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# Teachers' Theories of Teaching and Learning and the Use of Math Interventions

Nicole P. Jones
*Walden University*

# Walden University

College of Education

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Nicole P. Jones

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Review Committee
Dr. Stephanie Gaddy, Committee Chairperson, Education Faculty
Dr. Wade Smith, Committee Member, Education Faculty
Dr. Wellesley Foshay, University Reviewer, Education Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
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Abstract

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MA, Saint Joseph College, 1998

BS, University of New Haven, 1989

Dissertation Submitted in Partial Fulfillment

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Abstract

Despite the academic gap between students with learning disabilities (LD) and their nondisabled peers, schools continue to educate students with LD in regular education classrooms. In secondary math classes, such as Algebra 1, students with LD have high percentages of failure. The purpose of this cross-sectional study was to examine the relationship between teachers' personal theories of teaching and learning and their use of math interventions. Fox's (1983) theoretical framework of teaching and learning was used as a conceptual lens. Surveys were administered to 20 high school math teachers in an urban Northeastern U.S. school district. An ordinal logistic regression statistical test was used to analyze relationships between teachers' personal theories of teaching and learning and their use of math interventions, years of experience, gender, ethnicity, and age. A statistically significant relationship was found between teachers' years of experience and their use of math interventions, $p = .031$. Teachers with 6 or more years of teaching experience self-reported using math interventions more frequently than did teachers with 5 or fewer years of teaching experience. Recommendations for future research include examining why teachers with more years of teaching self-reported using math interventions more than did less experienced teachers and the impact, if any, of the use of math interventions on students with LD's academic performance in Algebra 1. This study can lead to positive social change by providing college and university secondary math candidates with training on how to use math intervention to teach algebra to students with LD.

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# Dedication

I would like to dedicate my dissertation to my grandmother, Carrie Alice Askew Porter, and my mother, Dorothy Jean Porter.  Grandma, you always remind me I am different.  I thank you for your support and belief in the strength, which lies within me (seen and unseen).  Mom, thank you for your continued support and love.  Your strength and resilience resides within me and holds me up when I am weak (for you make me strong).

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# Chapter 1: Introduction to the Study

## Introduction

As a result of the Individuals with Disabilities Act (IDEA, 2004), a significant number of students with learning disabilities (LD) receive their academic instruction in the regular education classroom. The spirit of IDEA is to provide students with LD an appropriate education in the least restrictive environment. According to IDEA, teachers should address the goals and objectives of students with LD in the regular education classroom. However, in an attempt to comply with this legislation, some schools place students with LD in regular education classrooms where teachers lack the skills and expertise to address their instructional needs (Wadlington & Wadlington, 2008).

Some students with LD receive instruction in regular education classes where there are limited or no accommodations directed towards their disability (Wadlington & Wadlington, 2008). When this occurs, students with LD may receive inadequate instruction in the regular education classroom, and their academic performance is lower than their nondisabled peers (Deshler et al., 2008). Failure to improve teaching and learning conditions in the regular education classroom for students with LD may have dire effects on their future success. Students with LD often fail college preparatory classes, such as algebra (Steele, 2010). There are many negative consequences associated with not being literate in algebra. Students not literate in algebra are less likely to achieve postsecondary success (Moses & Cobb., 2001; Steele, 2010; Witzel, Riccomini, & Schneider, 2008). Postsecondary success is defined as a student's ability to pursue postsecondary education and to perform in a technologically advanced society (Moses & Cobb, 2001; Steele, 2010; Witzel et al., 2008).

Schools must prepare students with LD for postsecondary success. To accomplish this goal, schools must improve students with LD's academic performance in algebra. According to Meyen and Greer (2009), teachers' instructional decisions have created an achievement gap between the academic performance of students with and without LD. To close the achievement gap between students with and without LD, regular educators must design and implement instruction that addresses the learning needs of all students in the regular education classroom. This expectation will require schools to focus on how and what students with LD learn in regular education algebra classes. This process will also include an examination of what intervention strategies and supports are in place to help students with LD achieve postsecondary success.

This chapter includes a background section, followed by a brief summary of the literature on the topic. Next is the identification of the gap in knowledge and the need for the study. The section pertaining to the problem statement is included, along with literature to support the relevancy of the problem statement and its significance to the discipline. An explanation of the purpose of the study follows, along with the research questions for the study. An overview of the conceptual framework is presented. The nature of the study section includes a rationale for the design of the study, along with a description of the key study variables and an explanation of the methodology. The definitions section includes the meaning of all key terms and variables. The assumptions section includes aspects of the study that are important to know, but are unable to be proven. In the scope and delimitations sections, I define the limitations of the study. In the last section, the significance section, I explain the future implications of the study in research and practice.

## Background of the Study

In 2011-2012, 6.4 million children or 13% of public school children qualified for special education services under IDEA (Condition of Education, 2014). Thirty-six percent of the students receiving special education services have a LD (Condition of Education, 2014). According to assessment and academic achievement data, students with LD do not perform as well as their typical peers. The 2013 National Assessment for Educational Progress (NAEP, 2013) indicated that 45% of fourth graders and 65% of eighth graders with disabilities scored below the basic achievement level compared to 14% of fourth graders and 21% of eighth graders without disabilities. Many students with LD receive their academic instruction in a general education classroom. According to the National Center for Learning Disabilities (NCLD, 2014), 66% of students with LD received 80% of their instructional time in the regular education classroom (p. 16). The NCLD noted that even as the number of students with LD receiving instruction in the general education classroom increased, their academic achievement in the regular education classroom fell below the academic achievement of their nondisabled peers (p. 17).

Schools must examine the effectiveness of their inclusion programs and the type of instructional and academic support that students with LD receive by the regular education teachers. This examination would include an analysis of whether regular education teachers use math interventions to support the learning needs of students with LD. However, the research on math interventions at the secondary level for students with LD is limited (Gersten et al., 2009; Stegall, 2013). Gersten et al. (2009) identified 42 studies that included math interventions to improve students with LD's math performance. However, Gersten et al. did not specify whether studies were conducted at the elementary, middle, or high school levels.

With the use of evidence-based math interventions, regular education teachers can improve students with LD's math performance. In a study involving the secondary math intervention, concrete representational approach (CRA), Strickland and Maccini (2013) found CRA useful for teaching students with LD algebra. However, Strickland and Maccini cited the study's small, nonpublic school setting as a limitation making it hard to determine the benefits of the math intervention in a larger school setting. Stegall (2013) also concluded that math interventions can help students with LD learn algebra. Stegall found that the math intervention, Supplemental Algebra Vocabulary Instruction (SAVI), helped students with LD learn algebra terminology. However, Stegall's study was completed with special education teachers and not regular education teachers. Future researchers must focus on how algebra teachers self-report their usage of math interventions in the general education classroom environment.

To increase students with LD's math performance, teachers must both know how and be willing to remedy and address their math deficiencies (Gersten et al., 2009). Meyen and Greer (2010) and Montague, Enders, and Dietz (2011) indicated that teachers do not feel math professional development trainings address the learning needs of students with LD. According to Stegall (2013), teachers received targeted professional development training for a math intervention, SAVI, for students with LD. However, participating teachers cited not having adequate time to implement the intervention as an obstacle that would prevent them from using the intervention in the future (Stegall, 2013). Schools must provide teachers with professional development trainings on supporting the math learning needs of students with LD.

Other factors, such as teachers' personal theories of teaching and learning, may influence whether regular education teachers self-report using math interventions to teach algebra to students with LD. Teachers' personal theories of teaching and learning affect their instructional practices (Fives & Buehl, 2014; Fox, 1983; Patchen & Crawford, 2011; Stemhagen, 2011). Stemhagen (2011) studied the relationship between teachers' beliefs and the use of transmittal, constructivist, and democratic classroom instructional. Stemhagen indicated that there was a correlation between teachers' pedagogical beliefs about teaching mathematics, their teaching philosophy, and teacher practice (p. 9). Cross (2009) found that teachers' beliefs determine teachers' instructional practices. Cross observed teachers' daily instructional practices and examined whether teachers' beliefs influenced the use of NCTM math reform practices. Cross found that teachers' instructional practices did not align with the NCTM's math reform practices. If changes are to occur in teachers' practices, teachers' beliefs cannot be ignored, and teachers must receive opportunities to consider new beliefs (Stemhagen, 2011, p. 9). In this study, I examined teachers' self-reported usage of math interventions when teaching students with LD algebra in an inclusive classroom. The data from this study will add to the existing research on algebra math interventions and LD.

## Problem Statement

This research study was prompted by the need to better understand why students with LD do not achieve the same level of academic achievement as their peers without LD in inclusion algebra classes. According to Fox (1983), teachers teach from one of two theoretical frameworks (simple or developed). Researchers (Impecoven-Lind & Foegen, 2010; Strickland & Maccini, 2010) stated that there are certain math interventions that teachers should use when teaching algebra to students with LD. In this study, I examined how Fox's theoretical frameworks of teaching and learning (simple or developed) impacted teachers' decisions to use math interventions when teaching algebra to students with LD.

## Purpose of the Study

The purpose of this quantitative, cross-sectional study was to examine how Fox's theoretical frameworks of teaching and learning (simple or developed) influenced teaching and learning in inclusive algebra classrooms. The first aim of this study was to identify teachers' theoretical framework of teaching (simple or developed) as defined by Fox (1983). I collected data and categorized teachers as either having a simple or developed theoretical framework of teaching. The second aim of this research study was to explore the relationship between teachers' theoretical framework of teaching and learning and their use of math interventions. I collected data to explore the relationship between teachers' theoretical framework of teaching and learning and the use of math interventions recommended in the literature (calculators, graphic organizers, student groupings, manipulatives, or technology) when providing Algebra 1 instruction to students with LD (Foegen, 2008; Strickland & Maccini, 2010).

## Conceptual Framework for the Study

The conceptual framework of this research study was based on Fox's (1983) personal theories of teaching and learning. A teacher's belief about teaching and learning influences his or her instructional decisions (Fox, 1983; Samuelowicz & Bain, 2001). In Fox's personal theories of teaching and learning, teachers' beliefs are defined as simple or developed theories (see Table 1). In the literature related to teachers' beliefs about the definition of teaching, Fox's simple theoretical framework was associated with descriptors that define traditional teaching beliefs (Kember, 1997; See Table 1). Scholars correlated Fox's developed theoretical framework with characteristics that define student-centered teaching beliefs (Kember, 1997; Samuelowicz & Bain, 2001). Fox focused on how university teachers perceived teaching and how the purpose of teaching related to learning (Fox, 1983; Kember, 1997; Samuelowicz & Bain, 2001).

According to Fox (1983), a teacher's perception of teaching defines his or her personal theories of teaching and learning as either a simple or developed theory of teaching and learning. Teachers who have a simple theory of teaching and learning perceive the teacher's role as being responsible for imparting knowledge to students (Fox, 1983). Teachers with a simple theory of teaching and learning also view the teacher as being responsible for shaping students' understanding of concepts (Fox, 1983). Teachers who describe teaching as guiding students through the process of active learning have a developed theory of teaching and learning (Fox, 1983). According to the NCTM's (2008) position on algebra, learning algebra requires teachers to teach students a systematic approach to understanding the world. Developing these complex skills takes time. It is imperative that regular education teachers provide students with LD the time and appropriate instructional support to develop their algebra skills. Teachers with a developed theory of teaching and learning attend to students' intellectual personal growth and development.

Table 1

*Teacher's Personal Theories of Teaching and Learning (Fox, 1983)*

| Simple Theoretical Framework Characteristics | Developed Theoretical Framework Characteristics |
|---|---|
| Transmission of knowledge | Role of teacher shifts towards helping |
| Student is passive recipient | Emphasis on student learning outcomes not content |
| Providing and facilitating understanding | Helping students develop expertise |
| Teacher-centered teaching or traditional teaching | Student-centered teaching |

*Note*. Adapted from "A Reconceptualization of the Research Into University Academics' Perceptions of Teaching," from D. Kember, 1997, *Learning and Instruction, 7,* p. 255-275. Retrieved from https://www.journals.elsevier.com/learning-and-instruction/

In this quantitative, cross-sectional study, I expanded on Fox's theoretical framework by examining whether there was a relationship between how a teacher self-reports his or her personal theories of teaching and learning, a teacher's self-reports of the use of math interventions, and teachers' self-reported instructional practices. The investigation included teachers' self-reported personal theories of teaching and learning and the usage of math intervention when teaching algebra to students with LD. The purpose of the comparison was to explore teachers' self-reported instructional practices in inclusion Algebra 1 classes. Chapter 2 of this research provides a more detailed description of the relationship between a teacher's personal theories of teaching and learning and a teacher's instructional practice.

## Research Questions

1. What is the relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom?

$H_0$1: There is no significant relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom.

$H_1$1: There is a significant relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom.

## Independent and Dependent Variables

The independent variables in this study were Fox's (1983) theoretical frameworks of teaching and learning–simple (teacher-centered) and developed (student-centered). Fox's theoretical frameworks of teaching and learning are also defined as teachers' personal theories of teaching and learning. The dependent variables were the use of math interventions and the type of math interventions used, if any.

## Nature of Study

In this quantitative, cross-sectional study, I investigated how teachers' personal theories of teaching and learning influenced their self-reported use of math interventions when teaching students with LD algebra. I analyzed the relationship between teachers' personal theories of teaching and learning and teachers' self-report of the usage of math interventions. This study included teacher responses from Algebra 1 teachers in one large urban district located in the Northeastern section of the United States.

In this study, teachers self-reported their teaching beliefs and classroom practices. In a study designed to capture teachers' beliefs about mathematical classroom practices, Walker (1999) used the Teacher's Classroom Practices Survey (TCPS) to classify teachers' instructional practices as either student-centered or teacher-centered. In this study, Survey Monkey was used to create a survey consisting of questions from the TCPS and the Math Intervention Checklist. The Survey Monkey survey was used to collect demographical information from Algebra 1 teachers, data pertaining to Algebra 1 teachers' personal theories of teaching and learning, and data on teachers' math intervention usage.

In Research Question #1, the independent variable was Fox's theoretical frameworks of teaching–simple or developed. Covariates and factors included a teacher's age, ethnicity, gender, and years of experience. The dependent variable was the use of math interventions.

A cumulative odds ordinal logistic regression statistical test was executed in SPSS to measure the relationship between teachers' personal theories of teaching and learning and math intervention usage. I also measured the relationship between teachers' years of experience, ages, gender, ethnicity, and math intervention usage.

## Definitions

*Algebra*: A way of thinking about mathematical concepts and skills (NCTM, 2008). Teachers can have either a deductive or inductive view of algebra. Teachers with a deductive philosophy believe that the teaching and learning of algebra is a set of rules and procedures (Cooper & Null, 2011). Teachers with an inductive philosophy believe that the teaching and learning of algebra is the process of providing students with authentic learning experiences that allow students to arrive at their own set of mathematical rules and procedures (Cooper & Null, 2011).

*Balanced approach to instruction*: A learning environment that encompasses a mixture of both teacher-centered instruction and student-centered instruction.

*Direct instruction:* An instructional strategy where the teacher has the most control over the learning. With direct instruction, the goal is to transmit information (Gersten & Keating, 1987, p. 78). Direct instruction lessons are structured and allow teachers to immediately assess and mediate students' learning (Gersten & Keating, 1987). In this study, direct instruction was referred to traditional teaching or teacher-centered teaching.

*Inclusive class*: Students with LD receiving instruction in a regular education classroom with nondisabled peers.

*Low socioeconomic students*: Students who qualify for free and reduced lunch as defined by the federal government.

*Math intervention(s)*: Alternative approaches used in a mainstream classroom by regular education teachers to accelerate student learning (Fuchs, 2003; Fuchs, Mock, Morgan, & Young, 2003). Foegen (2008) described four interventions as beneficial for helping students with LD learn algebra: gradual instructional sequence, class-wide peer tutoring, cognitive strategy instruction, and graphic organizers.

*Personal theories of teaching and learning*: Fox's description of teachers' beliefs about what teaching and learning is. Fox (1983) created two categories for describing teachers' beliefs-simple theories (transfer theory and shaping theory) and developed theories (travelling theory and growing theory).

*Specific learning disability (LD)*: Students with psychological processing difficulties that inhibit their ability to perform well in listening, thinking, speaking, reading, writing, spelling, or mathematics (IDEA, 2004).

*Student-centered instruction (constructivism)*: Instructional strategies that allow students to have control over their own instruction and learning (NMAP, 2008). In this type of learning environment, teachers may have a role as coach or facilitator. The teacher also does less of the teaching. Cooperative learning groups are an example of student-centered instruction.

*Teacher-centered instruction*: Instructional strategies where the teacher has the most control over instruction (NMAP, 2008). Lectures are an example of teacher-centered instruction or traditional teaching.

*Teaching (instructional) strategies*: Teacher-centered or student-centered interactions between students and teachers used when teaching mathematics (NMAP, 2008).

## Assumptions

There were many assumptions in this study. The first assumption was that the teacher participants responded honestly to all surveys and questionnaires. Because I relied on teachers' self-reports, it was important for all teachers to respond honestly to the questions on the Survey Monkey survey. Chapter 2 includes literature on the validity of teachers' self-reports. Chapter 3 includes research literature on the validity and reliability of the survey instruments included in this research study.

I investigated whether teachers' personal theories of teaching and learning influenced the use of math interventions to support students with LD's learning within inclusive classrooms. An assumption inherent in the study was that the students identified as having an LD were identified accurately. Because I focused on students with LD, I assumed that the teachers were able to identify what students in their classrooms are identified as having LD.

## Limitations

The research study contained some limitations. Identified limitations may have influenced teachers' self-reported Survey Monkey responses. Teachers' limited knowledge of the math interventions identified in the study may have resulted in teachers not accurately responding to questions about intervention use. The Survey Monkey survey provided teachers with a detailed description of each of the math interventions. Although the teachers were provided with this description, it is possible that a teacher did not understand the definition of the math intervention.

Another limitation was teachers' self-reports of their classroom practices. I assumed that teachers accurately self-reported information pertaining to their classroom practices.

