2019

The Effects of Common Core State Standards in Mathematics on Inclusive Environments

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Walden University
2019

Abstract

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MA, Walden University, 2008

BS, Virginia State University, 1983

Dissertation Submitted in Partial Fulfillment

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May 12, 2019

Abstract

The Common Core State Standards for Mathematics (CCSSM) require students with learning disabilities in mathematics to use a range of cognitive, skills, and foundational numerical competencies to learn and understand complex standards. Students with learning disabilities in mathematics experience deficits in cognitive processes skills and foundational numerical competencies which have emerged as underlying barriers associated with mastering CCSSM. Examining the impact of high-stakes assessments on readiness for college and careers and student achievement may provide evidence that deficits in cognitive processing skills and numerical competencies can impact achievement levels. Using the cognitive theoretical frameworks of Bandura and Gagné, along with the concepts of cognitive learning, instructional interventions, and inclusion, the relationship between students' scores in the algebraic foundations (AF) intervention inclusion method and the regular algebra (RA) nonintervention inclusion method, as measured on the end of the year assessments were examined in this study. An ANCOVA design was used to test the statistical significance of the relationship between the two intervention methods and the use of cognitive and numerical competencies for the two groups and to analyze the disparity in achievement scores between the AF intervention inclusion method and RA nonintervention inclusion method. The results revealed a statistically significant relationship between cognitive processing skills and foundational numerical competencies as measured on the final exam for both methods. The intended audience include academic communities using evidence-based inventions to improve college and career readiness results, leading to positive social change.

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Dedication

This dissertation is dedicated to my parents, Arlgo and James Jordan, along with my four children: Chalika,.Byron Jr., David, and Jerrel. I want to say thank you for all your support and understanding during this long journey. Your constant encouragement helped me to hang in there and finish the journey.

Acknowledgments

I wish to acknowledge some of the people that helped me to succeed in getting this degree. To my committee chair, Dr. LeDosquet, thank you for your guidance, support, patience, and friendship over these many years as I pursued my degree. To Dr. Smith, thank you for your candid discussions and advice during this dissertation process. I want to especially acknowledge and thank my family and friends who helped and contributed so much to my success. To my siblings, I want to say thank you for all your patience and support during my journey. To my extended family, I would like to thank each of you for your encouragement and support. To my dear friend Kimnada (Sunshine) Bobb, thank you for encouraging me to embark on this doctoral journey. Finally, a special acknowledgement to my children, Byron Jr., David, Jerrel, and Chalika, your love, patience, and understanding during this long journey is greatly appreciated. It would not have been the same without your love, support, and encouragement.

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Chapter 1: Introduction to the Study

INTRODUCTION

In 2010, the Common Core State Standards Initiative (CCSSI; 2010) enacted state legislation that instituted a common set of new standards containing the core knowledge and skills that all students are expected to know for English/language arts and mathematics at each grade level in order to be college and career ready after high school. The CCSSI were designed as an overarching instructional framework for K - 12 teachers to follow in order to address the expectations of what all students should know and be able to do by high school graduation as a result of mastering the Common Core standards (Powell, Fuchs, & Fuchs, 2013). In order to reach these goals, students must be exposed to evidence-based practices and have highly-qualified instructors guiding them (Schmidt & Houang, 2012). According to the authors of Common Core, if students show mastery of all the mathematical common core standards, they will be college-and-career ready in mathematics (CCSSI, 2010). Conley (2010) defined college and career readiness (CCR) as:

> The level of preparation a student needs in order to enroll and succeed-without remediation-in a credit bearing course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program, or high-quality certificate program that enables the student to enter a career pathway with potential future advancement. (p. 21)

Conley's (2010) definition described the minimum level of skills that students are expected to have obtained during their high school academic career in order to experience success in a college environment or career endeavors, or in other words, the minimum level of what CCR should look like for all students. Conley suggested that all students, including students with special needs, covet four dimensions of CCR for maximum learning impact and preparation: (a) cognitive strategies, (b) content knowledge, (c) academic behaviors, and (d) college knowledge. However, extant research was sporadic when it comes to what this picture should look like for students enrolled in special education programs.

The Common Core mathematics standards demand a shift from the traditional teaching and learning paradigm to one that includes a change in instructional methods and, in some cases, the learning environment as well. The key factors, in the end, are providing the necessary skills to achieve CCR in mathematics (Christinson, Wiggs, Lassiter, & Cook, 2012). The Common Core mathematics initiative necessitates moving away from traditional math instructional methods where lessons are teacher centered instead of student centered. The new instructional math paradigm involves using teaching pathways that contain an integrated math framework that is capable of providing the conceptual understanding and processing competencies required by each Common Core standard (Christinson et al., 2012). Posamentier and Krulik (2015) commented on teacher-centered instructional models, stating, “Teacher-dominated lessons (sometimes referred to as chalk and talk) are usually not effective because they do not adequately engage students” (p. 9).

It is not only the traditional instructional model of the teacher centered approach that has to be addressed, remarked Christinson et al. (2012), but the traditional mathematics curriculum pathways that fall short of the qualifications necessary to enter institutions of higher learning at the level requested by universities and colleges. Christinson et al. suggested the following pathways be considered as a substitute for the traditional pathway in order to meet the level of requirements necessary for college readiness: (a) integrated, (b) accelerated, and (c) double-up (p. 10). The standards apply to all students, including students with disabilities (SWD) that intend to graduate with a high school diploma. According to CCSSI (2010):

> The standards define what students should understand and be able to do in their study of mathematics…. the standards set grade-specific standards but do not define the intervention, methods, or materials necessary to support students well below or well above level grade-level expectations…. It is also beyond the scope of the Standards to define the full range of supports for English language learners and for students with special needs. (p. 4)

The teaching and learning mandates required by the Common Core State Standards for Mathematics (CCSSM) present tremendous challenges for inclusion teachers with regards to providing special education services in an inclusive environment. Perhaps not the same challenges as teaching an accelerated inclusion class, but definitely challenges associated with children with special needs mastering the CCSSM (Doabler et al., 2014). In fact, for children with disabilities, mastering the CCSSM grade-level standards will certainly build a stronger content knowledge base, improve self-efficacy, and demonstrate independence (Kleinert et al., 2015). Furthermore, the CCSSM will give students with special needs more opportunities to select higher course levels of mathematics that may ultimately lead to new pathways and the potential for positive social change (Kleinert et al., 2015).

In this study, I focused on inclusion and the evidence-based interventions that have been found to be effective for teaching children with math disabilities (MD) in various inclusion models. A review of literature revealed that, while there were tremendous teaching challenges associated with inclusion, there were barriers impeding the progress for students with MD receiving special education services in an inclusion setting. These findings reflected the significant number of students attempting to access the Common Core standards curriculum for mathematics and finding out they cannot due to deficits in numerical and cognitive competencies (Jimenez & Staples, 2015; Powell & Stecker, 2014; Schmidt & Burroughs, 2013). Children with MD tend to exhibit challenges in domains that have been identified as part of the bases for the underpinning framework of the math content and practice standards (Fuchs et al., 2014). The core structure of the CCSSM framework is constructed by attributes found in cognitive processing skills and foundational numerical competencies (Powell & Stecker, 2014).

My investigation into the effectiveness of inclusion teaching models and the benefits of their services to children who have special needs was significant for several reasons. First, I highlighted the fact that students with MD need to be college and career ready post high school just as all their peers are required to be (see Powell & Stecker, 2014). It was also important to identify those barriers that are preventing students with MD equitable opportunity and access to the general education curriculum (see Kleinert et al., 2015). By identifying how the mathematics core standards were being taught to children with disabilities, it helped to understand what works, what needs to be improved, and what practices need to be eliminated.

Inclusive interventions provide alternative pathways for students with disabilities in high school (SWD_HS) to experience positive social change through taking higher levels of mathematics and taking advantage of the opportunity available to students with MD. Also, the benefits of acquiring 21st century math skills that will be useful and necessary to compete in a global society can also lead to personal independence and positive social change. Finally, the findings from this study can be used to inform teachers, administrators, and other stakeholders of cognitive strategies, academic behaviors, and instructional methods that are evidence-based and effective in an inclusion setting.

