (2017). Revisiting bias in qualitative research: Reflections on its relationship with funding and impact, *International Journal of Qualitative Methods, 16*(1), 1-2. https://doi.org/10.1177/1609406917748992

Goldstein, J., McCoach, D. B., & Yu, H. (2017). The predictive validity of kindergarten readiness judgments: Lessons from one state. *The Journal of Educational Research, 110*(1), 50-60. https://doi.org/10.1080/00220671.2015.1039111

Hagens, V., Dobrow, M. J., & Chafe, R. (2009). Interviewee transcript review: Assessing the impact on qualitative research. *BMC Medical Research Methodology, 9*(47), 1-8. https://doi.org/10.1186/1471-2288-9-47

Harris, J. & Bourne, P. A. (2017). Perception of teachers and pupils on factors influencing academic performance in mathematics among a group of fifth and sixth graders in Jamaica. *International Journal of Transformation in Applied Mathematics & Statistics, 2*(1), 1-23.

http://technology.eurekajournals.com/index.php/Young_Scientist/article/download/194/332

Johnson, B., & Christensen, L. (2008). *Educational research: Quantitative, qualitative, and mixed approaches* (3rd ed.). SAGE Publications.

Johnson, N. A. (1987). The pervasive, persuasive power of perceptions. *The Alberta Journal of Educational Research, 33*(3), 206-228. http://psycnet.apa.org/psycinfo/1989-17095-001

Kahneman, D., & Tversky, A. (1973). On the psychology of prediction. *Psychological Review, 80*(4), 237-251. https://doi.org/10.1037/h0034747

Kahneman, D., & Tversky, A. (1974). Judgement under uncertainty: Heuristics and biases. *Science, 185*(4157), 1124-1131. https://doi.org/10.1126/science.185.4157.1124

Lewis, K. E. (2016). Difference not deficit: Reconceptualizing mathematical learning disabilities (reprint). *Journal of Education, 196*(2), 39-62. https://doi.org/10.1177/002205741619600203

Mannikko, L., & Husu, J. (2019). Examining teachers' adaptive expertise through personal practical theories. *Teaching and Teacher Education, 77*, 126-137. https://doi.org/10.1016/j.tate.2018.09.016

Marita, S., & Hord, C. (2017). Review of mathematics interventions for secondary students with learning disabilities. *Learning Disability Quarterly, 40*(1), 29-40. https://doi.org/10.1177/0731948716657495

Merkley, R. & Ansari, D. (2016). Why numerical symbols count in the development of mathematical skills: Evidence from brain and behavior. *Current Opinion of Behavioral Sciences, 10,* 14-20. https://doi.org/10.1016/j.cobeha.2016.04.006

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation.* Jossey-Bass.

Morgan, P. L., Farkas, G., Hillemeier, M. M., & Maczuga, S. (2016). Who is at risk for persistent mathematics difficulties in the united states? *Journal of Learning Disabilities, 49*(3), 305-319. https://doi.org/10.1177/0022219414553849

Morgan, P. L, Farkas, G., Wang, Y., Hillemeier, M. M., Oh, Y., & Maczuga, S. (2019). Executive function deficits in kindergarten predict repeated academic difficulties across elementary school. *Early Childhood Research Quarterly, 46*, 20-32. https://doi.org/10.1016/j.ecresq.2018.06.009

Mulligan, J., Woolcott, G., Mitchelmore, M., & Davis, B. (2018). Connecting mathematics learning through spatial reasoning. *Mathematics Education Research Journal, 30*(1), 77-87. https://doi.org/10.1007/s13394-017-0210-x

National Association for the Education of Young Children (NAEYC). (2002). *Early childhood mathematics: Promoting good beginnings.* NAEYC.