**Scope and Delimitations**

The scope of this research study included high schools in one Northeastern urban district in the United States. Terminology related to student-centered and teacher-centered instruction was used only to discuss how researchers define the two approaches in research on algebra instruction and students with LD. The research on student-centered instruction or constructivism and teacher-centered instruction or direct instruction is complex (NMAP, 2008). There is no agreed upon definition for these two teaching approaches (student or teacher-centered; NMAP 2008 Task Force; Schumacher & Kennedy, 2008). The term student-centered instruction or constructivism is often used as a phrase to describe all teaching characteristics where students have control over teaching (Schumacher & Kennedy, 2008). It is difficult to designate one approach (teacher- or student-centered instruction) as more beneficial than the other approach because researchers regard both teaching strategies (student- and teacher-centered) as effective instructional strategies for all students (NMAP, 2008). Chapter 2 provides additional information regarding how the terms align with the study's conceptual framework. Chapter 3 references the survey instrument used to collect teachers' self-reports of their instructional practices.

There are a few delimitations included in the research study. First, I only included teachers with experience teaching Algebra 1. Additionally, all teacher participants self-reported experience teaching in an inclusive classroom with students with LD. Another delimitation included the limited number of other factors that might impact a teacher's effectiveness, such as years of experience teaching algebra, gender, age, and ethnicity. Math interventions included in this research study were limited to the math interventions recommended for teaching Algebra 1 to students with LD (Class-wide peer tutoring, graphic organizers, concrete to abstract instructional approaches, graduated instruction, technology; Foegen, 2008; Strickland & Maccini, 2010).

## Significance

This study contributed to the literature on math instruction as I included information about what occurs in inclusion Algebra 1 classes. I found that teachers, regardless of self-reported theoretical framework of teaching and learning (simple, developed), use math interventions when teaching Algebra 1 to students with LD in an inclusive classroom.

Students with LD must have access to algebra. However, access is not enough. Students with LD must acquire the skills taught in algebra if they are to increase their odds of achieving postsecondary success. There are positive social implications of this research study. The more years of education a student has beyond high school increases his or her potential earning power. As the students' earning power increases, their economic status changes (Moses & Cobb, 2001).

The goal of this study was to examine the intersection between teachers' self-reported teaching beliefs, use of math interventions, and classroom practices. School districts and higher education instructions should provide teachers with professional development opportunities that inform teachers how personal theories of teaching and learning influence instructional decisions. The recommendations of this research study provide school districts and higher education institutions with information on the future steps that should be taken to ensure the achievement gap between students with and without LD.

**Summary and Transition**

Many graduation requirements include passing algebra (Impecoven-Lind & Foegen, 2010). This increased emphasis on math literacy affects students with LD who, as a result of IDEA (2004), receive the majority of their instruction in the regular education classroom (Impecoven-Lind & Foegen, 2010). When students with LD receive their algebra instruction in the regular education classroom, they are better prepared to pursue postsecondary programs (Steele, 2010). Although a significant number of students with LD fail algebra (Steele, 2010), an understanding of why students with LD fail algebra is essential. In this study, I examined teachers' self-reported use of math interventions when providing students with LD algebra instruction. Researchers have found that these math interventions improve the performances of students with LD in algebra. Teacher's personal theories of teaching and learning were examined to determine how these theories influenced teachers' reported use of math interventions and teachers' self-reported classroom practices.

Chapter 2 includes a presentation of a review of the literature. The conceptual framework, Fox's personal theories of teaching and learning, grounded this study and helps to create the context of the study. The chapter also includes a review of the literature focused on LDs, math instruction, personal teaching, and learning theories.

# Chapter 2: Literature Review

## Introduction

The purpose of this quasi-experimental study was to explore whether general education teachers' personal theories of teaching and learning influenced the math interventions used to teach Algebra 1 to students with LD. There is a need to understand the classroom practices that general education teachers use to assist students with LD's academic achievement in regular education settings. Regular education teachers' classroom practices are not supporting the academic needs of students with LD in the inclusive classroom (Meyen & Greer, 2010; Wadlington & Wadlington, 2008). According to Wadlington and Wadlington (2008), a majority of students with LD receive math instruction in a general education classroom with limited to no accommodations directed towards students with LD and by teachers who lack the skills and expertise in meeting their instructional needs. Meyen and Greer (2010) stated that high stakes assessments provide evidence that students with LD are not learning concepts taught in the regular education classroom. Additionally, according to a disaggregation of high stakes assessment data, there is an achievement gap between students with LD and their typical peers (Meyen & Greer, 2010). With the inclusion of more students with LD in the regular education classroom, teachers must continue to receive information that will help them to increase their effectiveness in providing instruction to students with LD that will result in improved academic achievement. However, some regular education teachers may not provide students with LD with appropriate classroom instruction (Meyen &

Greer, 2009). To increase students with LD's academic outcomes, regular education teachers must use interventions during class instruction (Deshler et al., 2008).

In the literature review, I will present the most current research on teachers' personal theories of teaching and learning related to students with LD. This section includes a discussion of the relationship between a teacher's personal theories of teaching and learning and the implementation of math interventions. The theoretical framework supporting this research study, Fox's (1983) personal learning theories, is analyzed, evaluated, and synthesized by presenting the origin of the theory, the definition of the theory, the literature analysis of the theory, and the rationale of why this theory was selected to support this research study. Additional topics related to math instruction and algebra interventions are also analyzed, evaluated, and synthesized. I describe how these studies related to this study, why and how other researchers approached the study of these topics, a justification for including the selected literature, and a review and synthesis of the literature.

## Literature Search Strategy

Selected studies were from scholarly, peer-reviewed journals dating from 1986 to 2015. All of the studies I chose included a focus on students with LD, teachers' theories of teaching and learning, and math interventions. Walden University's library databases were used to complete this research study. Electronic search engines accessed to find literature pertaining to this topic included SAGE journals, ERIC, Education Research Complete, and Walden University's dissertations and theses search engine, which is supported by Proquest.  Google scholar was also a resource used to gather information about the conceptual model.

Articles were selected if they addressed one of the topics of the study, students with LD, mathematics instructional practices, and teachers' personal theories of teaching and learning.  To locate research literature, the following combination of search terms were used: *LDs, high school students, characteristics, math, math instruction, math skills, direct instruction, student-centered instruction, algebra, teachers' beliefs, teacher practices, interventions,* and *teachers' personal and learning theories*.  In this study, the literature search terms for teachers' personal theories of teaching and learning focused on two instructional models (teacher-centered or direct instruction and student-centered instruction).  By limiting terms to these two instructional models, I focused on how teachers' personal theories of teaching and learning develops from both internal factors (such as beliefs), external factors (such as curriculum, time), and district mandates (such as standardized testing).  The intent of this study was to identify a teacher's theoretical framework of teaching and to investigate whether a teacher who employs this theoretical framework is more likely to use math interventions.

**Fox's Personal Learning Theory**

The theory applied in this research study was Fox's (1983) personal learning theory.  According to Fox, as individuals, each teacher possesses a theory about teaching and learning.  To elaborate on the concept of a teacher's theory of teaching and learning, Fox developed four personal learning theories.  Each one of these theories includes the relationship between a teacher's personal theory of what teaching is, what learning is, and instructional practices are. The four personal learning theories are the transfer theory, the shaping theory, the travelling theory, and the growing theory. According to Fox, a teacher's response to the question, what is teaching, informs the teaching and learning that will occur within the teacher's classroom (p. 152). A teacher's personal theory of teaching and learning affects instructional decisions made or not made in the teacher's classroom. Fox categorized the personal learning theories as simple and developed theories. In this study, I explored whether teachers' philosophical beliefs about teaching and learning influenced their self-reported use of math interventions when teaching algebra to students with LD in regular education classrooms.

**Simple Theories and Developed Theories**

Fox (1983) categorized four personal learning theories into two categories: simple theories and developed theories. Fox's personal learning theories are used to determine whether a teacher assumes responsibility for his or her student learning. The question is whether teachers feel their actions (taken or not taken) influence student learning. In simple theories, the teacher believes that teaching concepts automatically leads to student learning. These teachers feel that students who have not acquired the information taught are unmotivated or lack the skills necessary to learn the information being taught. In Fox's transfer theory, responsibility for student learning occurs before teaching; in Fox's shaping theory, responsibility for student learning occurs during learning.

In the developed theories, the student is viewed as partnering with the teacher to determine and define the learning outcomes about the experiences and needs of the student (Fox, 1983). In the simple theories, the learning outcomes are already predetermined. With the developed theories, the teacher uses and applies his or her expertise of the subject matter in a manner that will make the learning meaningful for the students. Teachers who teach using the developed theories are open to leaving room for uncertainty during lesson implementation. Teachers who teach from the developed theoretical framework do not expend a great deal of time and energy on lesson planning. Teachers who meet Fox's developed theoretical framework remain open to what occurs during the learning process, make changes and modifications during the learning process, and regularly monitor and assess students' learning and adjust accordingly.

**Transfer Theory**

Fox (1983) used the transfer theory to describe teachers who believe that knowledge is a commodity that can transfer from one object to another. Teachers who adopt this personal learning theory believe that knowledge is information that can transfer from one person (the teacher) to another person (the student). These teachers focus on the "what" and "how" of knowledge with little to no attention to what happens to this knowledge received by the student. There is an emphasis on the knowledge that students will receive, and the instructional practices chosen to deliver this knowledge will have a direct impact on students' academic learning, needs, interests, and future endeavors.

Blame associated with students not demonstrating possession of the knowledge imparted to them is attributed to the student because the teacher crafted and planned the lesson, and the choice of delivery was exemplary (Fox, 1983). The classroom lecture is an example of the transfer theory. During a classroom lecture, the teacher is making complex knowledge less complex and manageable (Fox, 1983). Fox (1983) suggested that there are two ways to view the transfer theory and its formation into a teacher's personal learning theory. At one spectrum, the teacher views him or herself for being primarily responsible for students' understanding of this complex knowledge and selects a delivery method to impart the knowledge so that it is less complex. At the other end of the spectrum, the teacher teaches the content, and the student must assume responsibility for demonstrating an understanding of the content.

**Shaping Theory**

Fox's (1983) shaping theory is used to describe teachers who allow students the opportunities to make their own connections. A connection occurs when there is a relationship between the information taught and students' experiences. The shaping theory is supported by behaviorists who focus on learning and metacognition (Fox, 1983). An example of the learning environment of the shaping theory is the lecture hall or a laboratory where students engage in completing science experiments. The processes involved in the shaping theory include the teacher presenting students with problems and case studies, solving case studies and problems, and then requiring students to apply the information learned to a new set of problems and or case studies independently.

**The Travelling and Growing Theories**

The travelling theory includes a focus on the subject taught. Teachers who teach from this theoretical framework have knowledge of their subject matter and the various approaches for assisting students with acquiring this knowledge (Fox, 1983). Even with this knowledge, they recognize that teaching and learning are changing, so they remain open to learning new approaches and information to help their students acquire knowledge. This teacher knows that his or her students bring different perspectives to the learning experience and is open to learning new insights and considering information from a different perspective, even if suggested by their students.

The teacher who teaches from the growing theoretical framework is similar to the teacher who teaches from the travelling theoretical framework with the exception that there is more of a focus on the student. These teachers are concerned about what is happening to the student during the learning process, such as whom and what the learner is becoming as a person as they acquire new knowledge (Fox, 1983). In this study, I categorized teachers as having either a simple or developed theoretical framework of teaching and learning.

**Literature and Research-Based Analysis of the Theoretical Framework**

Fox (1983) suggested that the responses received by teachers to the question "what is teaching?" inform their personal theories of teaching and learning. Higher education institutions use Fox's question collect data about teachers' beliefs about teaching and learning (Kane, Sandretto, & Heath, 2002, p. 199). In a comparative analysis involving three teachers, Burnard (2004) applied Fox's personal theories of teaching and learning to capture information pertaining to teachers' and students' views about what defines learning. Using Fox's personal theories of teaching as a data collection method, Burnard designed categories for each of the four theories and recorded students' and teachers' responses about their experiences of learning in Fox's categories.

Kennedy and Deshler (2010) used Fox's (1983) personal theories of teaching and learning as one of the four principles to support the rationale for a conceptual framework designed to improve literacy instructional outcomes for students with LD. By using technology within a tiered instructional model (RTI), students with LD's literacy outcomes improved. Referring to Fox's personal theories of teaching as the enzymatic theory of teaching (ETE), Kennedy and Deshler suggested that students with LD need student-centered instruction to facilitate, enhance, and improve their cognitive processes and motivation (p. 295). Teachers who ascribe to Fox's developed theories provide students with instruction that is student-centered. However, Kane et al. (2002) believed that the methods employed in Fox's theoretical framework were not appropriate.

**Criticism of Fox's Theoretical Framework**

Kane et al. (2002) stated that the methods employed by Fox (1983) to gather information about teachers' beliefs and practices were flawed (p. 177). Kane et al. criticized contemporary literature's overemphasis and reliance on Fox's personal theories of teaching (p. 199). Kane et al. cited Fox's failure to disclose the methodology used and the number of teachers who participated in the study as the reason why the researchers considered the framework flawed (p. 196). Additionally, Kane et al. criticized Fox's research, which was built around teachers' responses to the question, what is teaching, problematic due to the lack of depth and simplicity of a single question (p. 199). Kane et al. outlined the inappropriateness and ineffectiveness of using Fox's litmus test of what is teaching as a sole indicator of a teacher's instructional practice. According to Kane et al., the response a teacher gives to the question, what is teaching, does not provide sufficient information to define a teacher's personal theory of teaching and learning. There are many other factors that determine a teacher's instructional practices (Kane et al., 2002).

Fox (1983) agreed that the process of teaching and learning is an abstract concept that is difficult to define. Researchers who referenced Fox's theoretical framework for teaching and learning discussed the model at the postsecondary level in higher education institutions. Although the questioning involved in Fox's conceptual framework is abstract, asking teachers what teaching is provides teachers an opportunity to share their understanding of what their role is in the classroom as it relates to teaching and learning (Fox, 1983).

In this study, I examined whether algebra teachers' personal theories of teaching and learning influenced their self-reports of math intervention(s) use during instruction. Additionally, I examined whether a teacher’s theoretical framework of teaching and learning (simple, developed) influenced his or her self-reported classroom practices. I used Fox's (1983) conceptual framework as a support. Fox addressed the need for teachers to consider what they are doing when they are teaching. As a part of this retrospection process, Fox did not suggest the superiority of either of the two theoretical frameworks. However, Fox suggested that teachers who exhibit a developed theoretical framework of teaching and learning are better positioned to use instructional approaches that address students' intellectual growth and development. Fox also acknowledged that during a teacher’s teaching career, the teacher’s theoretical framework of teaching might change.

**Transforming From a Simple to Developed Theory**

The transformation from simple theories to developed theories occurs when a teacher realizes that he or she cannot do the learning for his or her students (Fox, 1983).

Fox (1983) concluded that, for most teachers, this revelation occurs when faced with trying to identify strategies to motivate unmotivated students. These teachers realize the key to teaching unmotivated students is not by dictating the relevancy of the information taught, but through the process of helping students make personal connections with the learning. Some teachers do not have an awareness of their personal theories of teaching and learning.

**Teachers' Awareness of Their Personal Theories of Teaching and Learning**

Teachers may have limited or no knowledge of their personal theories of teaching and learning. A teacher's awareness of his or her personal theories of teaching and learning and its effects on teaching and learning can begin the process of improving teaching and learning (Zaki, Rashidi, & Kazmi, 2013). Teachers must be knowledgeable about what instructional approaches are necessary for improving teaching and learning within their classrooms (Zaki et al., 2013). Zaki et al. (2013) designed a theoretical model to describe teacher and student actions exhibited and displayed at each one of Fox's personal learning theories. The purpose of Zaki's et al.'s model is to illustrate to teachers where they and their students are performing on a continuum and the next steps required improving teaching and learning. Teachers must have opportunities to reflect on their personal growth and development.

**The Theoretical Framework and Teacher- and Student-Centered Instruction**

Over time, teachers may progress from simple to developed theoretical frameworks of teaching and learning. As a teacher's beliefs progress from simple to developed theoretical frameworks of teaching and learning, his or her personal theories of teaching and learning move from more traditional approaches of teaching and learning to student-centered approaches of teaching and learning. In this study, a measurement scale, the TCPS, was used to determine teachers' personal theories of teaching and learning. This measurement scale allowed teachers to self-report their classroom practices as either teacher (simple) or student-centered (developed).

Because Fox's (1983) research was conducted at the higher education level, the application of Fox's frameworks at the secondary level is unknown. In this study, I explored which theoretical framework of teaching and learning secondary algebra teachers used when delivering instruction. I also examined whether a teacher's theoretical framework of teaching and learning influenced how a teacher self-reported math intervention(s) use when teaching algebra to students with LD.

**The Theoretical Framework and Students' With Learning Disabilities**

In the general education classroom, students with LD must receive instruction in a learning environment that provides them with appropriate access to curriculum and resources (Deshler et al., 2008). As teachers grapple with how to meet the diverse learning needs of their students, they must identify multiple strategies that will meet the learning needs of all students, including students with LD (Deshler et al., 2008). In this study I examined whether a teacher's personal theory of teaching and learning (teacher/simple or student-centered/developed) influenced a teacher's self-reporting of math intervention(s) us, and the teacher's self-reported classroom practices.

**The Theoretical Framework in the Research Study**

In this study, algebra teachers of students with LD answered questions that defined their role as teachers who ascribes to a simple or developed theoretical framework. The information gleaned from this questionnaire was compared to teachers' self-reports of math intervention use, if any, and teachers' self- reported classroom practices. The intent of this study was not to establish the superiority of either of the two theoretical frameworks– simple or developed. Instead, this information was used to analyze the effects of Fox's (1983) theoretical frameworks and the absence or presence of math interventions.

## Students with Learning Disabilities

A student with LD is considered to have a psychological processing disorder that affects the student's academic ability in math, reading, writing, listening, or speaking (IDEA, 2004). Students with LD may exhibit difficulty in one or more of these areas (math, reading, writing, listening, or speaking). A planning and placement team (PPT), consisting of school personnel, the child's parents, and in some cases outside community organizations, determine if a student has LD. At the PPT, the team decides whether the student has a disability. Another purpose of the PPT is to establish goals and objectives for the students and to develop a special education service delivery model that identifies the types of services the student will receive, who will provide the service, and the setting where the student will receive services. The team will also identify what types of accommodations and modifications are necessary to address the student's learning needs. Information discussed at the PPT is recorded on an individual education plan (IEP). The

IEP is the blueprint designed to improve the student's learning in the identified area(s) of weakness(es).