In Chapter 1, I will discuss student achievement, cognitive processing skills, and foundational numerical skills and present evidence for providing interventions that include strategies that measure progress towards mastering the CCSSM. Additionally, I will discuss student content knowledge, academic behaviors, and college knowledge and present evidence for providing strategies that measure progress towards mastering CCR skills. The remainder of Chapter 1 will include the background for the study, along with the problem statement, purpose of the study, hypotheses, theoretical framework, nature of the study, definitions, assumptions, scope and delimitations, limitations, significance, and conclude with a summary of the study.

Background of the Study

The Application to Students with Disabilities report suggested, that SWD be provided with needed supports, accommodations, and related services in order to realize the Common Core promises (CCSSI, 2010). For example, Universal Design for Learning and Response to Intervention are evidence-based supports that have been recommended by the CCSSI (2010) and the Individual with Disabilities Education Act (IDEA: 2004) for providing specialized instruction. The IDEA promised access to the curriculum standards, and the CCSS included the promise that all students will be college and career ready by the time they graduate high school, provided they master the standards (CCSSI, 2010)**.** Under the current initiatives, CCSSM and IDEA can be united by defining and accomplishing what all students should be able to understand and do after completing their high school careers in mathematics.

Under IDEA (2004), SWD were granted access to the general education curriculum and placed in the least restrictive environment (LRE) for academic instruction with supports. In most cases, this placement was in a general education inclusion classroom with their nondisabled peers (McLeskey & Waldron, 2014). One of the goals advocated by LRE is the opportunity for students with special needs, to the appropriate extent possible, be included in an educational learning environment that is conducive to improving their social and practical skills as well their academic achievement levels (McLeskey, Landers, Williamson, & Hoppy, 2012). The LRE initiative mandates that children with special needs make progress in the general education classroom as well as on assessments (McLeskey et al., 2014). Portions of this legislation require interventions be made by schools that use evidence-based practices and establish student outcomes that reflect the coherence between the student's individual education plan (IEP) and curriculum (McLeskey et al., 2014).

Least Restrictive Environment

Application of the LRE mandate extends to a range of placement settings for children with special needs: however, in this study I was focused on the inclusion of students with special needs who are being educated in general education classrooms for 80% of the school day (see McLeskey et al., 2014). Thirty-nine percent of students who have been identified under IDEA (2004) are students with a learning disability, and approximately 62% of those students receive 80% of their academic instruction in inclusion classes (Brady, Duffy, Hazelkorn, & Bucholz, 2014). The goal for IDEA is to include 90% of children with special needs in inclusion classrooms for 80% of the school day (McLeskey et al., 2014).

According to McLeskey et al. (2014), in a 2-year study, the percentages of children with special needs involved in inclusion classes have increased significantly due to changes in the identification process for students with special needs. Unfortunately, when factoring the growth rate of special education programs, the special education student dropout rate, the high school certificate of completion pathway taken by children with special needs, and low-test scores, little progress had been made with regards to closing the achievement gaps for students with special needs (McLeskey et al., 2014). While only small gains were reported by McLeskey et al. in academic achievement, in a 3-year study, Fuchs et al. (2014) examined inclusive fraction instruction versus use of the specialized fraction intervention model and found significantly stronger learning tendencies and smaller post-intervention achievement gaps for the specialized fraction intervention compared to the inclusive fraction instructional method. The authors reported higher expectations and evidence-based interventions strategies as a contributing factor to the differences in student outcomes.

There have been mixed results regarding the effectiveness of inclusion programs for students with learning disabilities (Brady et al., 2014; Powell & Stecker, 2014). Controversies over the achievement gap, high expectations, and graduation rates have emerged as inclusion concerns for school districts across the United States (Center on Education Policy, 2013). Inclusion of students with special needs in the regular education classroom has significantly changed the way instruction is administered (Lee, 2012). According to Kunkel (2013), “Inclusion is a philosophical belief that all students can be educated in a single environment, even though a wide range of academic diversity may exist. Students with disabilities learn age-appropriate material at levels commensurate with their certified ability” (p. 4). This definition is not exhaustive for describing the inclusion perspective, however, it exposes the overwhelming challenges for teachers associated with accountability under No Child Left Behind (NCLB, 2001) and the difficult task of improving achievement scores for SWD under IDEA, 2004 (Croteau, 2014).

McLeskey and Waldron (2014) found that, although many school districts are making progress with regards to school inclusion, many efforts by schools to become equitable, inclusive, and effective often postured IDEA, NCLB, and CCSSM legislative acts as competing demands. Moreover, their research suggested that instead of viewing them as competing demands, schools must unite the three legislative acts in order to safeguard the letter and spirit of all three laws. However, only a limited number of schools have been able to successfully accomplish this goal (McLeskey & Waldron, 2014).

The instructional demands inherent in CCSSM have clearly articulated the framework's essential qualities in providing content and knowledge that will benefit students with special needs upon leaving high school (Brady et al., 2014). From the beginning, when developing the CCSS, high expectations were set for all students including children with special needs. Consideration was given to the appropriateness of CCR in light of having access to the general education curriculum. Much research has already been conducted on inclusion and inclusive practices in mathematics (e.g., Doabler et al., 2014; Fuchs et al., 2014); however, because the Partnership for Assessment of Readiness for College and Careers (PARCC) assessments of the CCSSM were in their second year, not much research data were available on the impact of the common core standards on foundational numerical skills and the cognitive processing skills necessary to access the standards associated with common core at the high school level. The CCSSM (2010) initiative required that all students, including children with MD, obtain a deeper understanding of mathematics and master the standards at each level before moving on to the next level of core mathematics standards. These proficiency requirements hold true for all students regardless of whether the student is in the special education or regular education program (Conley, 2010).

The complexity of the mathematics standards and the limited pathways available for SWD present barriers that students with special needs must face in order to pursue the overarching ideas of CCR. According to Brady et al. (2014), with the institution of the common core mathematics standards, standardized mathematics assessments, and lack of coherent instructional practices, reaching these higher pathways will be difficult but not impossible. Therefore, in order to realize the promises of CCR, children with mathematics disabilities will need to access the general education curriculum by using highly-qualified instructors, evidence-based-instructional methods of instruction, and having an IEP that is aligned with the general education curriculum.

According to McLeskey et al. (2014), an IEP that is aligned with the general education curriculum will allow SWD to address the same grade-level mathematics standards as all other students are required to master. The CCSSM initiative is not specific about how to align the general education curriculum and the IEP; however, the standards are more focused, which allows the IEP developer to include supports that will make the standards grade-level accessible (McLeskey et al., 2014). The implications for SWD are the positive impact these supports will have addressing the barriers associated with CCSSM for Mathematics and the promise of positive social change through CCR (McLeskey & Waldron, 2014).

By the 2012 school year, 45 states and three territories had adopted the common core of national math standards (Powell et al., 2013). The CCSSM were released as a national initiative to reform and unify mathematics standards in the United States (Center for Educational Policy, 2013). The standards are divided into two sections: K – 12 standards and CCR standards (Christinson et al., 2012). The mandates driving the collaboration between federal, state, and local education agencies are an attempt to define a core set of knowledge and skills that should be acquired by all students in order to prepare them for college or careers; this federal mandate includes students with special needs (Powell & Stecker, 2014).

The CCSS proposed legislation that require students to be college and/or career ready after completing high school. Along with the CCSS, many states have also adopted the PARCC examination as their testing consortium (Center for Educational Policy, 2013). This body is composed of 22 states that collaborate in order to create assessments for the CCSSM (Center for Educational Policy, 2013). The PARCC assessments track students' performance and progress over time in order to measure their growth toward achieving CCR. The CCSS and PARCC initiatives will align with the general curriculum to provide greater access for students with an IEP and help facilitate reaching the learning goals and objectives listed on the IEP (Fuchs et al., 2013).

The CCSSM, the mandates set forth in NCLB, and the special education mandates from IDEA (2004) have left some professionals despondent and overwhelmed by the number of legislative responsibilities they must follow in order to remain compliant with the various legislative initiatives (Kleinert et al., 2015). According to Brady et al. (2014), there are mixed results about the effectiveness of the interventions being used in inclusion classes. The CCSS require teachers to implement challenging instruction that will meet the new standards plus address college readiness and vocational readiness skills (Conley, 2010). Also, embedded in the new policies is a mandate that children receiving special education services be responsible for demonstrating what they know and can do on high stakes assessments without many of the accommodations they may have received in the past (Brady et al., 2014). Educators must design high-quality lessons that will cover the new assessments created by PARCC.