National Center for Education Statistics. (2018). *State Education Reforms.* https://nces.ed.gov/programs/statereforms/

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

Nguyen, T., Watts, T. W., Duncan, G. J., Clements, D. H., Sarama, J. S., Wolfe, C., & Spitler, M. E. (2016). Which preschool mathematics competencies are most predictive of fifth grade achievement? *Early Childhood Research Quarterly, 36,* 550-560. https://doi.org/10.1016/j.ecresq.2016.02.003

Powell, S. R., & Nelson, G. (2017). An investigation of the mathematics-vocabulary knowledge of first-grade students. *The Elementary School Journal*, *117*(4), 664-686. https://doi.org/10.1086/691604

Raab, M., Dunst, C. J., & Hamby, D. W. (2016). Effectiveness of contrasting approaches to response-contingent learning among children with significant developmental delays and disabilities. *Research & Practice for Persons with Disabilities*, *41*(1), 36-51. https://doi.org/10.1177/1540796915621189

Ravitch, S. M., & Carl, N. C. (2016). *Qualitative research: Bridging the conceptual, theoretical, and methodological*. SAGE Publication.

Rittle-Johnson, B., Fyfe, E. R., Hofer, K. G., & Farran, D. C. (2016). Early math trajectories: Low-income children's mathematics knowledge from ages 4 to 11. *Child Development, 88*(5), 1727-1742. https://doi.org/10.1111/cdev.12662

Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. *Early Childhood Research Quarterly, 46*, 166-178. https://doi.org/10.1016/j.ecresq.2018.03.006

Russo, J. M., Williford, A. P., Markowitz, A. J., Vitiello, V. E., & Bassok, D. (2019). Examining the validity of a widely-used school readiness assessment:

Implications for teachers and early childhood programs. *Early Childhood Research Quarterly, 48*, 14-25. https://doi.org/10.1016/j.ecresq.2019.02.003

Saldana, J. (2015). *The coding manual for qualitative researchers* (3rd ed.). SAGE Publications.

Schoenfield, A. H. (2016). Research in mathematics education. *Review of Research in Education*, *40*(1), 497-528. https://doi.org/10.3102/0091732X16658650

Shanley, L., Clarke, B., Doabler, C. T., Nelson, E., & Fien, H. (2017). Early number skills gains and mathematics achievement: Intervening to establish successful early mathematics trajectories. *The Journal of Special Education*, *51*(3),177-188. https://doi.org/10.1177/0022466917720455

Starks, H., & Trinidad, S. B. (2007). Choose your method: A comparison of phenomenology, discourse analysis, and grounded theory. *Qualitative health research*, *17*(10), 1372-1380. https://doi.org/10.1177/1049732307307031

Stevens, J. J., Schulte, A. C., Elliott, S. N., Nese, J. F. T., & Tindal, G. (2015). Growth and gaps in mathematics achievement of students with and without disabilities on a statewide achievement test. *Journal of School Psychology, 53*(1), 45-62. https://doi.org/10.1016/j.jsp.2014.11.001

Thiede, K. W., Brendefur, J. L., Osguthorpe, R. D., Carney, M. B., Bremner, A., Strother, S., Oswalt, S., & Snow, J. L. (2015). Can teachers accurately predict student performance. *Teaching and Teacher Education, 49*, 36-44. https://doi.org/10.1016/j.tate.2015.01.012

Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation*, *27*(2), 237-246. https://doi.org/10.1177/1098214005283748

U.S. Department of Health & Human Services. (2017). *Head Start programs.* https://www.acf.hhs.gov/ohs/about/head-start

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2015). *Elementary and middle school mathematics: Teaching developmentally* (9th ed.). Pearson Education.

Virinkoski, R., Lerkkanen, M. K., Holopainen, L., Eklund, K., & Aro, M. (2018). Teachers' ability to identify children at early risk for reading difficulties in grade 1. *Early Childhood Education Journal*, *46*(5), 497-509. https://doi.org/10.1007/s10643-017-0883-5

Watts, T. W., Duncan, G. J., Clements, D. H., & Sarama, J. (2018). What is the long-run impact of learning mathematics during preschool? *Child Development, 89*(2), 539-555. https://doi.org/10.1111/cdev.12713

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). SAGE Publications.