In the area of mathematics, the academic performance of students with LD is typically lower than nondisabled peers (Shifrer, Callahan, & Muller, 2013). When entering high school, students with LD often test into lower level math classes. These lower level math placements are less rigorous than college preparatory classes. Not receiving college preparatory math instruction impedes students with LD's ability to succeed in college math courses. Students with LD must receive their algebra instruction in the regular education classroom (Steele, 2010). When students with LD receive algebra instruction in the regular education classroom, they have opportunities to learn necessary concepts that are prerequisite skills for postsecondary college math classes.

**Math Ability of Learning Disabled Students**

Deficits in math ability and performance result in schools enrolling students with LD in lower level high school math classes. In mathematics, students with LD's math growth trajectories start to decrease at age 13 (Wei, Lenz, & Blackorby, 2012). Wei et al. (2012) examined national math growth trajectories of students by disability, race, gender, and socioeconomic status. Participants in this study were students with LD ranging from ages 7 to 17. Over 40% of the participants had LD. The Woodcock-Johnson III (WJ III) applied problems and calculations subtests were used to measure students' math growth trajectories. In the results of the WJ III, Wei et al. indicated on average at age 12.67 students with LD scored 7.08 points higher on the calculations subtest than the applied problems subtest (p. 162). The applied problems subtest has more literacy demands compared to the calculations subtest. Students with LD found the applied problems subtest more challenging because the test had more literacy demands compared to the calculations subtest that has fewer literacy demands. As the mathematics becomes more challenging, students with LD's math growth trajectories start to plateau. At the secondary level, students with LD may find math more challenging as the literacy demands of the math classes start to increase.

Learning deficits in reading, writing, language, and processing contribute to students with LD's difficulties with algebra (Steele, 2010). For example, difficulties in reading may result in students not understanding algebra problems. Writing deficits might interfere with students' ability to provide a written response that demonstrates their understanding of the problem. Language difficulties might prevent a student from responding orally to questions raised in class. Problems with processing might distort what a student hears and sees. Reading, writing, language, and processing are all areas that might prevent students with LD from performing well in algebra. To compensate for these learning deficits, algebra teachers of students with LD must understand how these learning deficits interfere with learning and provide students with avenues to overcome these learning challenges (Steele, 2010).

In algebra, there are three areas where students with LD might have difficulty learning algebra (Impecoven-Lind & Foegen, 2010). These three areas are cognitive processing, content foundations, and algebra concepts (Impecoven-Lind & Foegen, 2010). For example, cognitive processing includes a focuse on a student's attention, memory, language, and metacognition abilities (Impecoven-Lind & Foegen, 2010). A student who has attention issues may have trouble persevering when required to solve multistep problems (Impecoven-Lind & Foegen, 2010). If a student has problems with memory, the student might experience difficulty recalling previously learned concepts. When students have difficulties in language processing, these difficulties might preclude the student from understanding mathematic language (Impecoven-Lind & Foegen, 2010). This differs from having metacognition deficits. Students with metacognition deficits might have difficulty in knowing how to solve algebra problems (Impecoven-Lind & Foegen, 2010). In addition, after solving the problems, students with metacognition deficits may not recognize the reasonableness of the math solution (Impecoven-Lind & Foegen, 2010).

Another area of algebra where students with LD experience academic difficulty is with content foundational skills (Impecoven-Lind & Foegen, 2010). Students with LD have trouble learning algebra when they lack content foundational skills (content knowledge, procedural processing, and conceptual knowledge; Impecoven-Lind & Foegen, 2010). When faced with solving mathematical problems, students must demonstrate an ability to recall previous learning. Impecoven-Lind and Foegen (2010) referred to this learning as declarative knowledge. Students must know how to retrieve previously learned information with fluency and automaticity. Procedural processing is the process of retrieving previous learning and using this information to solve new problems (Impecoven-Lind & Foegen, 2010). Having difficulty retrieving previous learning with fluidly and automaticity results in a student having procedural deficits (Impecoven-Lind & Foegen, 2010).

Algebra concepts is a third area of algebra that students with LD find challenging (Impecoven-Lind & Foegen, 2010). Deficits in conceptual knowledge hinder a student's ability to learn algebra (Impecoven-Lind & Foegen, 2010). A student with LD who has deficits in algebra concepts finds it difficult to understand the relationship between mathematical functions and symbols (Impecoven-Lind & Foegen, 2010).

Students with LD may have deficits in reading, writing, language, and processing that make it challenging to learn algebra (Steele, 2010). To learn algebra, students with LD must demonstrate proficiency in cognitive processing, content foundational skills, and algebraic concepts (Impecoven-Lind & Foegen, 2010). Teachers must understand the challenges that students with LD have with learning algebra (Impecoven-Lind & Foegen, 2010; Steele, 2010). If students with LD are to succeed in the general education classroom, algebra teachers must deliver instruction that help students with LD overcome learning challenges (Impecoven-Lind & Foegen, 2010; Steele, 2010).

Other researchers (e.g., Shifrer, 2013; Shifrer et al., 2013) have noted common characteristics of secondary students with LD. These common characteristics contribute to their low academic performance. Negative attitudes toward academics and low expectations of parents and teachers are also other factors that affect students with LD's academic performance (Shifrer, 2013; Shifrer et al., 2013).

**Characteristics of Secondary Learning Disabled Students**

Secondary students with LD have common characteristics that affect their learning performance. Shifrer et al. (2013) investigated the effects of the LD label on students' academic outcomes by socioeconomic status. The labeling rheory conceptual framework was used in the study to compare course-taking outcomes of students with LD to students without LD to compare course-taking gaps between the two groups of students. The data source for this study was the Educational Longitudinal Data (2002). Shifrer et al. found that students with LD have more disadvantaged backgrounds, are significantly poorer, and start high school in lower level math and science courses. Students with LD also have negative attitudes toward academics, fail to obtain the required credits for graduation, and take fewer college preparatory courses. These findings were consistent across socioeconomic status. Students with LD received limited course-taking opportunities compared to students without LD.

There are numerous implications for practice mentioned in the study (Shifrer et al., 2013). First, if students with LD are to achieve postsecondary success, schools must enroll this group of students in college preparatory courses. Second, educators must become knowledgeable about the intellectual ability of students with LD so that this group of students receive placement in classes based on their potential and not their label. Although it is important for teachers to increase their understanding of students with LD's learning needs, teachers must also understand how their perceptions influence students with LD's learning outcomes.

**Teachers' and Caretakers' Perceptions of Learning Disabled Students**

Students with LD are not the only individuals who have low expectations of their learning outcomes. Parents and caretakers often also have low expectations for students with LD's academic performance. Shifrer (2013) examined the effect of a student's label of LD on the expectations of parents and teachers. The data source for this study was the

Educational Longitudinal Data (2002). Shifrer examined how the label of LD influenced individuals' perceptions of the students, including the students' perceptions of themselves. Shifrer found that parents and teachers had lower expectations of students with LD compared to students without LD. These attitudes were not a result of students with LD's academic performance, but a result of their LD label. Students with LD are more likely to be socially disadvantaged, have poorer academic histories, poor academic behavior, and possess a negative attitude towards learning. Shifrer also indicated that parents and caretakers of students with LD had low academic expectations for their students. As a result of the low expectations set by themselves and others, students with LD create self-fulfilling prophecies that ultimately affect their academic outcomes (Shifrer, 2013; Shifrer et al., 2013). In high schools, students with LD enroll in classes that do not prepare them to attend a postsecondary institution (Shifrer et al., 2013). Additionally, many students with LD fail to meet graduation requirements (Shifrer et al., 2013).

If students with LD are to achieve postsecondary success, they must receive the same learning opportunities as students without disabilities. Providing students with LD similar opportunities as students without LD might change these students' attitudes towards learning. Teachers and parents also play a role in this process. Teachers must understand how their expectations of students with LD affect their expectations. Teachers must also understand how their personal theories of teaching and learning influence their instructional decisions. In this study, I investigated how regular education algebra teachers' personal theories of teaching and learning influenced their self-reports of math intervention(s) use when teaching algebra to students with LD and their self-reported classroom practices.

## Teachers' Personal Theories of Teaching and Learning

A teacher's personal theory of teaching and learning either places the content at the center of instruction or the student at the center of instruction. The teacher who elects to use a more teacher-centered approach places the content at the center of instruction. In a teacher-centered environment, students learn content knowledge through the process of information being transmitted from the teacher to the student. This approach differs from a student-centered approach. In the student-centered approach, the teacher delivers the content information through the process of student discovery and exploration. A teacher’s beliefs and attitudes towards teaching and learning determine whether they use a teacher-centered or a student-centered approach to teaching and learning (Cross, 2009; Fives & Buehl, 2014; Patchen & Crawford, 2011; Stemhagen, 2011).

Collins and Pratt (2011) stated that teachers are increasingly being asked to describe and reflect on their approaches to teaching. According to Collins and Pratt, instruments such as the Teaching Perspectives Inventory (TPI) are effective tools for collecting teachers’ self-reports of their teaching practices. Previously, researchers used complex processes such as extensive interviews, observations, and analyses to capture information about teacher practices. According to Collins and Pratt, the TPI is classified as a good or satisfactorily reliable and valid testing instrument to measure teachers’ qualitative characteristics. Similar results were found with the TCPS (Walker, 1999). Walker (1999) used the TCPS to collect data on teachers’ self-reports of classroom practices in math classrooms. The TCPS was the testing instrument used in this research study. Fox (1983) stated that a teacher's response to the question what is teaching determines the teacher's personal theories of teaching and learning. In this study, Algebra 1 teachers' responses to questions on the TCPS were used to categorize their theoretical framework of teaching as either teacher-centered (simple) or student-centered (developed).

Despite the validity and reliability of these testing instruments, the results of whether teachers provide correct self-reports on surveys is mixed (Kaufman & Junker, 2011). In a study designed to determine the accuracy of teachers' self-reports of their classroom practices, Kaufman and Junker (2011) found that a teachers' level of proficiency (based on teachers' observation ratings) in regards to instructional practices influenced the accuracy of their self-reports on teacher surveys. Teachers with low levels of proficiency were more likely to overestimate their teacher practices, whereas teachers with high levels of proficiency underestimated their teaching practices. Only teachers with medium levels of proficiency accurately completed self-reports that aligned with their teaching practices. To compensate for this discrepancy in this study, the teachers signified that the information that they were providing on their self-reports was accurate. The accuracy of teachers' self-reports was also identified as an assumption where I stated that it was assumed that teachers responded honestly to survey questions. The accuracy of teacher's self-reports was also identified as a limitation where it cannot be confirmed with 100% accuracy that teachers responded accurately to TCPS survey.

A varied list of factors influences a teacher's beliefs and attitudes about teaching and learning. Researchers (Cross, 2009; Fives & Buehl, 2014; Patchen & Crawford, 2011; Stemhagen, 2011) described how teachers' personal theories of teaching and learning are influenced by what they teach, who they teach, years of experience, and whether teaching is considered an innate ability or a skill to learn. Each of these scholars provides recommendations that schools and researchers conduct additional research on the role of teacher's beliefs and their influence on teacher's instructional decisions. Schools should provide teachers with professional development opportunities that will lead to opportunities for teachers to change their personal theories of teaching and learning.

**Teachers' Beliefs about Teaching Mathematics**

Cross (2009) investigated the relationship between teachers' mathematical beliefs, instructional practices, and the impact of teachers' beliefs on teachers' implementation of math reform practices. Qualitative data collection methods and analyses were used to capture information about the relationship of five ninth grade algebra teachers' beliefs and the implementation of math reform practices. This study was part of a larger study where all of the participants received professional development on increasing students' engagement with writing and discourse tasks. Cross indicated that factors such as the years of experience, the type of class taught, and the teachers' beliefs about what is the study of mathematics influenced the algebra teacher's instructional decisions. Teachers with less than 2 years of teaching experience described mathematics as procedures, formulas, and calculations. Although all the teachers in the study received professional development on how to increase students' engagement in writing and discourse tasks, this group of teachers continued to teach using an initiate-response-evaluate (IRE) model.

Cross (2009) found that teachers with more than 3 years of experience described mathematics as involving mental processes and activities. These teachers classified themselves as facilitators of instruction in the classroom and described their classes as environments where students are engaged and take responsibility for their learning. However, in observations, Cross found inconsistencies in teachers' assessments of themselves and their actual instructional practices. For one of the two veteran teachers, factors such as the type of math class taught and student ability determined the extent to which the teacher provided opportunities for students to become more engaged in student-centered activities. This teacher felt that students in lower level math classes should receive more of a traditional approach to teaching and learning.

There are other factors that influence how teachers provide instruction (Cross, 2009). Cross (2009) claimed that one of the teachers reported it challenging to teach a diverse group of students in one classroom. This teacher explained that a teacher-centered instructional approach is better for this type of learning environment. Other teachers used teacher-centered instruction because they felt this approach was appropriate for the learning needs of low ability math students (Cross, 2009). All but one of the teachers stated that they do not align their instruction with math reform practices. Cross suggested that teachers use math reform practices to provide students with more opportunities to engage in problem-solving, reasoning, and cognitive processes.

There are many factors that influence teachers' personal theories of teaching and learning (Cross, 2009). Teachers who provided teacher-centered instruction are teachers who teach from the simple theoretical framework. These teachers provide instruction in an environment where students are passive recipients of math procedures, formulas. and calculations. Additionally, these teachers view their roles as having the mathematical knowledge to make sure that students learn mathematical procedures, formulas, and calculations through practice. Teachers who provide student-centered instruction teach from the developed theoretical framework. These teachers believe that students must have authentic learning opportunities that allow them to become mathematical thinkers who can develop their ideas about math.

**Beliefs about Teaching Ability**

Fives and Buehl (2014) examined whether teachers viewed teaching as a skill to learn or an innate ability. To collect data on teachers' views about teaching (an innate skill or a skill to learn), 443 teachers from various grades and content areas completed the Teaching Ability Beliefs Scale (TABS). A second scale, The Importance of Teaching Knowledge Scale (ITKS), was used to measure the value teachers placed on teaching knowledge. The ITKS measured the following factors: knowledge of students, learning, and motivation (SL&M), content and pedagogical content knowledge (C&PC), knowledge of theory (theory), strategies over theory (SoT), and instructional practices and classroom management (IP&CM). A Fives and Buehl grouped teachers' beliefs about teaching ability into four groups: hybrid (innate and learned), required polish, learned, or innate. Fives and Buehl found that the majority of teachers considered teaching a skill to learn. Fives and Buehl stated that if teachers are to improve teaching and learning for students with LD, they must demonstrate a willingness to learn strategies that will result in positive academic outcomes. When designing professional development to increase teachers' capacity, schools must consider whether teachers view teaching as an innate skill or a skill to learn (Fives & Buehl, 2014). Schools must understand that not all teachers consider teaching as a skill to learn. Teachers who feel that teaching is an innate ability may not find professional development designed for learning new instructional strategies meaningful (Fives & Buehl, 2014). For this group of teachers, schools and districts must identify strategies on how to motivate teachers that feel teaching is an innate ability.

**Teachers' Perceptions of Classroom Practices**

Patchen and Crawford (2011) examined the relationship between teachers' perceived role of themselves in the classroom and their instructional practices. Thirty-two teachers (30 elementary teachers, one physical science, and one music teacher) who enrolled in a graduate-level education course (The Study of Teaching) participated in the study. In The Study of Teaching course, students described who they are as teachers, their practices, and the impact these practices have on instruction. The students wrote story narratives using metaphors to describe their role as a teacher. Patchen and Crawford found that teachers described teaching as a process that led to an outcome or goal. These methods resulted in two outcome themes: teacher outcome or student outcome. Teachers who held perceptions that teaching led to student outcomes have constructivist beliefs about teaching and learning. Nineteen of the 32 teachers fit this category (Patchen & Crawford, 2011, p. 290). This group of teachers felt that the role of the teacher and the student is to achieve the learning goals established by the teacher. Teachers who held perceptions that teaching led to teacher outcomes have behaviorist beliefs about teaching and learning. The remaining 13 teachers were in this category (Patchen & Crawford, 2011, p. 290). Teachers holding a behaviorist view of teaching indicated that students were minimally responsible for meeting learning goals.

Patchen and Crawford (2011) used the same data analysis to determine additional themes. This second level of analyses resulted in two additional themes: instructional practices acquisition or participation learning processes. Teachers who held instructional practices acquisition completed narratives that included metaphors that described their role as primarily being the person responsibility for the growth and development of students' learning. Teachers who held participation learning processes' narratives included metaphors that described a shared responsibility (between teacher and student) for the growth and development of the student's learning. Patchen and Crawford found that 24 teachers met the acquisition-based category (p. 292). Thirteen of the teachers in the acquisition-based category were initially in the teacher outcome category (Patchen & Crawford, 2011, p. 292). Patchen and Crawford indicated that 11 of the teachers in the first analysis viewed teaching and learning from the perspective of student outcomes (constructivist teaching). However, in the second analysis, the same group of teachers indicated that they had an acquisition-based philosophy, which is more teacher-centered or aligned with behaviorist beliefs (Patchen & Crawford, 2011, p. 292).

Patchen and Crawford (2011) identified challenges that might influence a teacher's instructional decisions. The factors that were considered possible challenges for teachers were curriculum standards and accountability, student diversity and special education, professional development, multiple duties and roles, and discipline and classroom managements. Teachers considered each of the identified factors a challenge. Results were curriculum standards and accountability (*n* = 24), student diversity and special education (*n* = 24), professional development (*n*= 9), multiple duties and roles (*n*= 7), and discipline and classroom management (*n* = 6; Patchen & Crawford, 2011, p. 293). When considering these challenges, it is possible that discrepancies between teachers' perceptions of what teaching is and their instructional practices might be a result of the factors teachers find challenging.