High stakes assessments, on the standards, moved into full implementation during the 2012 - 2013 academic school year (Kunkel, 2013). Students no longer participated in the-end-of-the-year middle school assessment (MSA). Some problems that emerged related to the CCSS for children with special needs were located in the test designs, testing accommodations, and complexity of the assessments (Kunkel, 2013). Additionally, general educators now need to know and implement a number of legislative mandates and new evidence-based strategies in order to replace years of testing accommodations and alternative testing modifications (Center on Education Policy, 2013; Kunkel, 2013).

SWD face significant challenges under CCSS. Perhaps the biggest challenge for SWD is the requirement to meet the same rigorous learning outcomes as their general education peers. However, in those cases where the academic parameters were clearly identified and instruction was properly instituted, SWD experienced overall improvement on high-stakes assessments (Saunders et al. 2013). The graduation rates among SWD remained constant at approximately 30% for a 6-year period, while inclusive classes increased 62% over the same period (Brady et al., 2014).

Employing effective learning and instructional interventions are paramount to the success of students with MD; especially in an inclusive environment. Conley (2010) explained that CCR includes preparing students to enter their freshman year of college without needing to take remedial courses during their freshmen year or entering the workforce ready for the challenges and expectations of a career. Current research suggests that close to 60% of all first-year college students are not ready for the rigor of college courses, and approximately 3 million college students (or 39%) are currently taking remedial math and 34% are currently taking high-school math identified as College Algebra (Center on Education Policy, 2013; National Conference of State Legislators, 2014). These statistics include children with special needs as well.

A few goals driving the mathematics initiative are the efforts to close the achievement gaps and improve student learning and the quality of instruction. The common core standards have linked together many of the core human learning strategies with many of the foundational numerical skills that have been reported as essential to being CCR (Brady et al., 2014). One reminder, under CCSS, children with special needs that are working towards a high school diploma were held to the same rigorous curriculum standards and high-stakes assessments as nondisabled, general education students (Brady et al., 2014).

There are many teaching models being used in inclusive classrooms to teach the CCSSM, and some teachers present the CCSSM using instructional frameworks that may or may not be inclusive of cognitive and intellectual strategies. For example, the 2010 - 2011 overall proficiency gap in mathematics between the lowest subgroup and the highest subgroup was 43.2% (Center on Education Policy, 2013). The percentage gap identified in mathematics was relatively consistent across the curriculum for other subjects and vertically among grade levels K - 12 (Brady et al., 2014).

Gap in Knowledge /Need for Study

In this study I focused on two instructional delivery models: the AF intervention inclusion model employs the coteaching model; modified instructional time; accommodations; and various special education-based strategies (i.e.; pullouts, tutoring, and one-to-one; Kleinert et al., 2015). The RA nonintervention inclusion model employs the one teacher model and direct instruction method. While both teaching models were found to be effective, only one study (i.e., Kleinert et al., 2015) compared similar models to this present study under controlled conditions. The researchers found significant development in mathematics competences under controlled conditions; however, no attempt was made to compare the groups in terms of academic readiness. In a continued search of the literature concerning the topic of CCSSM, special education delivery services, and modified inclusion settings, I found no empirical comparisons between these two inclusion models and no comparative PARCC assessment scores between the two models. Therefore, with this study, I had the opportunity to provide insight into the effectiveness of the AF intervention model in comparison to the RA nonintervention inclusion model and address this gap in the literature.

This study was warranted to highlight the need for children with disabilities to have the opportunity to participate in the CCR promise. There are many students with MD attending college, enrolling in vocational courses, and many more immediately entering the workforce after high school. More importantly, special education programs are expanding at a rate of over 25% per year on the way to meeting the projected goal of 90% full inclusion (Brady et al., 2014). A decrease in the number of qualified general and special educators available to teach inclusion programs has also been projected (Saunders, Bethune, Spooner, & Browder, 2013).

The development of academic readiness skills are important in both teaching models and a major focus of the CCR initiative. Because there is a projected increase in the number of special education students being serviced in inclusive classes, improvement in academic outcomes would have positive social change implications for SWD. In this study, I compared the academic, cognitive, and numerical readiness of ninth grade, freshmen students who had completed their first year being taught with the AF intervention inclusion method with those who completed their first year being taught with the RA nonintervention inclusion method as measured on the PARCC exam. The results of this study provided insight as to whether students with MD, under these two teaching methods, achieved the academic readiness skills required by CCSSM.

The findings of this study highlighted the impact foundational numerical processing skills have on student's ability to access the general education curriculum and the inconsistencies associated with implementing the CCSSM in an inclusive environment. Klinger, Boardan, and McMaster (2013) found that, when it comes to education reform, the implementation process must be overarching to avoid using the traditional one teacher and one school at a time process. They suggested scaling up professional development and emphasized sustaining evidence-based practices as a districtwide effort in order to meet the core math goals of the entire district and special education programs.

Additionally, the results of this study highlighted the inequality experienced by students with math learning disabilities in inclusion classes and the unequal opportunity they face in accessing the mathematics curriculum or achieving CCR status. According to Christinson et al. (2012), the standards for mathematics are part of a strategic effort to motivate more students to pursue majors in college and careers in science, technology, engineering, and mathematics. The primary focus of the national standards is to encourage students to obtain a deeper understanding of mathematics concepts, apply a variety of critical thinking skills, and gain a comprehensive view of how math works in the real world (Christinson et al., 2012). One of the primary goals of the CCSSM (2010) is to provide an academic framework that will prepare American students for college and career endeavors, as well as interacting with and taking a more visible lead in a global society (Christinson et al., 2012).

Problem Statement

My initial review of the literature revealed two things: (a) the relationship between academic achievement and foundational numerical competences was unclear and, (b) educators do not know why students with special needs are having difficulty relating to the CCSSM, and they do not understand the impact of standardized testing on student achievement levels (Powell et al., 2013). Therefore, the problem was, while educators know that the CCSSM initiative is geared towards making mathematic standards accessible for all students, researchers do not know how these standards have impacted the achievement gaps for children with MD using the AF intervention method.

The CCSSM require students with MD to use a range of foundational numerical competencies to learn and understand the complex standards (Cirino, Fuchs, Elias, Powell, & Schumacher, 2013). The CCSSI mandated that students demonstrate mastery of grade-level standards on the PARCC examination before moving on to the next level. Researchers have noted that students with MD that struggled in lower grades with foundational numerical competences experienced an overwhelming challenge trying to access the accelerated CCSSM for high school (Doabler et al., 2014; Powell et al., 2013).

According to Powell et al. (2013), "… 95% of students identified with a mathematics learning disability before fifth grade continue to struggle with mathematics in high school" (p. 40). Learning disabilities accounts for 39% of students identified under the IDEA (Brady et al., 2014). Emerging research has suggested that many interventions being used are instructionally beneficial for children with special needs; however, researchers have also suggested that many high school students have MD are struggling to make adequate progress in an accelerated standards-based system (Christinson et al., 2012; Powell et al., 2013).

For several years, general and special educators have been trying to increase the academic rigor along with closing the achievement gap for students with special needs (Powell & Stecker, 2014). Of the many aspects of CCSSM, the assessment scores are arguably the key component in determining a student's understanding and mastery of the mathematics standards (Christinson et al., 2012). Recent literature reviews on the IEP outcomes and special education services being delivered during inclusion models found gaps between the demands of the inclusion instructional setting, student achievement levels, and numerical competencies skills on standardized tests (Brady et al., 2014; Jimenez & Staples, 2015).

Purpose of the Study

The purpose of this quantitative, group comparative study was to evaluate the effectiveness of the mathematics intervention approach provided by the AF inclusion method. In this study, I established whether the AF intervention inclusion method improved student achievement test scores compared to the RA nonintervention inclusion method. The comparison was used to determine the effectiveness of the AF intervention inclusion model to increase academic rigor and improve achievement test scores in mathematics.

I also compared to what extent the scores of students in the AF intervention inclusion model differed on the PARCC assessments from those in the RA nonintervention inclusion model. The independent variables in this study were the AF intervention method and the RA nonintervention method, while, the dependent variable was the end-of-year PARCC examination that was administered to all ninth grade students. The pretest was the covariate in the study.

Research Questions

RQ 1: Is there a difference in the performance assessment scores on the posttest means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

H_{01}: There is no statistically significant difference in the performance assessment scores on the posttest means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

H_{a1}: There is a statistically significant difference in the performance assessment scores on the posttest means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

RQ 2: Is there a difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

H_{02}: There is no statistically significant difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

H_{a2}: There is a statistically significant difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

RQ 3: Is there a relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination?