Appendix A: Interview Questions

1) Think of the children you teach right now. Think specifically about the children who have not been identified as having a learning disability or significant developmental delay. Among these children, the ones without any sort of learning disability or delay, which ones struggle to learn mathematics? Can you get these children in mind?
    a) What are the common signs of mathematics struggle you see in these students who haven't been identified with any sort of learning disability or delay?
2) Next, think of the children whom you have taught in the past who are now in fourth or fifth grade. Of those, think specifically of children who, when you taught them, had no diagnosis of a learning disability or any evidence of a significant developmental delay.
    a) Of these children, were there any signs of mathematics struggles in kindergarten? What do you remember?
    b) How similar to what you recall of these past students is what you see now in your current students who struggle with mathematics?
    c) What do you know about how those past students are doing now, in fourth or fifth grade?
3) How is the information you have available today about student mathematics learning the same or different from the information you had back when you were teaching past learners?
    a) What information would be helpful to you today that you don't have available?

4) Based on your teaching experiences with present and past learners and observations you have made, do you think you could predict how the children you teach now – both the ones who struggle and the ones who don't seem to struggle – will do in math when they are in fourth or fifth grade?

   a) How is your ability to predict mathematics outcomes for children today based on what you know about how children have struggled in the past?

Appendix B: Codes and Categories from Data

Codes	Categories
Lack foundational skills (3) Weak preschool experience Lack solid background Younger end of age requirement	Foundational causes of struggle
Not supported at home Lack strong support system Impoverished No help with homework Uneducated parents Parents struggled themselves Parents feel unable to help	Environmental causes of struggle
Lack number sense (3) Inability to count (2) Do not understand (2) Lack desire Unmotivated Inattentive [zoning out] Poor attention span Lack comprehension Lack confidence Unable to explain Behavior problems cover up not knowing Low problem-solving skills Issues with fine motor skills Can mimic what is modeled Slow progress	Individual causes of struggle
Number recognition (3) Adding/subtracting (2) Basic facts Regrouping One to One correspondence Counting Math story problems Mental math Sorting objects Number reversal [reading 14 as 41] Counting from one [not counting on] No connection between objects and numbers Struggle to visualize problems	Math content causing struggle
Poor reading comprehension (3) Struggle in other areas (2)	Struggle in other academic areas

Same struggles year to year (5) Most of them struggle (3) Struggled in previous years (2) Same characteristics of struggle (2) Basically, the same signs Math struggles are common	Past and present learners
Information today is similar (4) More information now with more experience (2) Information today is slightly different from the past Access to more modalities for practice More data available	Available information
Past test scores Previous grade specific skills inventories Information about better serving low learners Ideas for introducing math standards	Needed information
Number talks (3) Hands on tools [manipulatives] (2) Additional support (2) Promote critical thinking (2) Provide interventions One-on-one tutoring Modify activities Extra time Help outside of school Hands on experiences Dedicated teachers Adequate support Understand how a child is thinking Small group observations Reduce drill and practice Formative assessments Baseline assessing Appropriate discussion questions Challenge students Work towards closing gaps Spend more time on common signs of struggle Provide strong foundation Help students like math Maintain student interest Avoid learner frustration	Teacher methods of increasing success
Explain thinking (2)	Student methods of increasing success

Draw pictures to demonstrate learning Reading questions out loud Use manipulatives	
It is difficult to predict (3) I think I would be able to predict (3) I do not think I can predict (2) Ability to predict is accurate Only somewhat	Teachers' ability to predict
Varying teaching practices (2) Past experiences (2) Same trends amongst demographics Patterns develop Likely students will continue to struggle Children can change Students fall behind Students may eventually develop an interest	Factors affecting teachers' ability to predict