Patchen and Crawford (2011) revealed teachers' desire to teach from a developed theoretical framework of teaching. Teachers want to increase the level of student engagement in their classrooms and give students more ownership and responsibility for their learning (Patchen & Crawford, 2011). However, pressures to teach the curriculum and to prepare students for standardized testing prevents teachers from providing a more student-centered learning environment. Teachers also felt that the inclusion of students with special needs within the regular education classroom prevented them from providing student-centered instruction. To address these concerns, schools should help teachers balance between teaching to the curriculum, preparing students for standardized assessments, and delivering meaningful instruction (Patchen & Crawford, 2014).

**Relationship between Teachers' Beliefs and Instructional Practices**

Stemhagen (2011) conducted a nonexperimental research study on the relationship between teachers' beliefs and mathematical instructional practices. The three instructional practices studied were transmittal, constructivist, and democratic classroom practices. The study's conceptual framework consisted of a web system of beliefs of teachers' background characteristics, content knowledge, attitudes, instructional beliefs, and instructional practices. The study included a web system of beliefs as opposed to a linear design because it is difficult to determine what set of teacher's beliefs influences a teacher's instructional practice. The study's participants, 323 Grades 4 and 5 and Grades 7 and 8 teachers, completed an on-line survey to collect data based upon on a web system of teacher's beliefs- nature of math (absolutist), nature of math (constructivist), constructivist pedagogy, transmittal pedagogy, and democratic pedagogy. Grade 6 teachers were excluded from the study because the intent was to examine differences and similarities between teachers' results of elementary and middle schoolteachers. Stemhagen indicated that elementary teachers and teachers having math specialist training held more of a constructivist belief of mathematics and engaged in constructivist instructional practices. Middle school teachers held more of an absolutist belief about mathematics teaching and engaged in more transmittal instructional practices. In some instances, there was a misalignment between a teacher's beliefs and the instructional practices employed in the classroom. These teachers indicated that their beliefs aligned more with the constructivist approach to teaching; however, their instructional practices aligned with the transmission model of teaching. A possible reason for the misalignment is that teachers may implement a teacher-centered teaching model because they find it challenging to implement a student-centered teaching model.

In addition, Stemhagen (2011) indicated that there are correlations between having an absolutist philosophy of mathematics and transmittal teaching practices. Stemhagen did not indicate a strong correlation between a constructivist philosophy of teaching mathematics and constructivist teaching. Teachers' philosophical beliefs of mathematics were not a focus of this study. In this study, I explored if how a teacher classifies his or her personal theories of teaching and learning (student- or teacher-centered) influences self-reporting of the use of math interventions. By examining teachers' personal theories of teaching and learning and the influence these theories have on the use of math interventions, I examined whether there was a relationship between teachers' personal theories of teaching and learning and the use of math interventions.

**Factors That Influence Teachers' Personal Theories of Teaching and Learning**

It is difficult to pinpoint the exact factor that influences a teacher's instructional practice. Factors such as gender, years of experience, schooling, and other factors may influence a teacher's instructional practices (Stemhagen, 2011). For algebra teachers, factors, such as the students' ability level, the type of math class (algebra versus geometry), and the extent to which the class includes multiple ability groupings, influence a teacher's instructional decisions (Stemhagen, 2011). Some teachers' instructional practices are influenced by whether they view teaching as an innate ability or a skill to learn (Fives & Buehl, 2014). For other teachers, multiple challenges such as curriculum and teaching students with special needs influences their instructional decisions (Patchen & Crawford, 2011). These influences make up teachers' personal theories of teaching and learning, which ultimately dictate a teacher's instructional practice (Cross, 2009; Fives & Buehl, 2014; Stemhagen, 2011).

Because there are multiple factors that may influence teachers' instructional practices, teachers often have multiple belief systems operating simultaneously (Fives & Buehl, 2014). A teacher's personal theory of teaching and learning is the actual instruction that he or she delivers in the classroom. Because how a teacher teaches influences students' learning outcomes, it is important for researchers and schools to consider what influences a teacher's beliefs and attitudes towards teaching and learning. This study added to the literature on what influences teachers' instructional practices through an examination of the relationship between algebra teachers' personal theories of teaching and learning, teachers' self-reported use of math intervention, and teachers' self-reported classroom practices.

## Math Instruction

In the majority of schools, teachers employ outdated methods of instruction that will not prepare students to compete in a global society (Thompson & Ongaga, 2011). In the area of math instruction, the news is even more disturbing. This research study was not designed to address the debate of what teaching strategies (student- or teaching-centered) are most appropriate for teaching algebra. Additionally, this research study was not designed to address the debate of what teaching strategies teachers should use when delivering algebra instruction to students with LD. This section was included to present the debate surrounding what instructional strategies are most appropriate for teaching math and to students with LD.

One argument is that teachers should seek to deliver a balanced approach to teaching and learning that includes both student- and teacher-centered instruction (Boaler, 2008; Riccomini, 2010). Math teachers should not waste time deciding which approach (teacher- or student-centered instruction) is more meaningful (Boaler, 2008; Riccomini, 2010). Researchers (Boaler, 2008; NMAP, 2008; Riccomini, 2010) recommend a balanced approach to teaching; however, in practice, evidence of a teacher-centered instruction is more prevalent in the classroom (Cole & Washburn, 2010; Thompson, 2009). Teachers' definitions of what it means to teach mathematics may affect teachers' instructional practices (Cooper & Null, 2011).

**Mathematical Teaching**

According to Cooper and Null (2011), mathematicians can either be categorized as having a deductive approach to mathematics teaching or an inductive approach to mathematics teaching. Teachers who adopt a deductive approach to mathematics teaching believe that math should be taught and learned as a set of rules and procedures to be followed and memorized. Fox (1983) described the instructional practices of the deductive approach as simple theories. Teachers who take an inductive approach to mathematics teaching feel that math should be taught and learned by providing students with authentic learning experiences that require students to arrive at their own rules and procedures for solving problems. Fox described the instructional practices of the inductive approach as developed theories. The deductive approach places the content in the center, while the inductive approach places the student and their learning needs in the center.

**Math Instruction for Learning Disabled Students**

There is quandary between the recommendations of how to deliver math instruction and the recommended practices for teaching students with LD (Cole & Wasburn, 2010). Math educators are advised to provide more student-centered teaching and learning. However, the recommendations for how to instruct students with LD calls for more direct instruction (Cole & Washburn, 2010). The problem with direct instruction is that this form of instruction places a low demand on the student (Cole & Wasburn, 2010). This low demand limits students with LD's ability to apply critical thinking skills. Critical thinking skills help students to solve complex problems, which are an asset for postsecondary (Cole & Washburn, 2010).

In the inclusion math classroom, teachers must provide students with LD a balanced approach of instruction. When appropriate and necessary, teachers must use direct instruction to help students with LD acquire and gain access to the learning occurring in the inclusion mathematics classroom. Direct instruction is an instructional strategy where the teacher has the most control over the learning. With direct instruction, the goal is the transmission of information (Gersten & Keating, 1987, p. 78). According to Gersten and Keating (1987), direct instructional strategies are structured lessons that allow teachers to immediately assess and mediate students' learning. Teachers should also build in opportunities for students with LD to stretch their learning through activities and lessons that require problem solving and discovery learning (Hill, 2010).

To improve students with LD's academic outcomes, some researchers suggest that regular education teachers and special education teachers become more proficient in student-centered instruction (Cole & Washburn, 2010; Thompson, 2009). Students with LD achieve greater academic gains when teachers deliver student-centered instruction (Hill, 2010). According to NMAP (2008), student-centered instruction is instructional strategies that allow students to have control over their own instruction and learning (NMAP, 2008). Although the NMAP created a definition for student-centered instruction, Pederson and Miu (2003) concluded that, in the absence of a clear definition of this type of instruction, researchers often define student-centered instruction as the opposite of traditional instructional approaches (Pederson & Liu, 2003). In the research, traditional teaching is referred to as lecture style teaching (Prince & Felder, 2006; Schwerdt & Wupperman, 2011).

There is more of a focus on teacher-centered instruction than student-centered instruction (Cole & Washburn, 2010; Thompson, 2009). Due to the number of factors that might influence a teacher's instructional practices, it is difficult to state why a teacher employs one teaching method over the other. The intent of this research study was not to engage in the argument between which teaching approach is most appropriate for teaching algebra to students with LD. Instead of joining the argument of which instructional approach (direct instruction, traditional teaching or student-centered instruction) is more beneficial to providing students with LD math instruction, Impecoven-Lind and Foegen (2010) focused on the math interventions that algebra teachers should use when providing students with LD math instruction.

In this study, I investigated teachers' self-reported instructional practices at the secondary level. At the secondary level, there is limited research about what instructional practices support students' learning of mathematics (Rakes, Valentine, McGatha, & Ronau; 2010; Thompson, 2009). Fox (1983) did not use the terminology of direct instruction, traditional instruction, or student-centered instruction. Instead, Fox stated that teachers who teach from the developed theoretical framework place students at the center of instruction. By including problem solving and authentic learning experiences, teachers adopt a personal theory of teaching and learning that focuses on the intellectual and development growth of students (Fox, 1983). Additionally, Fox described teachers who teach from a simple theoretical framework as engaging in the transfer theory where information is transferred from the teacher to the student. The typical strategy used in this method is modeling where the teacher models how to solve a problem and the student mimics the steps the teacher followed to solve the problem.

In this study, a distinction was made between teaching strategies and the math interventions that Foegen (2008), Impecoven-Lind and Foegen's (2010), and Strickland and Maccini (2010) listed as recommended math interventions for teaching algebra to students with LD. I explored the relationships between how teachers self-report their personal theories of teaching and learning, their self-reported use of math interventions as mentioned by Foegen (2008) and Impecoven-Lind and Foegen (2010), and self-reported classroom practices.

## Providing Learning Disabled Students With Access to Algebra

As a result of IDEA (2004), the majority of students with LD receive algebra instruction in the general education classroom. If students are to learn the concepts required for preparation for postsecondary coursework, then they must enroll in the classes where teachers are teaching these concepts (Steele, 2010). As the number of students with LD enrolled in the regular education classroom increases, teachers must use interventions to provide these students access to the learning that occurs in the classroom (Strickland & Maccini, 2010).

To help students with LD make academic gains while enrolled in algebra, teachers must use interventions (Impecoven & Foegen, 2010; Strickland & Maccini, 2010). Students with LD can achieve academic gains when given opportunities to use interventions during algebra (Impecoven & Foegen, 2010; Strickland & Maccini, 2010). To achieve success in this inclusive learning environment, students with LD must receive opportunities to learn (OTL; Kurz et al., 2014). OTL is time allotted for students with LD to learn concepts being taught in the class and the instructional practices teachers employ to help students learn these concepts. Evidence-based interventions are examples of instructional practices designed to help students with LD learn algebra.

### Teachers' Use of Interventions

Teachers do not dispute that interventions improve students with LD's math achievement (Bulgren et al, 2002; Stegall, 2013). Teachers agree that interventions are beneficial in addressing students with LD's math deficiencies (Bulgren et al. 2002; Stegall, 2013). There is a connection between a teacher's beliefs about the value of interventions and the actual implementation of the interventions. Students with LD's math performance improves when teachers use math interventions during instruction (Stegall, 2013). However, teachers are not committed to using math interventions during instruction (Bulgren et al., 2002; Stegall, 2013). Teachers do not use math interventions because they feel some interventions are too time consuming to use during class instruction (Stegall, 2013). To improve students with LD's academic performance in algebra, the discrepancy between teachers' beliefs regarding the use of interventions and the actual implementation of interventions needs addressing (Bulgren et al., 2002).

There are other reasons why teachers fail to use math interventions to teach students with LD. Teachers often do not use interventions because they overestimate students' understanding (van de Pol & Elbers, 2013). van de Pol and Elbers (2013) investigated how students' level of understanding influenced the type of instructional support teachers provided. The study consisted of 22 teachers. Teachers were randomly assigned to either the intervention or the control group. The 10 teachers in the intervention group received instruction on using scaffolding to improve student learning. van de Pol and Elbers found that students who understood the least at the beginning of the lesson benefitted the most from the scaffolding intervention. Teachers also tended to overestimate than underestimate students' understanding. When teachers overestimate students' understanding of concepts, they feel students will understand concepts taught without the use of interventions. Teachers' perceptions of students' understanding influence the use of interventions. Teachers' self-efficacy in the use of interventions is another consideration that influences teachers' use of interventions (Maccini & Gagnon, 2006).

Teachers need to receive additional support and training on how to use interventions to support the learning needs of students with LD (Maccini & Gagnon, 2006). Maccini and Gagnon (2006) examined intervention use of secondary regular and special education teachers. All teachers participating in the study completed a survey about the teachers' background, age, gender, education, math courses taught, years of experience teaching students with LD, and level of preparedness teaching students with LD. Maccini and Gagnon found that special education teachers provide students with LD more math interventions support. However, general education teachers were more likely to provide math intervention support if they had training in using math interventions with students with LD. General education teachers are typically the primary teachers responsible for teaching algebra and other higher-level math courses. General education teachers are also more comfortable teaching math to students without LD.

Although general education teachers are the primary teachers of students with LD, they do not feel comfortable teaching this population of students. Regular education teachers who do not have formal training in the use of math interventions support also do not use interventions to support the learning needs of students with LD (Maccini & Gagnon, 2006). This lack of confidence and comfortability in teaching students with LD result in math interventions not being used to support the academic learning needs of students with LD in secondary math classes. General education teachers should receive additional training on the use of math interventions support for teaching secondary mathematics to students with LD.

## Interventions for Teaching Algebra to Learning Disabled Students

Regularly using research-based interventions will remove barriers that students with LD encounter when learning algebra. Explicit instruction, graduated instructional sequence, class-wide peer tutoring, technology, and graphic organizers are examples of recommended research-based interventions that teachers should use to help students with LD to learn algebra (Impecoven-Lind & Foegen, 2010; Strickland & Maccini, 2010). Impecoven-Lind and Foegen (2010) and Strickland and Maccini (2010) developed a list of math interventions that teachers should use when teaching algebra to students with LD. The authors did not make a distinction between interventions and teaching practices. However, descriptions of the interventions and research studies that support the benefits of using these interventions to teach algebra to students with LD are included and referenced later in this chapter. This list of research-based interventions is not an inclusive listing of interventions. I limited my focus to the following recommended interventions: graduated instructional sequence, graphic organizers, class-wide peer tutoring, and technology. For the technology intervention, I did not focus on the specifics of the technology software used as an intervention. Instead, I focused on how technology is used and the benefits of using technology to leverage students' learning of algebra.

### Graduated Instruction

Graduated instruction or concrete to representational to abstract sequence instruction (CRA) is a proven intervention that teachers should use to improve students with LD’s math performance (Foegen, 2008; Impecoven-Lind & Foegen, 2010; Strickland & Maccini, 2010). With graduated instruction or CRA, instruction follows a sequence moving from a semiconcrete level to representational instruction, then to an abstract level. The search, translate, answer, and review strategy (STAR) is a form of graduated instruction.

**Graduated instruction versus traditional instruction.** Witzel et al. (2003) examined the effect of graduated instruction on students with LD’s academic outcomes. The study's design included 34 matched pairs from a population of about 358 sixth and seventh grade students from 12 different classrooms. Twelve teachers instructed the match pairs. These teacher either delivered instruction using the CRA strategy or traditional instruction. Witzel et al. described CRA lessons as lessons including manipulative objects and pictures. Traditional instruction was described as lessons consisting of only abstract instruction with no use of manipulatives and pictorial representations (Witzel et al., 2003). Witzel et al. indicated that students in the treatment and comparison groups’ scores improved from the pretest to the posttest and on the follow-up test. Although scores improved for both groups, the scores of students in the treatment group were significantly higher on the posttest and follow-up test compared to students in the comparison group. The type of instruction delivered (instruction with CRA strategy or traditional instruction) influenced students' posttest scores. The type of instruction (instruction with CRA strategy of traditional instruction) accounted for more than 56% of the posttest results (Witzel et al., 2003, p. 127).

Traditionally, CRA has been used to teach less complex math skills. The strategy is often used in resource room classrooms or during one-to-one instruction. However, some secondary teachers may be apprehensive to using manipulatives to teach complex math skills. Witzel et al.'s (2003) is beneficial because Witzel et al. used the CRA strategy in a mainstream classroom. Witzel et al. indicated the effectiveness of using the strategy as intervention for teaching complex math skills to students with LD.

Witzel et al.'s (2003) study contained a few limitations. First, the assessment tool used for the pretest and posttest was designed for this study and was not further evaluated. The assessment also included math problems that only about 50% of students could answer successfully (Witzel et al., 2003, p. 130). Additionally, the assessment did not align with the sequence of the math curriculum. Some of the skills assessed in the assessment were skills not previously learned or introduced in the curriculum.

**The STAR strategy**. Maccini and Hughes (2000) used the STAR within graduated instruction phases to teach students with LD problem-solving skills. The study's participants consisted of six students with LD enrolled in high school algebra. The students were taught how to use the STAR Strategy, a four-step strategy to solve word problems involving integers. The four steps of the STAR strategy are the following: Step 1 is to search the problem, Step 2 is to translate the problem into a word problem or picture, Step 3 is to answer the problem, and Step 4 is to review the answer. In the first phase, students received direct problem-solving instruction. After receiving direct instruction on how to solve the problem, students completed Steps 1 and 2 of the STAR strategy. In Step 1, students searched the problem. In Step 2, students used manipulatives, such as algebra tiles, to translate the word problem into a picture. Next, students answered the problem and reviewed their responses. In Phase 2, the students received a worksheet that instructed them to use the first steps of the STAR strategy. For Step 2, students solved the word problem by drawing a picture. Students were instructed to solve the problem using drawings of the algebra tiles. In the third phase of instruction, students were instructed to solve the problem using abstract symbols and to specify which integer rule (addition, subtraction, multiplication, or division) was used to solve the problem. For the final step, students reviewed the problem ensuring that the answer was reasonable.

Maccini and Hughes (2000) found that the STAR strategy within a graduated instructional phase was beneficial in improving students with LD's learning outcomes. Students were also able to apply the intervention after the initial implementation of the intervention. Ten weeks after the intervention was introduced, students maintained knowledge of how to use the strategy at the rate of 75% for problem representation and 91% for problem solution (Maccini & Hughes, 2000, p. 71). Although students did not have difficulty learning the steps, occasionally students failed to use the fourth step, review the problem. The strategy also affected students' overall well-being. Students socially validated the STAR strategy within a graduated instructional phase. Students indicated that they liked using the strategy to solve integer word problems, and they found that the intervention helped them to learn integers. The students' resource room teachers also noticed students' feelings towards mathematics changed during the study.