H_{03}: There is no statistically significant relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination?

H_{a3}: There is a statistically significant relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination?

Theoretical Framework

The theoretical basis for this study was the social cognitive theory and self-regulating systems. These theories addressed different ways of studying the cognitive processes that are associated with various methods of human learning and behavior. According to Bandura (1971), social cognitive theory has been used extensively in several areas of human learning and educational development. Additionally, social cognitive theory has been applied to affective processes, perceived self-efficacy, motivation, and pedagogy (Bandura, 1971; Bottge et al., 2015; Fuchs et al., 2014). Bandura’s (1994) social cognitive theory of self-regulation approach addresses different ways of studying causal processes that are associated with various methods of human learning and purposeful performances.

The application of Bandura’s theory of self-regulation has been used extensively to study several areas of human behavior, instructional interventions, and cognitive restructuring (Bandura, 1991; 1995). This theory indicates that social cognitive performances are regulated and driven by self-persuasion to act on an event (Bandura, 1991). I employed social cognitive theory in this, study, to describe the purposeful use of cognitive processes by individuals and the behaviors associated with their actions.

By using Bandura’s social cognitive theory with the framework of cognitive processing standards found in the CCSSM and the foundational numerical competencies that are required by students with MD, I obtained an understanding of the level of academic mastery in this area for students with MD. Additionally, my underlying logic for selecting this theoretical framework and conducting the investigation on cognitive human learning was to offer guidance into the motivation, intentions, and participatory control mechanisms being directed by cognitive processors (see Bandura, 1994). If students with special needs believe that they have access and equitable opportunity to achieve CCR and other stakeholders will follow through on their instructional promises, they can obtain higher achievement levels than currently, and improve their testing scores, then students with MD will show significant improvements on the PARCC examination (Bottge et al., 2014).

Nature of the Study

I used a quantitative, group comparative study approach in this study. Quantitative group comparative studies are consistent with measuring academic achievement, isolating interventions, and identifying relationships between and among groups (Creswell, 2003), which was my primary focus with this study. By keeping the secondary focus on how students use their cognitive processes, I was consistent with investigating the disparity in mathematics achievement levels for children receiving a mathematics intervention and students not receiving a mathematics intervention (see Doabler, 2014; Watt, Watkins, & Abbitt, 2014). Descriptive statistics are appropriate for presenting large amounts of quantitative data in simple and easy to understand forms

(Trochim & Donnelly, 2007). Additionally, the quantitative analysis revealed the extent that foundational numerical competencies, in association with CCSSM, were mastered by students with an IEP as well (see Saunders et al. 2013).

The independent variables in this study were the AF intervention and the RA nonintervention methods. I collected data concerning the two teaching methods on performance levels (i.e., math scores), achievement levels (i.e., constructed response), and correlation significance of task types (i.e., cognitive skills and numerical competencies) as measured on the PARCC end-of-year assessments. The dependent variable included the PARCC end-of-year achievement scores for mathematics performance, achievement levels, and correlation of task types. Comparing the means of these two groups allowed me to generalize the findings to the accessible population. Additionally, the ANCOVA model was appropriate for measuring the statistical difference between two or more variables on a pretest and posttest while controlling for initial differences in the groups.

The data I analyzed in the study included archived data from the 2015 - 2016 and 2016 - 2017 end-of-year assessments. My analysis determined the disparity in academic performance, achievement levels, and correlation of task types in the mean sample scores of the two independent variables labeled AF intervention inclusion model and RA control inclusion model. The 2015 - 2016 data acted as the pretest and covariate, and the 2016 - 2017 data acted as the posttest and dependent variable in the study. My secondary focus was on student's purposeful use of their cognitive processes and numerical skills to address mathematics topics (see Norwhich & Ylonen, 2014). This area of focus was consistent with Bandura’s (1991) self-regulatory system and understanding causal processes in purposeful actions based on external influences.

Definitions of Terms

Algebraic foundations (AF) inclusion. An on-grade-level, high school freshman inclusion algebra class employing a coteaching model of instruction. Modifications are present with regards to instructional time, materials, and implementation of various interventions (Powel & Stecker, 2014).

Cognitive processing standards. Thinking processes involved in the acquisition, organization, and use of information (Bandura, 1994).

Common core mathematics conceptual categories. Numbers and quantities, high school algebra, functions, modeling, geometry, statistics, and probability (Kanold & Larson, 2012).

Foundational numerical competencies. Knowledge of numbers, counting, number combinations, operations, algorithms, rote counting, symbol use, and patterns (Jimenez & Staples, 2015).

Math learning disabilities (MD). A deficit in the automatic retrieval of simple arithmetic problems due to barriers associated and interacting with computation skills. For example, complex math problems associated with CCSSM standards may over stimulate the working memory capacity in students with MD (Christinson et al., 2012).

Mathematics processing standards. Standards that address problem-solving, reasoning abstractly and quantitatively, constructing arguments and critiquing the reasoning of others, model using mathematics, attend to precision, make use of structure, and be consistent recognizing patterns and reasoning (Zimmermann, Carter, Kanold, & Toncheff, 2012).

Mathematics task types. PARCC (2015) mathematics items that measure critical thinking, mathematical reasoning, and the ability to apply skills and knowledge to real-world problems (p. 2).

PARCC mathematics scoring rubrics. The scoring rubric describes the level of achievement a response demonstrates for each score point. PARCC (2015) mathematics rubrics are specific to each reasoning and model item (p. 2).

Partnership for assessment of readiness for college and careers (PARCC). A computer-based assessment comprised of constructed response questions, performance-based tasks, critical thinking competences, communications skills, and problem-solving skills (Kanold & Larson, 2012).

Regular algebra (RA) inclusion. An on-grade-level, high school freshmen inclusion algebra class. The class is inclusive of students with and without disabilities, one general educator, and non-modified instructional time and employs direct instruction as main teaching method (Powel & Stecker, 2014).

Specialized intervention. “Intervention programs that rely on carefully designed, complex instructional routines, based on principles of explicit instruction and state-of-the-art understanding of the domain” (Fuchs et al., 2014, p. 136).

Assumptions

I made the following assumptions in this study:

- Teachers followed all modifications, accommodations, and instructions described in each student’s IEP.
- Teachers implemented the AF intervention inclusion model based upon the IEP for SWD.
- All teachers in the inclusion teaching models received the school district’s professional development training for effective evidence-based teaching strategies.
- I was unbiased and impartial in retrieving and the analysis of data.
- The assessment that was utilized in this study was a reliable measure of student achievement as measured by the PARCC examination.

Scope and Delimitations

The scope of this study was to determine the impact of AF intervention inclusion model assessment scores of ninth grade students compared to scores from the RA nonintervention inclusion model in an eastern U.S. school district. Of the many aspects of CCSSM, the PARCC assessment scores were arguably the key component in determining a student’s understanding and mastery of the mathematics standards (Christinson, et al., 2012). The population for the study was comprised of students with and without special needs in ninth grade algebra inclusion classes. I excluded students in self-contained, gifted classes, and independent mathematics classes because of inclusion protocols set for the study. All students attended high schools in the same school district. The independent variables were the AF intervention inclusion method and the RA nonintervention inclusion method, and the dependent variable was the PARCC end-of-year examination scores. Comparing the means of these two groups allowed me to generalize the findings to the accessible populations. Also, using an ANCOVA design was appropriate for measuring the statistical difference between two or more groups or variables (see Green & Salkind, 2008).

Limitations

I identified the following limitations in this study, they required attentiveness in the analysis of the results and hindered the ability to generalize the finding to different populations:

- The student population was limited to a school district in the eastern part of the United States. The collection of archival data substantially limited the ability to take a broad view of the findings, which may not be applicable in other school districts.
- The professional development that general education teachers received in developing strategies for the AF intervention inclusion setting was limited

and impacted student achievement and the ability to take a broad view of the findings.

- I did not observe the classroom setting, instructional practices, or classroom behaviors. This limited my ability to take a broad view of the findings.