According to resource room teachers, students participating in the study appeared less anxious about mathematics.

Although Maccini and Hughes (2000) deemed the intervention beneficial in helping students with LD solve word problems involving integers, other students with LD might have memory deficits that might make it difficult to recall all steps. To accommodate the needs of students with LD who have difficulty with memorization, additional research should be conducted to determine which step should be eliminated.

**STAR strategy for solving integer problems involving subtraction**. Maccini and Ruhl (2000) conducted a study to determine the effectiveness of the STAR strategy for solving integer subtraction problems. Three students with LD participated in the study. At the beginning of the study, all three students were given a pretest to determine a baseline assessment of the students' performance. After establishing a baseline, students were introduced to the math intervention, the STAR strategy within graduated instructional phases. Maccini and Ruhl found that students successfully used the math intervention strategy to solve integer subtraction problems. Students successfully used the strategy for problem representation, problem solving, generalization measures, and maintenance measures (after initial teaching of the intervention).

For strategy use, Maccini and Ruhl (2000) found that all students' percentage points from baseline to the abstract phase experienced varying levels of improvement along the graduated instructional phases (Stage 1, explicit or direct instruction, Stage 2, representational instruction involving manipulatives and drawings, and Stage 3, abstract instruction without the use of manipulatives or drawings). All students' percentage points increased from baseline to the semiconcrete representational phase (Stage 2, representational instruction involving manipulatives and drawings). After receiving Stage 2 instruction, three students' scores increased respectively by 33, 20, and 53 percentage points (Maccini & Ruhl, 2000, p. 480). Only one of the three students' percentage points increased from baseline to the abstract phase of graduated instruction. Another student experienced a decrease of 7 percentage points from baseline to the abstract phase of graduated instruction, and there wrtr no data for one of the students (Maccini & Ruhl, 2000, p. 480). A possible explanation for the decrease of percentage points was that it was the last day of school, and the student lacked the motivation to perform well on the assessment.

For problem representation, all students increased their performance from baseline to concrete instruction (67.5, 66.25 and 46.25 percentage points; Maccini & Ruhl, 2000, p. 481). From the baseline to semiconcrete instruction, students' scores increased by 72.5, 56.25, and 46.25 percentage points (Maccini & Ruhl, 2000, p. 481). From the baseline to abstract instruction, students' scores increased by 72.5, 61.25, and 38.25 (Maccini & Ruhl, 2000, p. 481). For problem solving, all students increased their performance from baseline to concrete instruction (58.5, 29, and 64.5 percentage points; (Maccini & Ruhl, 2000, p. 481). From the baseline to semiconcrete instruction, students' scores increased by 62, 15.5, and 51.5 percentage points (Maccini & Ruhl, 2000, p. 481). From the baseline to abstract instruction, students' scores increased by 69, 43.5, and 50.5 percentage points (Maccini & Ruhl, 2000, p. 481).

On a near generalization task that involved solving similar subtraction problems with integers, Maccini and Ruhl (2000) found that students' mean accuracy score was 73% (p. 481). When required to solve subtraction integers problems for far generalization tasks where students were required to transfer the tasks learned to more complex tasks, the students' mean score was 29.3% (Maccini & Ruhl, 2000, p. 481). For maintenance of the strategy, after about 6 weeks of using the interventions, the students still retained the knowledge of how to use the math intervention (Maccini & Ruhl, 2000, p. 481). Although students successfully used the math intervention, some students had difficulty learning how to use the intervention. Throughout the study, the students had difficulty memorizing the steps involved in the STAR strategy. It would have been more effective to provide students with prompts to help them remember the strategy steps. Administering the posttest on the last day of school may have also affected students' academic outcomes. Students also experienced difficulty drawing pictures for problem representation and knowing which math symbols to use during the abstract instruction phase.

Maccini and Ruhl’s (2000) study added to the field of study on math interventions for students with LD. Maccini and Ruhl demonstrated the effectiveness of using a math intervention to teach students with LD higher level math concepts. Although the study is beneficial to the field of special education and math interventions, the study contained a few limitations. First, the posttest was given on the last day of the school, and this affected the students’ ability to remain focused on the task or assignment. Second, the students would have benefitted from receiving a structured worksheet that contained the

STAR strategy steps. The third limitation was that it is hard to generalize the effectiveness of the math intervention with a larger population.

**Graphic Organizers**

Graphic organizers are another intervention that teachers should use to improve students with LD's math performance (Foegen, 2008; Strickland & Maccini, 2010). Graphic organizers are visual representations, such as charts and graphs, that help students to organize information and ideas (Strickland & Maccini, 2010). Graphic organizers are visual representations of tiered boxes and arrows that assist students in understanding the processes and steps involved in solving algebraic equations (Barton & Little, 2013; Strickland & Maccini, 2010). Graphic organizers may also include mathematical symbols and expressions (Ives, 2007). Teachers should use graphic organizers as a tool to help improve students with LD's academic performance (Barton & Little, 2013). Graphic organizers can benefit students with LD who have deficits in language acquisition (Ives, 2007).

**Graphic organizers and solving linear equations with two variables**. Ives (2007) conducted a quantitative study to determine whether the use of graphic organizers is a beneficial intervention for teaching students how to solve linear equations with two variables. The participants in this study included 30 students with LD attending a private, Grades 6-12 school. The participants' ages ranged from 13.6-years-old to 19.3-years-old. The design was an experimental two-group design. The methods employed included teaching students in the treatment group how to solve linear problems with graphic organizers. Students in the control group did not use graphic organizers to solve linear equations. The materials consisted of graphic organizers, a test of prerequisite skills that measured students' knowledge of linear equations, and a test of content skills that measured students' ability to justify their problem solutions.

Ives (2007) found that students in the treatment group developed a better conceptual understanding of solving linear equations compared to students in the control group. Those students who used the graphic organizers scored higher than students who did not use graphic organizers. In the maintenance testing, four out of five students used the graphic organizer. In maintenance measures implemented after the initial study, Ives found that only two students continued to use graphic organizers consistently. A second study was conducted to determine the validity of using graphic organizers as intervention for teaching algebra to students with LD.

**Graphic organizers for solving linear equations with three variables**. Ives (2007) conducted a second study that was a replication of the initial study; however, with a different group of students and different content. Twenty students participated in the study, and the content was systems of linear equations with three variables. The methodology and procedures were similar to the initial study where there was a control group and an intervention group. The intervention or treatment group learned how to solve linear equations with graphic organizers. Ives (2007) found that students in the treatment group scored slightly higher than students in the control group; however, there were no significant differences in the scores between the two groups. One possible explanation offered for the different results was the second study's population size was smaller than the first study's population size (Ives, 2007).

**Using graphic organizers appropriately.** Although, Ives (2007) provided evidence of the effectiveness of using graphic organizers as an interventions for improving students with LD's academic performance, Barton and Little (2003) stated that teachers must have a pedagogical understanding of what interventions to use when teaching algebra content. Too often, teachers have limited pedagogical knowledge of what interventions to use when teaching various content to students with LD (Barton & Little, 2013). When this occurs teachers use interventions that are not appropriate for teaching the subject matter (Barton & Little, 2013). When deciding whether to use graphic organizers, teachers must ask themselves whether this intervention is the most effective for teaching algebra concept to students with LD.

## Class-Wide Peer Tutoring

When implemented with fidelity, class-wide peer tutoring is another proven intervention that improves students with LD's academic performance (Calhoon & Fuchs, 2003; Foegen, 2008; Impecoven-Lind & Foegen, 2010; Strickland & Maccini, 2010). This intervention involves pairing higher ability students with lower ability students. The higher ability student is the tutor, and the weaker student is the tutee. After, the roles reverse and the weaker student becomes the tutor and the stronger student the tutee. This intervention is effective because it allows students to receive immediate feedback and to engage in academic tasks (Allsopp, 1997). Instead of using the terminology class-wide peer tutoring, other researchers (Calhoon & Fuchs, 2003; Delquadri et al., 1986) used the term peer-assisted learning strategies (PALS) to describe peer tutoring.

**Class-wide peer tutoring and independent practice.** Allsopp (1997) compared two instructional practices, CWPT and independent practice, to determine which instructional practice was more effective in improving students with LD's algebra problem-solving skills. The study's population consisted of 262 students in 14 middle school classes. The study was designed so that one group of students in one class was randomly assigned to the independent practice group while the other group was randomly assigned to receive CWPT intervention group. All teachers who participated in the study received training on CWPT at the start of the study. Students assigned to the CWPT intervention groups were also trained in how to use the intervention. Testing measures were a pretest, posttest, and an assessment of maintenance (Allsopp, 1997). Allsopp found no significant differences between the two groups' performance on the pretest, posttest, and maintenance test. The fidelity rating for the implementation of CWPT was acceptable with all groups receiving a mean score of 92% (the acceptable fidelity score was 85%; Allsopp, 1997, p. 373).

Independent practice and CWPT are both effective in improving students' problem-solving algebra skills (Allsopp, 1997). Although there are no differences between the two instructional types, Allsopp (1997) demonstrated that CWPT is an effective strategy for improving students with LD's problem-solving skills. Additionally students felt that CWPT helped them learn problem-solving skills. Teachers also responded that CWPT was a beneficial tool for teaching LD algebra problem-solving skills. Allsopp included students identified as having LD. However, only a small percentage of students ($n$ = 10) were included in the study who met this qualification.

Due to the small percentage or number of students with LD included in the study, it is hard to determine the effectiveness of CWPT in improving students with LD's algebra problem-solving skills of higher order skills. Therefore, there is a need to conduct additional research on using CWPT as an intervention for teaching algebra to students with LD.

**Peer-assisted learning strategies.** Calhoon and Fuchs (2003) studied the effect of PALS on secondary students with LD's math performance. Three teachers and 92 students participated in the study. All teachers were special education teachers who taught self-contained classrooms. The study's design consisted of a control and treatment group. Each of the teachers' classrooms was randomly assigned to either the treatment or control group. Teachers received PALS training before implementing the intervention. Pre and posttests were administered before and after the intervention. Calhoon and Fuchs revealed a significant difference in scores for students with LD in the treatment group compared to the control group on math computational skills. In math computational skills, students with LD in the treatment group outperformed students in the control group skills (Calhoon & Fuchs, 2003). There were no significant differences in scores between the groups for concepts/applications and on the Tennessee Comprehension Achievement Tests (Calhoon & Fuchs, 2003). Both groups, treatment and control, showed gains from the pretest to the posttest (Calhoon & Fuchs, 2003).

The amount of time allocated to students' learning of PALS for concepts/applications and the Tennessee Comprehension Achievement tests may have affected students with LD's outcomes. Students in the math computational treatment group received 15 weeks of training (Calhoon & Fuchs, 2003, p. 243). However, students in the concepts/applications and Tennessee Comprehension Achievement test treatment groups only received 7 weeks of training (Calhoon & Fuchs, 2003, p. 243). Concepts/applications and many of the skills on the Tennessee Comprehension Achievement tests are higher level math concepts that require more teacher-directed instruction (Calhoon & Fuchs, 2003). Therefore, the reduced allocation of time for learning PALS for these skills may have negatively impacted students' outcomes.

**Using Peer Tutoring in this Study**

There is a need to conduct additional research on the effects of peer tutoring as an intervention for improving students with LD's academic outcomes in algebra. In the CWPT study (Allsopp, 1997), the intervention was found effective for improving students with LD's academic performance; however, the percentage of students with LD included in the study were small. In the second study (Calhoon & Fuchs, 2003), PALS were effective for improving students with LD's math computation skills, but not concepts/applications and performance on the Tennessee Comprehension Achievement tests. My study included an exploration of whether CWPT is a math intervention teachers use when providing algebra instruction.

## Supporting Literature for the Intervention Checklist

In this research study, an Intervention Checklist was the instrument used to collect information pertaining to teachers' use of math interventions. Other researchers (Lusk, 2006; Maccini & Gagnon, 2006) used similar survey instruments to collect data regarding math teachers' use of math interventions. In a study designed to measure how teachers' perceptions of inclusion influenced their use of math interventions, Lusk (2006) created a survey instrument to collect information regarding teachers' use of math interventions. In the literature on Algebra 1 and math interventions, Lusk identified 19 interventions beneficial for improving students with LD's performances in Algebra 1. Lusk's Instructional Strategies for Students with LD survey asked study participants whether they used each of the interventions. To support the validity and reliability of the survey, Lusk conducted a pilot study. In the results of the pilot test, Lusk indicated that alpha coefficient for the survey was .8281 (p. 69), and the item to correlation value was equal or greater to .30 for math interventions identified (graphic organizers, technology, CRA, and peer tutoring). In another study, Maccini and Gagnon (2006) collected information regarding what math interventions regular education and special education teachers use when teaching students with LD basic math computational skills and problem-solving strategies. Maccini and Gagnon provided regular and special education teachers with a listing of 14 interventions. Teachers were asked whether they used these math interventions during instruction. Maccini and Gagnon indicated that respondents were able to state whether they used math interventions during instruction.

## The Need for Additional Research on the use of Math Interventions

There is a need for additional research on the topic of algebra teachers' personal theories of teaching and learning, the use of math interventions, and teachers' inclusive classroom practices. Researchers (Allsopp, 1997; Ives, 2007; Maccini & Hughes, 2000; Maccini & Ruhl, 2002; Witzel et al., 2003) indicated the effectiveness of using interventions to improve students with LD's academic performance in algebra. These scholars focused on the use of math intervention in self-contained classrooms. These researchers focused on the use of math intervention in inclusive classroom. There are suggested reasons why teachers do not use math interventions to when instructing students with LD including not having adequate time and a need for additional professional development and training on math interventions for students with LD. Scholars have not provided sufficient information how regular education algebra teachers' personal theories of teaching and learning influences the use math interventions when instructing students with LD. The research on how math interventions are used in the regular education algebra classroom to support the learning needs of students with LD is limited. There is also limited research on factors that influence teachers' use of math interventions when teaching students with LD algebra. In this study, I examined the relationship between teachers' personal theories of teaching and learning and the use of math interventions.

## Summary

If students with LD are to achieve postsecondary success, they must enroll in academically challenging regular education classes (Steele, 2010). The type of teaching method the algebra teacher uses (teacher-centered or student-centered) to deliver algebra instruction to students with LD will determine whether the students achieve academic success in the regular education classroom. In teaching algebra, researchers recommended that teachers use a balanced approach, a combination of teacher-centered and student-centered. However, many teachers primarily use teacher-centered instruction when teaching algebra.

A teacher's personal theory of teaching and learning influences how a teacher delivers instruction (Cross, 2009; Fives & Buehl, 2014; Patchen & Crawford, 2011; Stemhagen, 2011). Personal theories of teaching and learning are complex because there are many factors that influence them (Stemhagen, 2011). It is difficult to state the factors that influence a teacher's personal theories of teaching and learning. A teacher's practice defines a teacher's personal theories of teaching and learning. In this study, I explored factors that might influence teachers' instructional practices.

Recommendations include the use of research-based interventions when teaching algebra. Foegen (2008) delineated how students with LD’s learning difficulties might impact performance in algebra. As a result, research-based interventions are recommended to provide students with LD access to algebra instruction in the regular education classroom (Impecoven-Lind & Foegen, 2010; Strickland & Maccini, 2010). Interventions recommended for improving students with LD’s algebra performance are concrete-representational-abstract instruction, class-wide peer tutoring, graphic organizers, and technology. These interventions are proven to improve students with LD’s academic performance. There is limited research on the use of these math interventions in the regular education classroom by algebra teachers. An examination of whether algebra teachers use research-based interventions to instruct students with LD in the general education classroom was conducted in this study.

Chapter 3 includes a presentation of the study’s research design and the rationale for the research design. This chapter includes an explanation of how variables (independent and dependent) were measured and information regarding statistical testing.

Additional information included in Chapter 3 relates to the recruitment process, external and internal validity, and ethical concerns of this research study.

# Chapter 3: Research Method

## Introduction

The purpose of this quantitative, cross-sectional study was to examine whether teachers' self-reported use of math interventions are influenced by how teachers view their personal theories of teaching and learning (as student/developed or teacher-centered/simple). In this study, I examined whether teachers self-reported using math interventions to teach algebra to students with LD. The major sections of Chapter 3 are as follows. The research design and rationale section includes information regarding the study's variables (independent and dependent), the research design, and an explanation as to how the design connects to the research question. Included in this section is information regarding time and resource constraints related to the research design and information as to how the research design advances the field of education. The methodology section includes information pertaining to the study's population. The sampling and sampling procedures sections includes information regarding the sampling strategy, sampling procedures, and the sampling size. This section also includes information on power analysis, effect size, the alpha level, and power. The source used to calculate the sample size is also included in this section. The procedures for recruitment, participation, and data collection sections include a description of recruiting procedures and the data collection process. The instrumentation and operationalization of constructs sections include information regarding the survey and observation checklists used in the study. The data analysis section includes identification of the software used to analyze the study's results. The threats to validity section includes a description of the internal and external validity threats and an explanation regarding what steps I took to limit these threats. Lastly, the ethical procedural section includes the steps taken to comply with expectations of the institutional review board (IRB).

## Research Questions

1. What is the relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom?

$H_0 1$: There is no significant relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom.

$H_1 1$: There is a significant relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom.

## Research Design and Rationale

There are two types of major research designs: experimental and quasi-experimental. This research study's design was a quasi-experimental design because it did not include random assignment (Trochim, 2006). Quasi-experimental designs are beneficial because the research occurs in a natural setting (Campbell & Stanley, 1963). In educational settings, quasi-experimental designs help to reduce logistical, financial, and ethical concerns (Butin, 2010). There are three ways in which quasi-experiments can be used in research: (a) to study the relationship between variables, (b) to examine the successfulness of an intervention, and (c) to explain the predictiveness of a variable to another variable (Butin, 2010). This research study was an exploration of whether a teacher's personal theories of teaching and learning influence his or her usage of math intervention.

The research design used in this study addressed one research question: Do teachers' personal theories of teaching and learning ($N_1$ = teacher-centered; $N_2$ = student-centered) influence whether they self-report using math interventions ($X_1$) when providing algebra instruction to students with LD? I examined whether the independent variables (teachers' personal theories of teaching and learning) influenced the use of the dependent variables (math interventions and classroom practices).

**Operational Definitions of Variables**

In Research Question #1, the independent variables were Fox's (1983) theoretical frameworks of teaching and learning, simple and developed. These variables were nominal, meaning that the numbers used to represent them *01* and *02* merely represent the names of the two variables. Initially, I planned to use an analysis of variance (ANOVA) test to determine which groups of Algebra 1 teachers (teacher- or student-centered) were more likely to self-report using math interventions during instruction. However, after reviewing the results from the Survey Monkey survey, I decided to use the cumulative odds ordinal logistic regression statistical test Laerd Statistics (2015). A discussion of how the cumulative odds ordinal logistic regression statistical test was executed in SPSS is included in Chapter 5.

Questions from the Math Intervention Checklist and the TCPS were used to develop a Survey Monkey survey. The frequencies that teachers use math interventions (graphic organizers, concrete to representational to abstract instruction, technology, and class-wide peer tutoring) were measured using the Math Intervention Checklist. Data collected from the Math Intervention Checklist provided information as to whether teachers used math interventions when providing instruction to students with LD in algebra. The TCPS was used to measure teachers' personal theories of teaching and learning. The TCPS scoring guide categorized teachers' classroom practices as either teacher-centered/simple (01) or student-centered/developed (02).

## Instrumentation

A Likert scale used in previous research was chosen for this research study. Teacher participants completed the Survey Monkey survey, which contained questions from the TCPS and the Intervention Checklist. The Intervention Checklist was self-designed and was not validated for its reliability. This information is included in the Limitations section of Chapter 1.

### Teacher Classroom Practices Survey

Walker (1999) used the TCPS to explore students' mathematical achievement based upon teachers' pedagogical approaches of teaching. In the study, Walker designed 16 questions to capture teachers' pedagogical beliefs about mathematics classroom practices. The reliability rating of the teacher survey used by Walker was .80. In Walker's study, 527 teachers completed the survey; however, 161 responses were not valid due to teachers not fully completing the questionnaire (p. 8). The survey included 15 Likert scale questions and one ranking question. Walker used the following ratings to determine teachers' pedagogical classroom practices. Teachers scoring a 42 or above were classified as having student-centered classroom practices, and teachers scoring at a 41 or below were classified as having teacher-centered or traditional teaching classroom practices (Walker, 1999, p. 10). The scoring for Questions 1–15 was as follows: for

Questions #1–4, *never* or *almost never* was scored at a 1, *some lessons* was scored at a 2, *most lessons* was scored at a 3, and *every lesson* was scored at a 4 (Walker, 1999, p. 9). For Questions 5-12, *never* was scored at a 1, *rarely* was scored at a 2, *sometimes* was scored at a 3, and *often* was scored at a 4 (Walker, 1999, p. 9). For Questions 13-15, *not important* was scored at a 1, *somewhat important* was scored at a 2, and *very important* was scored at a 3 (Walker, 1999, p. 9). Question 16 is a ranking question, and teachers were scored as follows: if a teacher selected a, b, or c the score of 1; d or e the score was 2; if the teacher selected f, the score was 3 (Walker, 1999, p. 9). For this research study, the scoring of teachers' responses mirrored the scoring used in Walker's study.

**Math Intervention Checklist**

Participants completed the Math Intervention Checklist (on Survey Monkey) within 1 to 4 weeks of giving consent to participate in the research study. In the literature on math interventions and Algebra 1 instruction (Impecoven & Foegen, 2010; Strickland & Maccini, 2010), teachers are advised to use graphic organizers, class-wide peer tutoring, technology, and concrete to representational abstract instruction when providing Algebra 1 instruction to students with LD. Algebra 1 teachers completed the Math Intervention Checklist specifying their frequency of using, if any, one or more math intervention(s) during instruction (See Appendix B). Teachers responding *not at all* to questions related to whether their use of math interventions in the specified time period were classified as not using math interventions. Teachers' self-reporting use of *any of the math interventions once*, *twice,* or *more than twice in the specified time period* were classified as using math interventions. Included in the Math Intervention Checklist was an explanation of each of the recommended math interventions as described in the literature (Impecoven & Foegen, 2010; Strickland & Maccini, 2010). An investigation of the data helped to explain which groups of teachers (simple or developed) were more likely to self-report using math interventions during instruction. In addition, in cases where teachers self-reported use of math interventions during instruction, data collected from the Math Intervention Checklist were used to explain which interventions teachers reported using during instruction.

The math intervention checklist used in this research study was deemed both reliable and valid. In the research on math interventions, researchers (Lusk, 2006; Maccini & Gagnon, 2006) used similar data collection tools to gather information about teachers' use of math interventions. To establish reliability and validity of such type of instrument, Lusk (2006) conducted a pilot study. In the results from the pilot study, Lusk indicated the alpha coefficient was .8281, and the item-to-total correlation for math interventions included in this research study (graphic organizers, CRA, peer tutoring, and technology) was greater or equal to .30.

## Population

The study only included teachers who self-reported experience teaching Algebra 1 to students with LD in an inclusion classroom.

## Sampling Strategy

In a census sample, all of the research subjects are included in the sample (Cantwell, 2008). This research study's sampling strategy included a census sample that included all teachers in the cooperating district who had experience teaching inclusion algebra classes that included students with LD. Participating secondary math teachers must also be certified to teach high school algebra.

I followed these procedures for obtaining a census sample. I informed the cooperating district of the intent to conduct research in the district. This process entailed completing paperwork that described the intent and purpose of the research. After completing the necessary paperwork, the paperwork was submitted to the district's personnel responsible for educational research. After receiving permission from the cooperating district to complete the research study, I contacted the director of mathematics for guidance on what approaches should be used to recruit participants. The director of mathematics provided me with a listing of all secondary mathematics teachers in the district. Using e-mail, a consent form and Survey Monkey survey link was sent to all possible participants.

**Sample Size**

The study's initial sample size was 27 Algebra 1 teachers. However, only 20 teachers participated in the research study.

**Recruitment Procedures**

Prior to conducting research, I requested consent from district personnel responsible for educational research to complete this study in the cooperating district. After receiving permission from the cooperating district personnel, I contacted the director of mathematics for a listing of Algebra 1 teachers. The director of mathematics suggested I first introduce my research project to the district's secondary mathematics teachers. So, at an August in-service professional development meeting, I introduced myself to the secondary mathematics teachers in the cooperating district and provided a brief overview of my research study. Secondary mathematics teachers were informed that they would receive a Survey Monkey survey link and consent form within 1 week. Next, I followed up with each secondary mathematics teachers with an introduction letter and description of my study via e-mail. The study's consent form was also included in this initial e-mail. In the consent form, I outlined the teachers' rights to not participate in the study, informed teachers that the study was only used for educational purposes, and I included confidentiality clauses. The IRB approved all communications to teachers.

## Data Collection Procedures

I used Survey Monkey as a resource for anonymously collecting teachers' feedback and responses. The information collected in the survey aided in categorizing teachers' personal theories of teaching and learning as Fox's (1983) simple or developed theoretical frameworks. The information collected in the survey also captured information pertaining to teachers' self-reported use of math interventions.

## Data Analysis Plan

### Statistical Test(s)

For this study, I used the cumulative odds ordinal logistic regression statistical test in SPSS to examine the relationship between teachers' personal theories of teaching and learning and the use of math interventions. At the beginning of the statistical analysis, I used the deviance goodness of fit test and Pearson goodness of fit test to determine the appropriateness of the test model. The purpose of this study was to examine the relationship between teachers' personal theories of teaching and learning and the use of math interventions.

The independent variable in this research study was teachers' personal theories of teaching and learning. In Research Question 1, I addressed whether a teacher's decision to self-report using math interventions is influenced by the teacher's personal theories of teaching and learning. The TCPS was the instrument used to categorize teachers' personal theories of teaching and learning. Responses from the TCPS were coded as either teacher- or student-centered teacher beliefs. In this study, teacher-centered beliefs of teaching and learning correlated with the simple theoretical framework. Student-centered beliefs of teaching and learning correlated to the developed theoretical framework. Teachers with mean scores ranging from 41 or below were categorized as having teacher-centered personal theories of teaching and learning (Walker, 1999). Teachers with mean scores ranging from 42 to above were categorized as having student-centered personal theories of teaching and learning (Walker, 1999). In the SPSS data table, I entered each teacher's personal theories of teaching and learning (student- or teacher-centered) and reports of math interventions use, if any.

**Data Cleaning**

The frequencies output window of SPSS provided an analysis of data cleaning and screening. The frequencies output window of SPSS also provided information on whether all variables have a code. This function of SPSS also provided information pertaining to any missing values. In cases where values were missing, these cases were assigned a value of *999* to denote a missing value.

**Software Used for Analyses**

The software used for analyses was SPSS. SPSS is a software designed to analyze social science data (Frankfort & Nachmais, 2008). Researchers use the software because it includes the procedures required to analyze social science's data.

## Interpretation of Results

There was one research question for this study. In this study, I entered data pertaining to the identified independent and dependent variables in the SPSS data editor. The independent variable in Research Question 1 was teachers' personal theories of teaching and learning, and the dependent variable was teachers' self-reports of usage of math interventions. In the SPSS data editor, a 01 was entered if a teacher was ranked as meeting the simple theoretical framework. A 02 was entered if a teacher ranked as meeting the developed theoretical framework.

In the SPSS data editor, a 0 was entered if a teacher self-reported not using one of the math interventions. If a teacher self-reported using one of the math interventions more than once, the code entered into the SPSS data table was a 1. If a teacher self-reported using one of the math interventions twice, the code entered into the SPSS data table was a 2. If a teacher self-reported using one of the math interventions more than twice, the code entered into SPSS was a 3. After entering the data for the variables in the SPSS data table, the cumulative odds ordinal logistic regression statistical test was executed in SPSS to determine whether a statistically significance relationship existed between the variables and whether to accept or reject the null hypothesis.

## Threats to Validity

According to Creswell (2008), internal validity threats are experimental procedures, treatments, or experiences that can interfere with drawing correct inferences from the study's participants. The internal validity threats section includes a description of possible threats related to this research study and an explanation as to how these threats were addressed. The external validity threats section includes a description of possible threats relevant to this study and an explanation as to how these threats are addressed in the study

### Internal Threats to Validity

The four internal threats to validity for this research study were instrumentation, regression, selection, and mortality. The Intervention Checklist is a self-designed survey instrument developed by me. The purpose of the survey instrument was to obtain information regarding teachers' self-reporting use of math interventions. To address validity issues and to increase the likelihood that teachers' self-reported responses produced the desired results (whether teachers use math interventions), I provided teachers with a definition of each math intervention. Teachers were also asked to respond to questions related to a timeframe.

A regression threat occurs when participants included in the study have extreme scores. As a part of the study, the participants completed the TCPS to determine the teachers' theoretical framework. The responses received from the TCPS categorized teachers as having either a simple or developed theoretical framework of teaching. Before administering the survey, it was impossible to include a representative sample of teachers that would produce an equal number of teachers for each category. Therefore, it was possible the TCPS could produce results where the majority or all of the teachers were categorized as either having a simple or developed theoretical framework of teaching. Additionally, categorizing teachers as either having a simple or developed theoretical framework does not preclude the fact that teachers may have teaching characteristics that qualify as both simple and developed.

Selection was the second internal threat to validity. A selection threat occurs when the majority or all participants have similar characteristics. All participants selected to participate in the study self-reported having experience teaching Algebra 1 to students with LD in an inclusive classroom. To increase the likelihood of having an appropriate sample, the following factors were not a consideration for determining whether a teacher qualified to participate in this research study: years of experience teaching algebra, years of experience teaching students with LD, or rating on the district's evaluation tool. It was possible that the sample might include teachers with more or fewer years of teaching experience, teachers with more or fewer years of experience teaching students with LD, and teachers who received satisfactory and below satisfactory evaluation ratings for their teaching performance.

Mortality was the third internal threat to validity. A mortality threat occurs when participants drop out of the study. Completion of the Survey Monkey survey by teacher participants indicated that teachers were agreeing to participate in the research study. Although teachers might have started the survey, it was possible that some participants may have not followed through with completing the actual survey. The study’s sample size was increased to account for the occurrence of a threat of mortality. Survey Monkey survey links were mailed to all secondary mathematics teachers in the district.

The following steps helped to avoid possible internal threats to validity. To address regression and selection internal validity threat, participants from various schools within the district received an opportunity to participate in the research study. By sending the survey to all secondary mathematics teachers, all teachers with experience teaching Algebra 1 to students with LD in an inclusive classroom could participate in the study even if they were not currently assigned to teach an Algebra 1 class. Providing an opportunity for all teachers with experience teaching Algebra 1 to students with LD in an inclusive classroom increased the odds of including teachers with varying characteristics (gender, age, years of experience, and years of experience teaching students with LD).

**External Threats to Validity**

This study included two types of external threats to validity: interaction of selection and treatment and interaction of setting and treatments. Interaction of selection and treatment’s external threats to validity occurs when the characteristics of the study's participants are limited (Creswell, 2008, p. 165). Interaction of setting and treatment’s external threats to validity occur when the characteristics of the study's setting are limited. The schools participating in this research study were urban schools located in a school district in an Eastern state. Therefore, all teacher participants were urban teachers. Because I study did not include teachers in nonurban settings, generalizations are not made about teacher groups not included in the study.

Researcher (Impecoven & Foegen, 2010; Strickland & Maccini, 2010) recommended that teachers use math interventions to improve students with LD's academic performance in algebra. Researchers (Impecoven & Foegen, 2010; Strickland & Maccini, 2010) did not provide guidance on how best to measure teachers' use of math interventions. The Intervention Checklist was developed with the intent to measure whether teachers use math interventions to improve the academic performance of students with LD in algebra. Definitions of each of the recommended math interventions were included in the Intervention Checklist to assist teachers with answering questions more accurately. Possible threats to validity included content validity (will the Intervention Checklist measure whether teachers use math interventions) and construct validity (there is no literature on what predicts a teachers use of math interventions). In addition to addressing internal and external threats to validity, I also addressed ethical concerns.

## Ethical Procedures

Ethical issues are addressed at various stages during the research process. The purpose of this study was to gain additional information about the factors that influence Algebra 1 teachers' instructional decisions. The purpose of this study was to not criticize, humiliate, or demean teachers' instructional practices. There are many factors that influence teachers' instructional decisions, and I only addressed a small number of factors that influences teachers' instructional practices. The intent of my research was to add to the research on strategies that promote academic achievement in students with LD. The participants in this study were included only for research purposes, and I completed this work independently as part of a requirement of a degree program. Additionally, the study was only conducted for research purposes and not for personal gains. I shared the intent and purpose of this study with the district's central office staff responsible for secondary mathematics, teacher participants, and other relevant personnel.

Prior to the data collection stage, I submitted the proposal to the IRB to ensure that there were no human rights violations. While recruiting teachers, informed consent forms were provided to all possible participants via e-mail along with the Survey Monkey survey link. Participants with a relationship to me were not recruited to participate in this research study

To protect participants' identity, all participants anonymously completed the survey on Survey Monkey. Participants were informed that participation in the study was voluntary and would not include any risks associated with their employment or well-being. To minimize risk and to reduce participant anxiety, I explained the study to the participants, the purpose of the study, data collection procedures, how anonymity will be maintained, and the storing of data at a district in-service meeting. Participants were also informed of their right to withdraw from the study during any point of the study. I communicated directly with all participants via e-mail. All communications were confidential.

To prevent data from being used for unintended purposes, I maintained a Survey Monkey account that electronically stored all collected data. The data are also stored on a flash drive. This flash drive is stored in a locked storage box. I only used personal computers during the research process. All data will be destroyed and discarded after a period of 5 years.

## Summary

In this era of college and career readiness and inclusion, schools focus on predictors that influence students with LD's postsecondary success. The performance of students with LD in Algebra 1 is a predictor that is used to determine student's postsecondary success (Moses & Cobb, 2001; NCTM, 2009; Steele, 2010; Witzel et al., 2008). In the literature on Algebra 1 and students with LD (Impecoven & Foegen, 2010; Strickland & Maccini, 2010), Algebra 1 teachers are recommended to use math interventions to improve students with LD's algebra performance. Meyen and Greer (2009) stated that the achievement gap between students with and without LD is a result of teachers' instructional decisions. Instructional decisions are influenced by teachers' personal theories of teaching and learning (Fives & Buehl, 2014; ; Fox, 1983; Patchen & Crawford, 2011; Stemhagen, 2011).

The purpose of this study was to determine the relationship between teachers' personal theories of teaching and learning and teachers' self-reports of the use of math interventions. The study included an exploration of whether the theoretical framework a teacher teaches from (simple or developed) influences teachers' self-reporting of the use of research-based interventions. Chapter 4 will include a report of the study's results.

# Chapter 4: Results

## Introduction

The purpose of this study was to determine the relationship between Algebra 1 teachers' personal theories of teaching and learning and the use of math interventions. In this quantitative study, which was approved by Walden's Institutional Review Board (#08-12-16-0171160), I used a quasi-experimental design to explore the predictiveness of specific variables to other variables. I examined whether an Algebra 1 teacher's personal theories of teaching and learning influenced the teacher's use of math interventions when teaching algebra to students with LD in an inclusive classroom. The independent variables of this study were teachers' personal theories of teaching and learning (simple, developed) and teachers' demographical information (e.g., age, ethnicity, years of experience, and gender). The dependent variables included teachers' use of math interventions and the categories of math interventions (graphic organizers, concrete-to-abstract representational instruction, class-wide peer tutoring, and technology). The research question and hypotheses used for this research design and the theoretical framework of this study included the following:

1. What is the relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom?

$H_0 1$: There is no significant relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom.

$H_1 1$: There is a significant relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom.

This chapter includes the results of this study and an analysis of the independent and dependent variables to determine whether correlations exist between the variables. The following sections are also included in this chapter: data collection, data analysis, results, and a summary.