Significance

For several years, general and special educators have been trying to increase the academic rigor and close the achievement gaps for students with special needs (Ainsworth, 2010; Saunders et al., 2013). However, for many students with MD, little progress has been realized because foundational numerical skills were either missing or extremely weak and there was not enough being done to remediate students' numerical competencies in order to overcome the foundational barriers many students with learning disabilities face (Jimenez & Staples, 2015; Powell & Stecker, 2014). Because the CCSSM were still in its early phases, this investigation addressed the sparsely-researched areas of the CCSSM, PARCC and MD was important for several reasons. The first reason was to achieve an understanding of the relationship between MD and CCSSM and how they promote positive social change by addressing the underlying barriers associated with mastering the CCSSM and by improving CCR opportunities for children with MD (Cirino et al., 2013).

This study was also key to providing teachers with data to help students with MD successfully cultivate their intellectual skills and promote crucial habits of mind, such as problem solving, persistency, strategic implementation, and social competences, that also contribute to positive social change for students with special needs (see Brady et al., 2014). Because there were no empirical comparisons studies between these two inclusion models or any comparative PARCC assessment scores between the two models, the results of this study provided insight into the effectiveness of the AF intervention inclusion model compared to the RA nonintervention inclusion model.

Social Change Implications

Students with special needs enrolled in freshman algebra classes are at the start of their final phase in the K-12 mathematics educational framework. It is important for children with MD to have the same access to the CCSS curriculum framework as others (Kunkel, 2013). It is through access to the curriculum that instructors can help transform the math capacity of this subgroup to learn higher levels of mathematics and create better opportunities to reach the CCR level. The positive social change implications of this study were apparent for children with special needs. Improving an individual's capacity to learn higher levels of math exposes them to more career fields to consider than otherwise would have been available to them. Overcoming the numeracy competence struggle helps students with MDs better understand how to handle their personal and financial affairs.

Summary

Chapter 1 included an introduction to the study, background information about the study, and the research focus that was described in the problem statement. In the purpose statement, I clarified the intent of the study, while the research questions were listed to narrow the focus of the study. In the significance of the study, I addressed the impact of providing evidence-based interventions and the potential for positive social change for SWD. In the definitions section, I introduced and provided clarification of terms that will be used in the study and in the scope and delimitations section, I provided parameters around the study.

In Chapter 2, I will present the history of the CCSS initiative and the overarching goals for 21st century education. The chapter will include a review of the theoretical perspectives selected to ground this study as well as research related to instructional methods, cognitive skills, numerical skills, and academic achievement for all students including students with MDs. In this chapter, I will also discuss the purpose, relevance, and feasibility of various instructional methods being used with special education programs. In Chapters 3, 4, and 5, I will provide the methodology, the data collection and analysis of the study, the findings, and the implications for future research.

Chapter 2: Literature Review

Review of Literature

Introduction

One of the purposes of this study was to examine the correlation between cognitive processing skills and the foundational numerical competencies that are required to access the general education mathematics curriculum. In this chapter I will discuss the possibility that the cognitive barriers associated with foundational numerical competencies may contribute to the problem of achievement for students with special needs as measured by the end-of-year PARCC assessments. Education reform is not new and certainly not new to the special education community. In fact, over the past few decades, there have been five important legislative acts that have moved special education programs from virtual obscurity to mainstream education (Tefs & Telfer, 2013). A few decades earlier, a search of the records would show, there was perhaps the most important court ruling for children with disabilities: The Brown versus Board of Education court decision. Under this ruling, children with special needs were recognized as a minority subgroup being discriminated against by the educational community (Tefs & Telfer, 2013).

A brief overview of past legislative initiatives sets the stage for the journey to CCSS. After Brown versus Board of Education, the next major education reform to effect special education programs was in 1975 with the passage of the Education for All Handicapped Children Act (EAHCA). This reform initiative was considered by many to be the first legislative act specifically focused on including and educating children with special needs in the public-school environment (Lee, 2012). After a few years, with no definitive framework for guidance, in the mid-90s, the discussion focused on the entitlement of every student to receive a free and appropriate public education (McLeskey et al., 2012). However, this law was met with inconsistent and subjective interpretations of exactly what it meant at the federal, state, and local levels (Watt et al., 2014).

In 1997, the IDEA was created from the EAHCA reform of 1975 (Kleinert et al., 2015). This legislative act moved students with special needs one step closer to inclusion with the mandate of equal access to the general education curriculum for all students (Kleinert et al., 2015). In 2001, No Child Left Behind legislation was enacted. The law was comprised of a strong framework that included accountability, adequate yearly progress, and the promise that all student would be academically proficient by 2014 school year, which turned out to be an unmet and unrealistic goal, according to Kleinert et al. (2015). Schools were now being held accountable for educating children with special needs and assessments were being used to measure the progress.

The next change to effect special education was in 2004 with the reauthorization of IDEA (Mulcahy et al., 2014). This change resulted in a stronger focus on children with special needs having access to the core of the general education curriculum (Mulcahy et al., 2014). Instructors were now required to be highly-qualified to teach, employ evidence-based interventions in the classroom, and improve learning outcomes for SWDs (Mulcahy et al., 2014). The journey of these legislative initiatives was much more complicated than portrayed in the past few paragraphs; however, each one contributed to the latest education reform entitled the CCSS.

Chapter 2 will include a discussion on current literature associated with foundational numerical competencies and recent trends on the cognitive processing skills required to access the general education curriculum and address complex mathematics problems. The following sections will include the literature search strategy, the theoretical foundation, the methodology used to investigate the hypothesis, the impact of cognitive interventions on student achievement, and key variables. In the literature review, I will also present several perspectives on human learning and methods to reach the new academic standards; including working models for assisting practitioners in meeting some of the legislative mandates mentioned. In the review, I will also discuss current literature concerning school reform, legislative interventions, human learning, and motivation.

Literature Search Strategy

I reviewed approximately 150 articles on CCSSM, end-of-year assessments, high-stakes testing, standards-driven curriculum and instruction, and cognitive processing. The following databases were reviewed to locate current literature published in the last 5 years: Educational Resources Information Center, SocINDEX, and Academic Search Premier. In addition, I reviewed the websites of the CCSSI, CCSSM, the National Council of Teachers of Mathematics, the Application to Students with Disabilities, and the National Governors Association Center for Best Practices looking for current data on student achievement.

I also included the seminal works of Bandura and Gagné. I conducted a literature search of the Internet and databases for current articles using the following key words: Common Core Mathematics, college and career readiness, cognitive processing and mathematics, common core assessments in mathematics, foundational numerical competencies, inclusion, mainstream, common core and special education, special education instruction, and mathematics interventions. All searches were filtered to search for current information; however, during the seminal investigation, classic perspectives revealed further discussions were warranted on the topic of human learning and special education services.

Theoretical Foundation

Social cognitive theory addresses various perspectives of studying causal processes associated with human learning and purposeful behaviors (Bandura, 1971). The theory also encompasses conceptualized knowledge acquired through cognitive processing of information (Bandura, 1971). In social cognitive theory, symbolic models are used as instructional tools to influence learning and developing human behaviors (Bandura, 1971). Early studies posited that there were several factors that influence cognitive and social learning (Bandura, 1971).

Two personal factors that influence cognitive and social learning are self-regulated systems and perceived self-efficacy (Bandura, 1971). Social cognitive theory maintains that self-regulated learning is purposive action exercised through motivation, affect, and forethought; while self-efficacy refers to an individual's beliefs concerning their ability to complete a task (Bandura, 1991). The personal factors involved with the self-regulated system are three subsystems: (a) self-monitoring, (b) self-efficacy, and (c) judgmental (Bandura, 1991). The personal factors involved with self-efficacy are: (a) mastery of experiences, (b) vicarious experiences, (c) social persuasion, and (d) physiological and emotional states (Bandura, 1991).

Gagné's (1965a) human learning theory suggested that learning is a causal factor in the growth and development of an individual. Previous studies explained the principles of human learning from research conducted on a variety of human performances that represented cognitive growth and maturity. Two major characteristics in Gagné's concept of human learning are the nature of complex learning and the diversity of learning. In Gagné's nature of complex learning model, growth-readiness can be identified through closely monitored patterns of mental growth. Diversity of instruction is an essential key to cognitive learning theory and the framework for addressing a variety of human capabilities (Gagné, 1988). There are five internal conditions of human learning: (a) verbal information, (b) intellectual skills, (c) cognitive strategies, (d) motor skills, and (e) attitudes (Gagné, 1988). The external conditions of the human learning process are theories of instruction that enhance the internal learning processes (Gagné, 1988). The external events that influence internal learning: (a) attention, (b) stimuli, (c) selective perception, (d) inspection and (e) deciphering of raw stimulation (Gagné, 1988).