## Data Collection

In August of 2016, the director of mathematics for the cooperating district stated that 24 Algebra 1 teachers were scheduled to teach Algebra 1. This was a change from the previous year where 27 teachers in the cooperating district taught Algebra 1. To ensure a representative sample of all Algebra 1 teachers, it was suggested that I send the survey to all secondary mathematics teachers. Data collection occurred during the month of September 2016. A Survey Monkey survey consisting of questions from the TCPS and the Math Interventions Survey was created and e-mailed to secondary math teachers in the cooperating district. The personnel of the school district provided access to math teachers' e-mail addresses. All secondary math teachers in the cooperating district received an electronic Survey Monkey link to access the study's survey via e-mail. Prior to engaging in recruitment practices, access was gained from the superintendent representative to conduct research within the district (Appendix F). The representative sample, which consisted of 20 participants, met the criteria for this research study. All participating survey respondents self-reported having experience teaching Algebra 1 to students with LD in an inclusive classroom (Table 3).

Data collected from the survey on Survey Monkey provided demographic information about teachers' age, years of experience, gender, and ethnicity (Table 2).

After collecting data, an Excel spreadsheet was created to record individual teacher's responses. Headings on the Excel spreadsheet included age, years of experience, gender, and ethnicity. The spreadsheet included heading numbers for all TCPS questions. Using Walker's (1999) scoring guide, each teacher received a score based on his or her responses. The spreadsheet included headings for each math intervention. On the Excel spreadsheet, teachers indicated the number of times, if at all, a participant self-reported use of a particular math intervention (graphic organizers, CRA, CWPT, and technology; Table 3).

Table 2

*Demographics of Representative Sample*

| Teacher | Age Range | Gender | Race | Year Experience |
|---|---|---|---|---|
| 1 | 45-54 | F | B | 18 |
| 2 | 45-54 | F | W | 999 |
| 3 | 55-64 | F | W | 11 |
| 4 | 35-44 | F | W | 6 |
| 5 | 35-44 | F | H | 5 |
| 6 | 25-34 | M | W | 0* |
| 7 | 45-54 | F | W | 11 |
| 8 | 55-64 | F | W | 2 |
| 9 | 45-54 | F | B | 0* |
| 10 | 25-34 | F | A | 999 |
| 11 | 25-34 | F | W | 9 |
| 12 | 55-64 | M | W | 20 |
| 13 | 18-24 | M | W | 0* |
| 14 | 65-74 | F | W | 999 |
| 15 | 18-24 | F | W | 2 |
| 16 | 45-54 | F | W | 10 |
| 17 | 55-64 | M | W | 12 |
| 18 | 18-24 | F | W | 999 |
| 19 | 25-34 | M | W | 12 |
| 20 | 25-34 | M | W | 3 |

*Note.* F = Female, M = Male, B = Black or African-American, W = White, H = Hispanic, A = Asian, 999 = missing variable, 0* = first year teacher.

Table 3

*Survey Results from TCPS and Intervention Use Survey*

| Teacher | Theoretical Framework | Graphic Organizers | CRA | CWPT | Technology Computer | Technology Calculator |
|---|---|---|---|---|---|---|
| 1 | Developed | 2+ | 2+ | 2 | 2+ | 2+ |
| 2 | Developed | 2+ | 2+ | 0 | 0 | 2+ |
| 3 | Developed | 1 | 2+ | 1 | 2+ | 2+ |
| 4 | Simple | 1 | 2 | 0 | 0 | 2+ |
| 5 | Developed | 2+ | 2+ | 2 | 2 | 2+ |
| 6 | Developed | 1 | 2+ | 2 | 2+ | 2+ |
| 7 | Simple | 2 | 0 | 1 | 2+ | 2+ |
| 8 | Simple | 2+ | 2+ | 0 | 2+ | 2+ |
| 9 | Developed | 2+ | 2+ | 2+ | 2+ | 2+ |
| 10 | Developed | 1 | 1 | 2+ | 0 | 2+ |
| 11 | Developed | 2+ | 2+ | 1 | 2+ | 2+ |
| 12 | Developed | 2+ | 2+ | 2+ | 0 | 2+ |
| 13 | Developed | 1 | 0 | 0 | 2 | 2 |
| 14 | Developed | 0 | 0 | 1 | 2 | 2+ |
| 15 | Simple | 1 | 1 | 1 | 2+ | 2+ |
| 16 | Developed | 2 | 1 | 2+ | 0 | 2+ |
| 17 | Developed | 1 | 2 | 2+ | 2+ | 2+ |
| 18 | Developed | 2 | 2 | 0 | 1 | 2+ |
| 19 | Developed | 2 | 1 | 2+ | 0 | 2+ |
| 20 | Simple | 1 | 0 | 2+ | 0 | 2+ |

*Note.* Use of Math Intervention: 0 = Not at All, 1 = Once, 2 = Twice, 2+ = More than Twice.

**Results**

In Chapter 3, I indicated an ANOVA statistical test would be used in this study. The initial plan was to use an ANOVA to measure group differences between teachers' reported use of math interventions and teachers' reported no use of math interventions. In the survey data collected from the study participants, I found that all teachers in the study's sample self-reported use of math interventions. Although all teachers self-reported use of math interventions, teachers' self-reported use of math intervention varied based on age, years of experience, gender, ethnicity, and personal theories of teaching and learning. Using the teachers' self-reported use of math interventions as an ordinal dependent variable, the decision was made to use a cumulative odds ordinal logistic regression statistical test.

A cumulative odds ordinal logistic regression statistical test was executed using SPSS to determine the effect of Algebra 1 teachers' personal theories of teaching and learning, years of experience, gender, age, ethnicity, and use of math interventions. At the beginning, a SPSS dataset was established by entering data from the Excel spreadsheet. After setting up the dataset in SPSS, dummy variables were created for the different categories of variables to facilitate the execution of the analysis in SPSS (Laerd Statistics, 2015). Dichotomous cumulative categories were established to run the assumptions tests for multicollinearity. The results from SPSS indicated the test of multicollinearity was met (Table 4).

Table 4

*Assumption Test Results for Multicollinearity*

| | Collinearity Statistics | |
|---|---|---|
| Variables | Tolerance | VIF |
| Age | .674 | 1.485 |
| Gender | .685 | 1.460 |
| Ethnicity | .697 | 1.436 |
| Simple | .657 | 1.481 |
| Years of Experience | .651 | 1.536 |

Next, GENLIN procedures were conducted in SPSS to determine whether a statistical significant relationship existed between teachers' personal theories of teaching and learning (simple, developed) and the overall use of math interventions. SPSS (GENLIN procedures) was also used to determine whether a statistical significant relationship existed between teachers' demographics (age, years of experience, ethnicity, and gender) and intervention type (graphic organizers, CRA, CWPT, and technology). Thirdly, SPSS (GENLIN procedures) was used to determine statistically significant relationships between teachers' personal theories of teaching and learning (simple, developed) and intervention type (graphic organizers, CRA, CWPT, and technology). The assumptions of proportional odds were met as assessed by a full likelihood ratio test comparing the fitted model to a model with varying location parameters, $\chi^2(7) = 8.432$, $p = .296$. The deviance goodness-of-fit test indicated that the model was a good fit to the observed data, $\chi^2$ (31) = 30.180, *p* = .508. The Pearson goodness-of-fit test also indicated that the model was a good fit to the observed data, $\chi^2$(31) = 37.891, *p* = .508.

The research question for this study was the following: What is the relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom? The research question was addressed by measuring the significance value between teachers' personal theories of teaching and learning and the use of math interventions. Because survey results (Table 3) indicated that all teachers surveyed reported the use of math interventions, I included an analysis of all factors (age, years of experience, gender, ethnicity, and intervention type). Table 5 shows the means and standard deviations for teachers' age and years of experience.

Table 5

*Means and Standard Deviations for Teachers' Age and Years of Experience*

| Variable | Mean | Standard Deviation |
|---|---|---|
| Age | 37.95 | 14.855 |
| Years of Experience | 6.05 | 6.411 |

In the tests of model effects, years of experience was a predictor for determining Algebra 1 teachers' use of math interventions, a statistically significant effect, Wald $\chi^2$(1) = 4.626, *p* = .031. For the relationship between teachers' years of experience and use of math intervention, the alternate hypothesis was accepted showing a significant level of less than .05.

In the final model, I indicated an Algebra 1 teachers' personal theories of teaching and learning, age, gender, and ethnicity did not add to the prediction of the dependent variable (use of math interventions), $\chi^2(7) = 13.041$, $p = .071$. For these variables (gender, ethnicity, personal theories of teaching and learning, and age), $p > .05$ (Table 5). The null hypotheses were accepted for examining the relationship between teachers' personal theories of teaching and learning where there was no significant difference between teachers' personal theories of teaching and learning and the use of math interventions. The null hypotheses were accepted for all other factors, with age, gender, and ethnicity showing significant levels greater than .05 (Table 5)

Table 6

*Ordinal Logistic Regression (GENLIN Procedures) Significance Values for Variables*

| Variable | Wald-Chi-Square | df | Sig. |
|---|---|---|---|
| Gender | 1.846 | 1 | $N_s$ |
| Ethnicity | .003 | 3 | $N_s$ |
| Personal Theories of Teaching and Learning | .622 | 1 | $N_s$ |
| Years of Experience | 4.626 | 1 | .031 |
| Age | 2.908 | 1 | $N_s$ |

*Note*. *Ns* = not significant, ($p$ > 05).

**Summary**

The purpose of this study was to examine the relationship between teachers' personal theories of teaching and learning and the use of math interventions. I found that there was no significant difference between teachers' personal theories of teaching and learning and the use of math interventions. All teachers included in the study's sample self-reported use of math interventions. SPSS's GENLIN procedures were conducted for the study's other factors (years of experience, age, ethnicity, and gender) to determine the relationship between these factors and Algebra 1 teachers' use of math interventions. I found a significant difference between the factor and years of experience and use of math interventions, $p = .031$. The interpretation of the findings and discussion of the limitations, recommendations, implications, and conclusions of the findings are further explained in Chapter 5.

# Chapter 5: Discussion, Conclusions, and Recommendations

## Introduction

The purpose of this study was to determine the relationship between Algebra 1 teachers' personal theories of teaching and learning and the use of math interventions. A Survey Monkey survey consisting of questions from the TCPS and the Math Intervention survey was developed and e-mailed to secondary math teachers in the cooperating district. District personnel provided access to secondary math teachers' e-mail addresses. Sixty-three surveys were e-mailed to secondary math teachers in the cooperating district. According to the district's director of mathematics, the total number of Algebra 1 teachers in the cooperating school district for the 2016-2017 school year was 24. The total number of teachers included in this research study was 20. All teachers self-reported having experience teaching Algebra 1 to students with LD in an inclusive classroom. I found that all teacher participants self-reported use of math interventions.

Teachers' personal theories of teaching and learning (simple, developed) did not predict teachers' use of math interventions. All teacher participants self-reported the use of math interventions when teaching Algebra 1 to students with LD in an inclusive classroom. In addition to teachers' personal theories of teaching and learning, other factors (ie., years of experience, age, ethnicity, and gender) were examined to determine the relationship between these factors and teachers' use of math interventions. A significant statistical difference was found between a teacher's years of experience and the use of math interventions, $p = .031$. This is interpreted to mean there was a relationship between a teacher's years of experience and the use of math interventions where teachers who have more teaching experience self-report using math interventions more frequently than teachers with fewer years of teaching experience. The interpretation of findings section includes additional information regarding the differences between these two groups of teachers (related to their years of experience) and the use of math interventions. No significant statistical difference was found for the study's other factors (teachers' personal theories of teaching and learning, age, gender, ethnicity) and the use of math interventions.

This chapter includes an interpretation of the findings for the relationship between algebra teachers' personal theories of teaching and learning and the use of math interventions in an inclusive classroom. The chapter also includes a discussion of the limitations of this research study, recommendations for future research, the implications for social change, and a conclusion.

## Interpretation of Findings

The research question for this study was the following: What is the relationship between algebra teachers' theory of teaching and learning and their use of math interventions in an inclusive classroom? In the results of the cumulative ordinal logistic regression, I found no significant relationship between teachers' personal theories of teaching and learning and the use of math interventions. I found that all teachers self-reported the use of math interventions. As a part of the data analysis, additional factors (gender, age, ethnicity, and years of experiences) were evaluated to determine the relationship between these factors and an algebra teacher's use of math interventions.

I found that a statistically significant relationship existed between algebra teachers' years of experience and the use of math intervention, $p = .031$. Four teachers self-reported having fewer than 6 years of experience teaching Algebra 1. Although one of these teacher's math intervention use was similar to the self-reports of math intervention used by teachers with more experience, math intervention use for teachers with fewer than 6 years of experience was lower than teachers with 6 or more years of experience teaching Algebra 1. In the literature related to this topic, Cross (2009) suggested that a relationship between teachers' years of experience and the use of math interventions may be a result of teachers' with more experience tendency to use more student-centered teaching approaches.

**Analysis of Findings in Relation to Theoretical Framework**

The theoretical framework for this study was based on Fox's (1983) personal learning theory. In Fox's framework of personal theories of teaching and learning, teachers teach from either a simple or developed theoretical framework. Teachers who teach from the simple theoretical framework have classroom practices that align with teacher-centered practices. Teachers who teach from the developed theoretical framework of teaching have classroom practices that align with student-centered practices.

The purpose of this study was to examine whether a teacher's personal theory of teaching and learning, as defined by Fox (1983), influenced whether a teacher used math interventions to provide Algebra 1 instruction to students with LD in an inclusive classroom. I found no statistically significant difference between teachers' personal theories of teaching and learning and their use of math interventions. In the data collected from the survey, both groups of algebra teachers, simple and developed, self-reported using math interventions to provide students with LD algebra instruction in an inclusive classroom.

**Analysis of Findings in Relation to Research Literature**

In this study, there was a statistically significant difference between years of experience and use of math interventions. Cross (2009) also reported that years of experience influenced a teacher's instructional practices. In Cross's study, novice teachers self-reported their teaching practices as teacher-centered. In this study, five teachers self-reported their classroom practices as teacher-centered. Of these five teachers, two teachers had fewer than 3 years of teaching experience.

In the literature about the use of math interventions, Bulgren et al. (2002) and Stegall (2013) suggested that teachers are not committed to using math interventions. Teachers self-report knowing the importance and significance of using math interventions as a resource to improve students with LD's math performance. In this study all teachers self-reported use of math interventions during a 2-week period. The findings from these studies differ from the findings of this research study where all study participants self-reported that they used math interventions when providing Algebra 1 instruction to students with LD in an inclusive classroom setting. The limitations section of this study provides an explanation as to why all teachers may have self-reported used of math interventions.

**Confounding Variable**

A confounding variable related to the district's algebra program might have influenced the results of this study. I examined Algebra 1 teachers' use of math interventions. In the school year 2016-2017, the cooperating district adopted a new Algebra 1 curriculum. The first unit of the Algebra 1 curriculum required teachers to use graphic organizers to assist students with learning mathematical concepts. It is possible that some teachers' self-reported use of graphic organizers may have occurred because of the district's new curriculum requirement.

## Limitations

This study had several limitations. In the cooperating district's new Algebra 1 curriculum, math interventions, such as graphic organizers, were embedded in the lesson unit curriculum. Therefore, it was difficult to determine whether teachers' use of graphic organizers were a result of the curriculum design.

Another limitation was the duration and consistency of teachers' math intervention use in the Algebra 1 classroom. All teachers self-reported use of math interventions during Algebra 1 instruction in a typical 2-week period. What was unknown is the extent to which these interventions were used consistently throughout the course of the 2016-2017 school year.

Another limitation was the appropriateness of the selected math intervention as a strategy to teach the intended concept or skill. Barton and Little (2013) stated that, too often, teachers do not know whether a selected math intervention is appropriate for the concept or skill they are teaching in the classroom. In this study, there was no examination as to whether the math intervention selected and used by the classroom teacher was the appropriate math intervention for the area of study.

## Delimitations

There were a few delimitations included within this research study. The first delimitation was that students' academic performance was not included as a factor. I found that all teachers self-reported using the math interventions (graphic organizers, concrete-to-representational-abstract instruction, class-wide peer tutoring, and technology) when teaching students with LD Algebra 1 in an inclusive classroom. What I did not do was measure the impact of these interventions on students with LD's academic performance in an inclusive algebra classroom. For example, did students' academic performance improve as a result of using these math interventions?

The second delimitation involved the study's participants. The data collection period for this research study started at the start of the 2016-2017 school year. Due to budget cuts and other factors, some secondary math teachers' teaching assignments changed from the 2015-2016 school year to the 2016-2017. This study was limited to only Algebra 1 teachers with experience teaching students with LD in an inclusive classroom. To ensure this delimitation was met, the study's survey included questions that required teachers to indicate whether they had experience teaching Algebra 1 to students with LD in an inclusive setting. As a result, only teacher participants who indicated experience teaching Algebra 1 to students with LD in an inclusive classroom were included in this study.

## Recommendations

In this study, I found a statistically significant difference between an algebra's teacher's years of experience and his or her use of math interventions, $p = .031$. Teachers with 5 years or fewer of teaching experience used math intervention less frequently than teachers with 6 or more years of teaching experience. What was unknown is why teachers with 6 years or more of teaching experience used math interventions more frequently. Additional researchers should focus on why and how a teacher's years of experience influences his or her use of math interventions.

For the cooperating district, data from the 2015-2016 school year indicated that 60% of students with and without disabilities received a passing score of a C or better in Algebra 1. According to Steele (2010), a significant number of students with LD fail Algebra 1. What was unknown is how many students with LD in the cooperating district fail Algebra 1 in any given year. In the cooperating district, future researchers should focus on examining how many students with LD received a passing score of a C or better in Algebra 1. This information will help to provide insight as to how students with LD are performing in Algebra 1 in the cooperating district. These data will also add to the research on whether there is a relationship between Algebra 1 teachers' years of experience, their use of math interventions, and the academic performance of students with LD.

Another question was whether students' passing scores in Algebra 1 are a result of students receiving Algebra 1 instruction. For example, what extent did students learn Algebra 1 concepts? What rigor of Algebra 1 instruction did students with LD receive in inclusion classrooms? Future researchers should also focus on the alignment of Algebra 1 teacher practices for students with LD, students with LD's classroom academic performance, and students with LD's performance on standardized assessments.

According to the data presented in this study, Algebra 1 teachers used math interventions. Researchers (Impecoven-Lind & Foegen, 2010; Strickland & Maccini, 2010) recommended that they use interventions when teaching Algebra 1 to students with LD. In this study, the academic performance of students with LD in an Algebra 1 inclusive classroom was not a factor. All of the participants included in this study self-reported the use of math intervention. However, there was no exploration as to whether students with LD's Algebra 1 academic performance improved as a result of teachers' instructional practices (use of math interventions). By not including this data point, it was questionable as to whether teachers' use of math interventions resulted in improved academic performances for students with LD in inclusive classrooms. Another question raised by the results was whether the teachers are accurately self-reporting their classroom practices in regards to math intervention use. Teachers may also take a closer look at how they are assessing the learning of students with LD in inclusive classrooms.

## Implications for Social Change

The findings of this research study added value to the literature on math interventions and secondary classroom practices in the area of Algebra 1. The data presented in this research study provides opportunities for social change at the school/district and higher education level. I found that there was a significant difference between teachers' use of math interventions and teachers' use of experience. I found that teachers with 6 years or more of teaching experience self-reported using math interventions more frequently than teachers with fewer years of teaching experience. The cooperating district included in this research study had a number of small, theme-based high schools. Many of these schools only had one teacher teaching Algebra 1. It is possible that teachers with fewer years of experience self-reported using math interventions less frequently because they had not received adequate training or support on how to deliver algebra instruction that supports the learning needs of students with LD. Newer teachers often self-report a lack of support and training in how to deliver instruction to meet the needs of students with LD. Colleges and universities still do not require students to take extensive coursework in teaching students with LD. Colleges and universities should provide secondary teacher candidates with more learning opportunities directed towards teaching students with LD in the inclusive classroom. Schools and districts should provide new teachers with teaching resources (materials and training) that are directly connected to their content area, which will help support teaching students with LD in the inclusive classrooms.

## Conclusion

This study was conducted because there was a need to better understand the type of instructional support that Algebra 1 teachers provide to students with LD in inclusive secondary math classrooms. The purpose of this quantitative, cross-sectional study was to examine the relationship between Fox's (1983) theoretical frameworks of teaching and learning (simple or developed) and Algebra 1 teachers' use of math interventions for students with LD. Students with LD typically perform poorer than their nondisabled peers in secondary mathematics. If students with LD are to achieve postsecondary success, they must receive the same level of rigorous math instruction as their nondisabled peers (Steele, 2010). Algebra 1 is considered a gatekeeper and predictor course of students' postsecondary success (Moses & Cobb, 2001; Steele, 2010; Witzel et al., 2008). According to Steele (2010), students with LD often fail Algebra 1. Teachers' instructional decisions, or lack thereof, is a cited reason as to why students with LD fail Algebra 1.

To examine the relationship between teachers' personal theories of teaching and learning and the use of math interventions, two surveys were provided to Algebra 1 teachers in the cooperating district. The TCPS was used to capture information regarding teachers' personal theories of teaching and learning. The Math Intervention Checklist was used to capture information regarding teachers' use of math interventions. In both cases, teachers self-reported their responses. I found that both groups of teachers (simple or developed) self-reported usage of math interventions. Included in the study was an analysis of other factors captured in the TCPS survey (gender, ethnicity, years of experience, and age). A statistically significant difference was found between the use of math interventions and teachers' years of experience, $p = .031$.

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Appendix A: Personal Information Questionnaire

Directions: Section 1: Personal Information. Please complete the following questionnaire.

Age: _____ Gender: _________________ Nationality: ______________
2 – Check your highest educational degree: __ Undergraduate __ Master __ Doctorate
3 – How many years have you been teaching Algebra 1? ___________
4 – How many years have you been teaching students with learning disabilities (LD)? _____
5 – Are you certified to teach Algebra 1? _______
6. Are you currently teaching Algebra 1 (2015-2016 school year)? Y N
7. If you answered no to question #6, did you teach Algebra 1 in prior years? Y N
8. If you answered yes to question #7, did you have students with LD in your classroom? Y N If yes, on average how many students with LD were enrolled? ___________

Appendix B: Math Intervention Checklist

**Directions:** First, read the definitions of math intervention. Then, read each one of the statements regarding math interventions and circle the most appropriate response.

**Graphic Organizers.** A visual tool used to organize information and ideas.
1. Typically within a two week time period, how often do you use Graphic Organizers when providing Algebra 1 instruction to students in your classroom identified as LD?

**Not at all** **Once** **Twice** **More than twice**

**Concrete to Representational Abstract Instruction (CRA).** Three staged instruction – stage one (explicit or direct instruction), stage two (representational instruction with manipulatives and drawings), stage three (abstract instruction).

2. Typically within a two week time period, how often do you use CRA when providing Algebra 1 instruction to students in your classroom identified as LD ?

**Not at all** **Once** **Twice** **More than twice**

**Class-wide Peer Tutoring or Peer Assisted Learning (CWPT/PAL).** Two students working together as pairs sharing the roles of tutor and tutee.

3. Typically within a two week time period, how often do you use CWPT or PAL when providing Algebra 1 instruction to students in your classroom identified as LD?

**Not at all** **Once** **Twice** **More than twice**

**Technology.** The use of computer software to solve mathematic problems.

4. Typically within a two week time period, how often do you use computer software when providing Algebra 1 instruction to students in your classroom identified as LD?

**Not at all** **Once** **Twice** **More than twice**

**Technology (calculators).** The use of calculators to solve mathematical problems.

5. Typically within a two week time period, how often do you use calculators when providing Algebra 1 instruction to students in your classroom identified as LD?
**Not at all** **Once** **Twice** **More than twice**

Appendix C: Teachers' Classroom Practices Survey (TCPS)

Circle the response that best describes your classroom practices.

In your mathematics lessons how often do you usually ask student to do the following?

1. Explain the reasoning behind an idea.

**Never** **Some Lessons** **Most Lessons** **Every Lesson**

2. Represent and analyze relationships using tables, charts, or graphs.

**Never** **Some Lessons** **Most Lessons** **Every Lesson**

3. Work on problems for which there is no immediately obvious method or solution.

**Never** **Some Lessons** **Most Lessons** **Every Lesson**

4. Write Equations to represent relationships.

**Never** **Some Lessons** **Most Lessons** **Every Lesson**

If you assign mathematics homework, how often do you assign each of the following kinds of tasks?

5. Reading in a textbook or supplementary material(s).

**Never** **Rarely** **Sometimes** **Often**

6. Writing definitions or other short writing assignment(s).

**Never** **Rarely** **Sometimes** **Often**

7. Small investigation(s) or gathering data.

**Never** **Rarely** **Sometimes** **Often**

8. Working individually on long-term projects or experiments.

**Never** **Rarely** **Sometimes** **Often**

9. Working as a small group on long-term projects or experiments.

**Never** **Rarely** **Sometimes** **Often**

10. Finding one or more uses of the content covered.

**Never** **Rarely** **Sometimes** **Often**

11. Preparing oral reports either individually or as a small group.

**Never** **Rarely** **Sometimes** **Often**

12. Keeping a journal.

**Never** **Rarely** **Sometimes** **Often**

To be good at mathematics at school, how important do you think it is for students to…..

13. Be able to think creatively.

**Not Important** **Somewhat Important** **Very Important**

14.Understand how mathematics is used in the real world.

**Not Important** **Somewhat Important** **Very Important**

15. Be able to provide reasons to support their solutions.

**Not Important** **Somewhat Important** **Very Important**

16.

Each year many teachers must help their students learn to solve problems such as “Juan was able to run 1.5 kilometers in 5 minutes. If he was able to keep up this average speed, how far would he run in 12.5 minutes?" If you needed to help your class solve such problems, what approach or sequence of approaches do you believe would best help students learn?

Place a '1’ in the box in the right-hand margin next to the approach you believe to be the best. If you believe other approaches would also be acceptable, place a number in the box next to each one indicating the order in which you would consider using it. You need not chose more than one approach. Write zero in the box for any approach you do not consider acceptable.

| Teaching Approaches | |
|---|---|
| a. I would present a general graph such as a graph with a constant ratio of change in ‘x’ to change in ‘y’ is one important mathematical tool for solving problems like this. | |
| b. I would present the method of using proportional equations to solve this problem, as in:<br><br>1.5=x->5x=(1.5)(12.5)>x=18.75/5=3.75km<br>5 12.5<br><br>After presenting other examples of this problem, I would assign practice exercises to students. | |
| c. I would use the method suggested by the textbook for dealing with problems of this type, carrying out the strategy suggested by the textbook | |
| d. I would work with students to develop a reasonable graph for this specific problem, and then work with students on using the properties of graphs like this one to find a numerical solution to the problem. | |
| e. I would have students use a calculator to find pairs of numbers that related to how long a person has to run at a constant average speed to find how far that person has travelled. I would then have students use these pairs of numbers to study how to determine the distance a person running at constant average speed would travel in a given time. | |
| f. I would divide the class into several groups and have the students in each group work together on the problem until each group found a method for solving the given problem and then found a method that would work for similar problems. | |

Appendix D: Confidentiality Agreement

CONFIDENTIALITY AGREEMENT

Name of Signer: ____________________________

During the course of my activity in collecting data for this research: "Dissertation" I will have access to information, which is confidential and should not be disclosed. I acknowledge that the information must remain confidential, and that improper disclosure of confidential information can be damaging to the participant.

By signing this Confidentiality Agreement I acknowledge and agree that:

- I will not disclose or discuss any confidential information with others, including friends or family.
- I will not in any way divulge, copy, release, sell, loan, alter or destroy any confidential information except as properly authorized.
- I will not discuss confidential information where others can overhear the conversation. I understand that it is not acceptable to discuss confidential information even if the participant's name is not used.
- I will not make any unauthorized transmissions, inquiries, modification or purging of confidential information.
- I agree that my obligations under this agreement will continue after termination of the job that I will perform.
- I understand that violation of this agreement will have legal implications.
- I will only access or use systems or devices I'm officially authorized to access and I will not demonstrate the operation or function of systems or devices to unauthorized individuals.

Signing this document, I acknowledge that I have read the agreement and I agree to comply with all the terms and conditions stated above.

**Signature:** ______________ **Date:**____________

# Appendix E: Letter of Cooperation

please sent

[redacted]

[redacted] PUBLIC SCHOOLS
RESEARCH PROPOSAL TRANSMITTAL FORM

This form should be initiated by the investigator who is proposing to conduct research in the [redacted] Public Schools [redacted]. The investigator should complete all items in Part A and required Research Proposal outlined on page 3 of this form. Please allow 4 to 5 weeks for the review of your proposal and letter providing the results of the review.

The completed proposal should be sent to [redacted], Executive Assistant to the Chief Academic Officer, by email, [redacted].

For [redacted] Research Review Committee use only

1. Date received from Principal Investigator: ?

2. Routed for review to: N/A Date: ______

To be completed by [redacted] Research Review Committee reviewer:

RESULTS OF THE REVIEW:

1. This proposal: ______ Qualifies for exempt status.

______ Requires a review by the [redacted] Research Review Committee.

2. This proposal: ✓ is approved with no modifications or additional information required.
______ is not approved, and requires the following modifications and/or additional information, as described on the reviewer feedback form.
______ is not approved for reasons provided by the reviewer.

3. Signature of [redacted] Reviewer: ______ Date: ______

4. Date returned to [redacted] Research Review Committee Chair: N/A

**PART A (to be completed by the Principal Investigator):**

Project Title: Algebra instruction for all: The relationship between teachers' personal theories of teaching and learning and their use of math interventions.

Principal Investigator Name: Nicole P. Jones
Street Address: 14 Tower Road
City, State, Zip Code: East Hartford, CT 06108
Phone Number and Email: 860-695-6150 (w); 860-214-4954 (c); jonen001@hartfordschools.org
Name of Organization/University: Walden University

Check all that apply:
______ X [redacted] Employee
______ University Faculty
______ University Student (undergraduate or graduate)
______ Other, please describe:

If a student, please provide the following information:
Major Advisor: Dr. Stephanie Gaddy
Campus Address: 650 S. Exeter Street, Baltimore, MD 21202
Campus Telephone: 866-492-5336

Note: Proposals that have not been approved by a dissertation committee may not be submitted to the [redacted] Research Review Committee. Has this research proposal been approved by the appropriate thesis or dissertation committee?

Check one: __x__ YES ______ NO

1. If your research involves the use of human subjects or data governed by other institutions, attach evidence of approval granted to you by the Institutional Review Board (IRB) or Human Subjects Committee (HSC) of those institutions, which permits your use of the subjects or data.

2. If your research involves the use of human subjects or data governed by other institutions, which do not have an IRB or HSC, attach evidence of approval granted to you by those institutions, which permits your use of the subjects or data.

3. Does your research involve subjects younger than 18 years of age?

Check one: ____ YES __x__ NO

**To be completed by Principal Investigator:**
I attest that all information stated in the Proposal Transmittal Form is true.

Signature of Principal Investigator: Nicole Jones ______ Date 5/19/16

**To be completed by Research Advisor (if applicable):**
I attest that I have reviewed this proposal and approve the content. To the best of my knowledge, the content is accurate, the study is methodologically sound, and the proposal conforms with all ethical requirements for human subjects research.

Signature of Research Advisor: Stephanie A. Gaddy, Ed.D. Date 5/20/2016

PRINCIPAL INVESTIGATOR CHECKLIST:
PLEASE CONFIRM THAT YOUR PROPOSAL INCLUDES ALL OF THE FOLLOWING ITEMS BY CHECKING IN THE APPROPRIATE COLUMN

| **Please address all items, a-j, in your research proposal. Do not attach your grant, dissertation, or thesis proposal. Rather summarize your research methodology using the format of this proposal transmittal form.** | YES | N/A *(Explain)* |
|---|---|---|
| a. Project description - including a description of the study population and study purpose. **Not to exceed 3 pages.** Provide a project timeline as well. | x | |
| b. Brief description of activities involving humans or human data (include participant selection procedures, sequence of procedures, numbers of participants and time commitment expectations). **Not to exceed 3 pages.** | x | |
| c. Provide a brief description of procedures related to participant confidentiality or anonymity. | x | |
| d. Samples of all informed consent and/or participant assent documents (see specific details for informed consent requirements below). | x | |
| e. Provide an assessment of participant risk for: 1) physical injury; and 2) psychological injury | x | |
| f. Describe any benefit to be gained by the participant and/or the District. | x | |
| g. Provide a brief description of any debriefing procedures. | x | |
| h. Attach a copy of all measures (e.g., questionnaires, scales, interview schedules, or focus group questions) | x | |
| i. Provide copy of all recruitment materials (i.e., letter of invitation, ads, flyers, emails, phone script) | x | |
| j. Attach proof of Principal Investigator's Institutional Review Board submission (e.g., pending approval letter) | | pending |

| **Please include all of the following in your informed consent forms (d):** | | |
|---|---|---|
| Description of the basic purpose of the research to the participant. | x | |
| Description of what participants will do and expected duration of participation. | x | |
| Description of benefits, or the lack of benefit, for participation (e.g. experimental credits). | x | |
| Description of experimental procedures to be followed. | | n/a |
| Description of foreseeable risks or discomforts (or lack of any known risks). | x | |
| A statement that participation is voluntary and that withdrawal will involve no penalty or loss of benefits to which participant is otherwise entitled. | x | |
| A statement describing the extent and procedures by which confidentiality of information will be maintained. | x | |
| Information that would allow the participant to contact the primary researcher and his/her advisor if applicable for student research. | x | |
| Text written at a readable level for the participant population. | x | |
| The following two sentences: If you have questions about your rights as a participant, please contact the school principal. | x | |

# Appendix F: Electronic Communication with Dr. Walker

**Nicole Jones** <nicole.jones7@waldenu.edu> 12/28/15
to cmwalker

Dear Dr. Walker,

I am a doctoral student from Walden University writing my dissertation tentatively titled "Teachers' Personal Theories of Teaching and Learning and the Use of Math Interventions" under the direction of my dissertation committee chaired by Dr. Stephanie Gaddy.

I would like your permission to reproduce a modified version of your Teacher Survey (Walker, 1999) in my research study. For my research study I will use questions #1 - 15. Your survey will be used under the following conditions:

- I will use this survey only for my research study and will not sell or use it with any compensated or curriculum development activities.
- I will include the copyright statement on all copies of the instrument.
- I will send my research study and one copy of reports, articles, and the like that make use of these survey data promptly to your attention.

If these are acceptable terms and conditions, please indicate so by signing one copy of this letter and returning it to me either through postal mail or e-mail. Mailing address = Nicole P. Jones, 14 Tower Road, East Hartford, CT 06108.

Sincerely,

Nicole P. Jones, Doctoral Candidate

Expected date of completion 05/01/2016

**Cindy M Walker** <cmwalker@uwm.edu> 12/28/15
to me

I am not sure what survey you are talking about...

*****************************************************************

Cindy M. Walker, PhD
Associate Dean of Research & Engaged Scholarship
Professor, Department of Educational Psychology
Director, Consulting Office for Research and Evaluation
Associate Editor, Applied Psychological Measurement
Board Member, National Council of Measurement in Education
School of Education
University of Wisconsin - Milwaukee
END 599
PO Box 413
Milwaukee, WI 53201
414.229.5441 (office)
414.218.2442 (cell)
cmwalker@uwm.edu

**Nicole Jones** <nicole.jones7@waldenu.edu> 12/29/15

to Cindy

Hello Dr. Walker,

I'm referring to the Teacher Survey in the paper/article, "The effects of different pedagogical approaches in mathematics' students achievement". I found the survey while conducting a search with ERIC. You presented the paper at the AERA conference in 1999.

...

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**Cindy M Walker** <cmwalker@uwm.edu> 1/4/16

to me

That scale is based on items from TIMMS, which is in the public domain, so you are free to use the scale. Good luck!

Cindy

*******************************************************************

Cindy M. Walker, PhD
Associate Dean of Research & Engaged Scholarship
Professor, Department of Educational Psychology
Director, Consulting Office for Research and Evaluation
Associate Editor, Applied Psychological Measurement
Board Member, National Council of Measurement in Education
School of Education
University of Wisconsin - Milwaukee