Bandura (1971) predicted reinforcement of the observed behavior would result in a major change in the performance of the observer. The human learning theory described by Bandura assumes self-regulated decisions are key requirements for human learning. For example, Bandura proposed the observational model as the principal method to communicate information to the observer and that purposeful response resides with the observer. Bandura also assumed that the reciprocal influences of behavior, the environment, and internal processing work in tandem to produce a response to a learning event. Reciprocal determination is the term proposed to describe this reciprocal three-way interaction of influence between each domain.

Additionally, Bandura (1991) assumed that human learning expresses itself as two separate occurrences and that learning is inclusive of verbal and visual codes that model desired behaviors. Bandura suggested that human learning is fostered through the use of symbolic knowledge transmitted in the form of verbal or visual codes. Finally, Bandura assumed that in order for learning to take place modeled behavior, the reinforcement, and cognitive processers of the learner must adhere to specific requirements. In other words, the components of human learning through models of observation and decision making are: (a) the behavioral model, (b) consequences of modeled behavior, (c) learners' internal processes, and (d) perceived self-efficacy (Bandura, 1991).

Gagné (1996) hypothesized "that a single instance of learning is made up of a number of events, some internal to the learner and others external. Training effectiveness can be greatly enhanced by optimizing these internal and external conditions" (p. 7). The theoretical framework for human learning suggested by Gagné is also known as information processing theory and the transformations that take place are referred to as learning processes. Gagné assumed that due to the number of learning styles, no one set of characteristics can be applied to all learning; instead, the author identified five categories of internal learning processes to address these learning conditions. Gagné also assumed that human learning incorporated complex structures of learned skills that are acquired and advance based on prior knowledge. Based on this assumption, Gagné's framework on the conditions for learning supports the structures that underlie the concept of information processing theory.

Additionally, Gagné assumes that a sufficient understanding of the concept of learning is applied in various contexts in which teaching, and learning interventions are instituted. Gagné (1965b) proposed that teachers promote learning in natural and realistic environments. Finally, Gagné assumed the transformation is the result of input and output decisions based on stimuli received. The interaction and subsequent reaction generally indicate the performance event has been acquired. The information processing framework proposed by Gagné (1996) scientifically collects knowledge about learning and verifies the results as learning principles.

A Closer Theoretical Look

Bandura's (1971) social cognitive theory was applied during a study in which human learning was promoted through observation learning and modeling various behaviors. Bandura remarked:

> When an observer witnesses a model exhibit a sequence of responses the observer acquires, through contiguous association of sensory events, perceptual and symbolic responses possessing cue properties that are capable of eliciting, at some time after a demonstration, overt responses corresponding to those that had been modeled. (p.114)

In Bandura's (1971) study on observational learning, children were expose to different kinds of stimuli for the acquisition of imitative responses. In one demonstration, the adult-size doll was treated very aggressively by the model, in the next demonstration the model was kind to the doll, and in the third demonstration the model was passive towards the doll. The results of the study demonstrated that vicarious experiences are influential on the behaviors of the observer. The findings also revealed a significant effect on the observer based on, according to Bandura "the number of matching responses that the children spontaneously reproduced" (p. 119).

Bandura (1994) explored the effects of goal setting on the self-regulatory system and purposive action. He reported an increase in participant's effortful performance in goal setting and performance feedback, self-reactive influences, and cognitive motivation based on results from self-regulatory control studies. Bandura's study revealed the impact cognitive skills have on self-efficacy and the importance of separating learning from performance in the acquisition of human learning. Personal attainment of performance goals demonstrates a control of cognitive processes that can produce improvements in learning outcomes (Bandura, 1991).

Gagné (1996) information processing theory was applied in a study for the U.S. Air Force on technical training. The purpose of the study was to include the nine events of instruction in the design of a lesson for training air force personal to handle the massive volume of information associated with a complex 32-step procedure for checking the electrical system of a gun aboard a F-16 fighter jet. Gagné's study demonstrated the application of his information processing theory in a real-life instructional environment with novice instructional designers and no experience in designing training courses. The results of Gagné's study determined that all participants were proficient with regards to designing usable lessons for training personal to use all 32-steps in the electrical system check and all participants were successful based on the training they received on implementation and being proficient with regards to embedding the nine events of instruction into their lesson designs (Gagné, 1996).

The two studies I referenced provided varying analysis for the application of the theoretical concept of cognitive learning. Their studies are similar to my study in three ways: (a) evaluated cognitive processes and performances associated with human learning, (b) used strategies for understanding complex information, and (c) employed evidence-based instruction for student training. Both Bandura and Gagné offer theoretical perspectives that share similar attributes that I am focusing on with regards to cognitive human learn and information processing. Table 1 displays theoretical information about internal processes, external processes, and educational applications for human learning.

Table 1

Summary of Cognitive Competencies

Human Learning	Bandura	Gagné
Internal Processes	Attentional Processes	Intellectual Skills
	Retention Processes	Cognitive Strategies
	Motivational Processes	Verbal Information
	Motor Reproduction	Motor Skills
		Attitude
External Processes	Modeled Events	Gaining Attention
	Purposeful Behavior	Informing the learner
	Physical capabilities	Stimulating Recall
	External Reinforcement	Stimulus
	Arousal Levels	Guided Practice
	Perceptual Skills	Performance
	Sensory Capacities	Providing Feedback
		Retention/Transfer
Education/Career	Lesson Designs	Lesson Designs
	Classroom Issues	Job Training
	Academic Readiness	Self-Instruction
	Transfer of Learning	Group Instruction

Social Cognitive Theory and CCSSM

Cognitive learning theory is well suited for studying the thinking processes, acquisitions of knowledge, and purposeful behaviors produced by individuals in a learning environment. Additionally, social cognitive theory addresses the components of learning that include the learning processes, perception, prior knowledge, comprehension, and information storage (Bandura, 1991; Gagné, 1996). The CCSSM practice standards include social cognitive skills that call for individuals to attend to, look for, and model with cognitive competencies (Kunkel, 2013).

Bandura's (1991) social cognitive theory and Gagné's (1996) information processing theory are proper selections for investigating the cognitive skills and foundational numerical competencies of students with MD. By using the social cognitive theory model to investigate areas of comprehension, executive function, perception, and self-regulation may provide guidance with regards to providing effective interventions for students with MD. Finally, human learning theory proposed by Bandura, and Gagné posit that individuals learn using cognitive processes and external stimuli. The use of cognitive processing theory as a conduit for gaining access to the CCR and career readiness are attributes which provided the rational for selecting this theory.

To address the need for improving mathematics for all students, including students with special needs, the CCSSM provide a set of standards that are more in-depth conceptually and instructionally coherent then are previous reform initiatives. More specifically, the mathematical practice standards are primarily concerned with students using their cognitive skills to obtain deeper levels of conceptual knowledge and understanding of content information (Christinson et al., 2012). Development of the CCSSM has introduced deeper and more complex mathematics standards than any other educational initiative to date. This development has led to a shift in the instructional paradigm for mathematics. In other words, in addition to teaching math concepts teachers must also impart cognitive processing skills and numerical competency skills that are associated with the students individual learning style and close the rigor gap (Christinson et al., 2012; Zimmermann et al., 2012). According to Christinson et al. (2012), in order to close the rigor gap for children with special needs, early interventions, and focusing on teaching models that are based on the infancy phases of Common Core must be a part of the framework for learning.

Literature Review Related to Key Variables

A thorough search of current literature revealed a limited number of studies comparing the achievement levels of students with MD to foundational numerical skills, cognitive processing skills, and CCSSM. However, there was research available that included pre and post assessments for children with MD, response to intervention, and self-contained classroom instruction (Croteau, 2014). The following studies offer value to the present study because of their similar use of cognitive learning perspectives, foundational mathematics skills, classroom interventions, and/or various instructional models. The methods implemented also serve as valuable examples for my study with regards to understanding the designs of various classroom interventions that can be used in association with social cognitive theory:

Interventions and Studies

Mathematics interventions: Doabler et al. (2013) conducted a multifaceted observation study on improving student's achievement scores on the CCSSM. The purpose of the study was to extend the knowledge on the early learning in mathematics (ELM) curriculum. The design of the study was to investigate explicit mathematics instruction in an inclusion environment. The researchers observed two groups of students. One group employed ELM with teachers using explicit instruction while the other group used the standardized instructional framework recommended by the school district. The researchers predicted that at-risk students for MD would benefit from ELM and explicit instruction.

The authors randomly selected 61 classrooms for the treatment program and 68 classrooms for comparison out of 129 total elementary school classrooms. Approximately 2,700 students from 46 schools participated in the study. The authors used four observation instruments to measure the efficacy of the ELM curriculum. Based on the results of a series of independent sample *t* - tests, the ELM classes significantly outperformed the comparison classes.

This study connects with the present study by implementing explicit mathematics instruction to inclusive treatment groups, while the comparison groups continued with the standardized mathematics instructional framework. The authors of the study used similar independents variables with regards to a treatment classroom and comparison classroom. A common characteristic shared between the two studies are efforts to improve achievement scores for all students specifically those students in the treatment group. The

Doabler et al. (2014) study investigated the MD along with the ELM curriculum and explicit instruction in association with CCSS at the elementary school level. However, the present study will investigate interventions and achievements at the high school level and employ archival data as oppose to observational data.

Achievement gaps/instructional time: Fuchs et al. (2014) examined the achievement gaps on fractions for children with MD as measured by CCSSM. The study covered 3 years of achievement scores for students that scored at or below the 10_{th} percentile in mathematics compared to a mean standard score of ~75. Achievement scores were also indexed for gaps in relation to their peers without disabilities. Fuchs et al. conducted a study using two service delivery models. The first group received specialized instructions on fractions in a general education inclusive classroom, also receiving an additional 90 min per week of math instruction in year 1 and year 2.

The regular inclusive fraction class received no additional instruction. The authors used a comparative analysis instrument to index posttreatment achievement gaps between the tradition inclusion class teaching fractions and the specialized fraction intervention inclusion class. Results indicated smaller achievement gaps were realized by the intervention group than the traditional fraction group. However, the authors reported, for both groups, as CCSSM standards increased in complexity the achievement gaps increased for both groups.

Fuchs et al. (2014) study parallels this present study in several ways. The authors restricted their study to inclusion classes that contained students that have mathematics disabilities. They also discussed the implications of SWD having access to the general education curriculum. By year 3, Fuchs et al. increased the instructional time of the specialized fraction intervention by 80% over the tradition inclusion class.

Academic sensory performance: Mulcahy, Maccini, Wright, and Miller (2014) conducted research on the implementation of CCSSM and students with emotional/behavioral disorders (EBD). The researcher's literature review included evidence-based interventions for improving mathematics performance among students with EBD in middle and high school. The authors included in their search background data on the participants, the settings, interventionists, interventions, and CCSM alignment. Two recommendations made by the study were that all students have foundational skills and the conceptual knowledge required for understanding grade level mathematics. Published literature suggests that students with EBD have significantly higher deficits in MD and these deficits tend to increase by middle and high school. The investigators in this study conducted research on inclusion classes with the following research criteria: mathematics performance scores were used as the dependent variable; the intervention and school-age students were independent variables.

Mulcahy et al., 2014 investigation included self-contained classes, inclusion classes, remedial classes in correctional facilities, and private schools. The study contained instructional strategies, delivery models, environmental issue, in addition to several interventions. The study also included self-regulated interventions for students involved with his or her own academic performance. The authors found that most of the programs abandoned teaching foundational math concepts above the basic level prior to high school. They went on to comment that, for SWD to access higher courses levels in math, algebra and geometry, foundational numerical competencies are a minimum requirement. The study connects with the present study by examining interventions for improving mathematics achievement, knowledge of foundational skills, and conceptual knowledge. The study also used the CCSSM as the dependent variable and the test scores to measure achievement levels.

Numeracy skills: Jimenez and Staples (2015) used a single subject across three classrooms to investigate the effects building numeracy skills in students with intellectual disabilities through embedded instruction that included guided practice on building mathematical skills. The CCSSM require all students implement strategies that are inclusive of foundational numerical competencies (e.g., knowledge of numbers, counting, number combinations, operations, and algorithms) as well as the appropriate cognitive strategies. The authors of this study found that many students in this subgroup had limited access to the general curriculum because they lacked numeracy skills.

According to the researchers, the need to build foundational numerical competencies in students, that include mathematical thinking and reasoning skills should begin as early as infancy and continue through the first five years of growth. The researcher in the study used the Common Core Alternative Assessment based on the Alternate Achievement Standards (AA-AAS). Results of the study indicate that there is a functional relationship between early numeracy skills, the intervention, and learning new grade level CCSSM. The authors of this study task analyzed two of the six Common Core mathematics conceptual categories across four math standards addressing specific numeracy skills. For example, a lesson in algebra (the category) on algebraic thinking-patterns (the standard) will assess the student on recognizing and extending patterns (the numeracy skill) of a number set. The results of the study indicated that all participants improved on the number of correct responses on the AA-AAS.

The study conducted by Jimenez and Staples (2015) connects with this present study by task-analyzing the Common Core math standards to ascertain the numeracy competencies necessary to access the general education curriculum and the math standards. I seek to add to the knowledge about achievement, for students with MD, on high-stakes testing, foundational numeracy skills, and instructional practices that are evidence-based. Whereas, in the Jimenez and Staples limited study, students with EBD were only graded on completing the steps correctly in complex math problems on the task-analyzed grade-aligned math standard and two content categories.

Inclusion and specialized invention: Cirino et al. (2013) compared four subgroups of students with various levels of cognitive and learning difficulties in reading and mathematics. The subgroups included students with MD, reading difficulties, both with MD and reading difficulties, and no learning difficulties. The study focused on foundational numerical competencies that are used to process links between math symbols, quantification, and number combinations. The authors suggest these competencies are directly related to math performances and the language required to solve simple and complex math problems.

The KeyMath-R assessment was administered in order to identify deficits in numerical competencies; the test reliability was .91. The Woodcock-Johnson-III tests of Cognitive Abilities was also administered in order to identify cognitive deficits in processing. Test reliability was .81 to .83. These two tests were used to evaluate the numeracy and cognitive summaries of each student in the study. The purpose of this study was to expound upon a previous investigation into building foundational numerical competencies in SWD. The authors found cognitive limitations in math fluency (processing speed) and problem solving (strategies) for MD and MD and reading difficulties subgroups. This study has value to my study with regards to the implications of the relationship between cognitive and foundational competencies effect on working memory. The results of this study pointed out that the MD subgroup had trouble in all areas compared to the other groups and processing speed to be an increasing issue.

Evidence-based practices: Watt et al. (2014) explored effective instructional practices in algebra for teaching students with mathematics learning disabilities. The authors did a literature review on studies that contained effective interventions that have been implemented with students with learning disabilities in an algebra setting. According to the investigators, the achievement gap is largest in algebra and among this subgroup. A 40-point deficit exist between students with MD and students without achievement scores at the eighth-grade level. Areas highlighted as concerns included algebraic inequalities, identifying graphs, and problem solving. The authors recommend evidence-based practices such as enhanced anchored instruction (EAI) and self-monitoring as highly effective interventions for teaching the new algebra standards. In addition, they suggest five essential components for creating effective curriculum and instruction: (a) explicit instruction, (b) use of heuristics, (c) verbalization of mathematical reasoning, (d) visual representation to solve problems, and (e) sequencing (p. 2). The researchers also coded grade level CCSSM standards and measured them against grade level outcomes. Students were randomly selected for either traditional algebra instruction or EAI instruction.

Watt et al. (2014) literature review looked at five evidence-based interventions to address the complexity of algebra content encountered by many students with MD. One of the purposes of the study was to extend the knowledge associated with MD and effective algebra interventions. The results of the study advanced the discipline with 15 studies not included previously.

Impact of evidence-based practices: Bottge et al. (2015) conducted a study that measured the achievement levels of students with MD taking math under two different instructional models. The research contained 25 classrooms from 24 middle schools. Both mathematics classrooms were inclusion and contained one general education teacher and one special education teacher in a coteaching model. The first model was comprised of 28% of students with MD and implemented enhanced anchored instruction in their math class. The second math class was comprised of 29% of the students with MD and employed business as usual instruction in their classrooms. Two researchers developed the standardized math assessments and administered them as well.

This action may have biased the assessment as well as the students taking the assessments. The results of the study showed that students with MD in the enhanced anchored instruction math class significantly improved their math scores from pre-to-posttest in comparison to business as usual student's slight gains. It should be noted that students without MD that participated in enhanced anchored instruction also significantly increased their achievement scores in comparison to a slight increase from the student in the business as usual class. This study connects with the present study in determining barriers to accessing the general education curriculum in mathematics. Contributing factors may involve encoding, comorbid learning difficulties (i.e., math, reading), and the efficacy of co-taught general educational classrooms.

Self-efficacy (teachers and students): Harrell-Williams, Sorto, Pierce, Lesser, and Murphy (2014) explored the attitudes and beliefs of teacher's efficacy to effectively provide instruction in statistics under CCSSM. The authors used the Self-Efficacy to Teach Statistics (SETS) instrument to evaluate $n = 309$ teacher's self-efficacy to teach some statistical topics to middle school students as required by CCSSM. The SETS instrument was selected because it addresses the areas of class-room management, student interaction and motivation, and implementing technology as an instructional tool.

The instrument also measures teacher's effectiveness, Harrell-Williams et al. (2014), stated "content knowledge, pedagogical content knowledge, and beliefs and attitudes regarding content" (p. 41). The authors focused on statistical literacy instead of age in order to measure teacher's statistical proficiencies, attitudes and beliefs towards statistics. Harrell-Williams et al., talked about the two levels used for measurement, he stated, "Level A, focused on teacher provided questions answerable by census of their class and Level B starts to include questions that are posed by students and that acknowledge random selection, sampling variability, and between-group differences" (p. 41). The rating scale used to interpret data from the survey questionnaire revealed that only 15% of the teachers were not at all confident to deliver statistical instruction in association with CCSSM, while just 27% responded as being completely confident to provide statistical instruction in association with CCSSM. The structure of the scale contained 6 categories ranging from not confident to completely confidence. The results of this study indicated that an unexpected high rate of teachers were below the 40% expected guideline and 6 teachers' performance only ranged from 14% to 35% of the expected guideline of teacher's efficacy to teach statistics under Common Core.

Cognitive skills: Sforza, Tienken, and Eunyoung (2016) explored the claim that Common Core math standards required Higher-Order thinking skills in comparison to previous state standards. In a comparative study the authors used the Webb's Depth of Knowledge (DOK) framework to comprise a framework for the level of thinking required by the CCSS. The authors suggest that the CCSS commitment to CCR has been constructed with reasoning, understanding, problem solving, and precision embedded in the standards and curriculum in order to promote creative and productive thinking:

> The purposeful cognitive design of curriculum standards and the dangers of functional fixedness are understood during the creation of curriculum standards, then standards can potentially increase cognitive originality and flexibility, by ensuring that a mix of cognitive levels appears throughout the standards in each subject and for each grade level. (p. 4)

This study addressed the levels of thinking required by the CCSS and compared them to the New Jersey state curriculum in English and mathematics content standards. A content analysis was conducted to compare the CCSSM with the New Jersey state core curriculum content standards. According to the investigators, the 2009 state standards contained a greater percentage of high-order thinking standards than the 2010 CCSSM. Sforza et al. (2016) expressed concern about the opportunity for students learning and acquiring the strategic thinking skills needed to be competitive in a global community. This study connects with the present study by using the DOK conceptual framework within an educational study that includes rating the standards according to the cognitive complexity of CCSSM. The authors state:

> Attributes and key words for each DOK level provide descriptive language and concrete boundaries for abstract concepts like strategic thinking. Each DOK level in Webb's framework describes a specific type of thinking and its associated cognitive complexity. In general, the higher the cognitive complexity of a standard, the more creativity and strategic thinking will be embedded in it. (p.4)

In this present study, I seek to identify those algebra standards that present the greatest barriers to students with MD. As well as identify creative thinking strategies, identify barriers embedded in the math standards, and provide evidence for effective classroom instruction.

College and career readiness gaps: Brady et al. (2015) discussed the impact of CCSSM on graduation rates for SWD. They explained the unintended outcomes and consequences of the new policy change. They found over a 3-year period that special education programs were experiencing a 62% year-over-year increase in the number of students identified for special education services, however, the graduation rate remained constant at 30% during the same period. The IDEA (2004) mandates required SWD receive instruction in the least restive environment. In many cases that means instruction in an inclusive environment with peers that do not have a disability.

The authors expressed mix results from their findings concerning whether inclusion improves the educational experience for children with special needs. According to the authors, during the 2008 - 2009 school year, 33% of SWD enrolled in 9th grade classes were not promoted to the 10th grade. Brady et al. (2015) also reported a similar trend in the 2003 -2004 school year, of those students who remained, 54% earn a regular high school diploma, while the remaining 45% received an alternative exit document entitled certificate of completion; 31% dropped out and “14% either earned a certificate of completion, reached maximum age, or died” (p. 242). The 2008 - 2009 results of the study show a positive increase in the inclusion rate for 8th grade from 28% to 38% and for the 12th grade inclusion rates increased from 44% to 68%. The complexity of the CCSS and high-stakes assessments were believed to have exacerbated the exodus from high school for children with special needs during the 2012 - 2013 school year.

Task analysis: Powell, Fuchs, and Fuchs (2013) research focused on the CCSSM and students with MD gaining quality access to the Common Core Math standards. The standards guide teachers through a coherent framework of mathematics standards structured to promote a deeper understanding of the content information. The authors specifically addressed the 9th through 12th grade Common Core standards that may be particularly challenging to students with MD due to the prerequisites associated with foundational numerical skills.

These foundational skills include: (a) knowledge of numbers, (b) number combinations, (c) counting, (d) operations, and (e) algorithms. For example, counting difficulties may manifest themselves as double-counting events, miscounting number values, comparing numbers, or void of problem-solving strategies. The researchers also pointed out that many high school instructors believe there is not enough time to reteach foundational skills while teaching the current Common Core Math standards. Their research suggests the use of explicit instruction, conceptual learning, procedural learning, and other evidence-base strategies were found to improve acquisition of the skills and knowledge required to access CCSS.

Achievement gaps: Lee (2012) compared performance standards, benchmarks, and norms (i.e., college admission scores) to determine college readiness gaps among all students. Special focus was place on gaps that included various subgroups such as racial and social subgroups. The author of this study addressed the issues associated with college readiness that exist at the preschool level all the way through 12_{th} grade. The researcher suggest, current pathways to college readiness will fall short of perceived achievement trajectories. The results of the study suggest, entrance into institutions of higher learning are challenging because certain math instructional levels were not achieved. Lee attributes these findings to the differences between what math concepts colleges desire students to know and understand, and knowledge of what is being taught. In other words, there is misalignment in the coherence of the K-12 math framework that has resulted in many math students not taking the necessary courses that reflects a strong math background to college admissions.

Online assessments: Croteau (2014) conducted a study to determine the value of formative assessments as measures of predictability in teacher's instructional methods. The online assessments were used as a tool to help with the alignment of math standards. According to the author, "the main purpose of the assessment is to provide feedback that can be used to increase student content knowledge, skills, and understanding" (p.1). The results of the study indicated that there was a significant relationship between the predictability of a student's success on the end-of-year summative assessment based on the online formative assessment and the iReady system.

Common core aligned: Polikoff (2015) study addressed the alignment of textbooks to the CCSS. The researcher investigated seven textbooks to determine if they were aligned with the CCSS framework. The publication dates of the textbooks reviewed ranged from 2009 – 2012. According to the author, the claims of alignment to the standards are questionable; for example, most textbooks encourage rote memory techniques over problem-solving and higher-order thinking strategies that are mandated by the CCSS. The author used the Surveys of Enacted Curriculum (SEC) to measure the alignment of the textbooks to the standards. The results of the study indicated that the textbooks content was only between 28% to 40% in alignment with CCSS.

Cognitive perspective: Hennessey, Higley, and Chesnut (2012) addressed several learning theories and best practices for classroom instruction. The authors of this study explored the benefits of using a cognitive framework that included competencies such as cognitive skills, working memory, attention, patterns, and information processing. Hennessey et al. suggested that a persuasive pedagogy framework "facilitates learning experiences that promote problem solving, reasoning and proof, communication, links prior knowledge, and multiple representations of information mathematics educators often use" (p. 189). Radical Constructivism is one framework announced by the researcher as an effective approach to helping students grasps the knowledge and skills like modeling, articulation, reflection, and exploration. Hennessey et al. also found improvement in students cognitive learning abilities to use strategies effectively for learning. Six cognitive teaching models were highlighted by authors:

- Social Constructivism – method used to help students grasp concepts through shared reality and each student constructs his owning meaning. Used under the guidance of a professional (i.e., teacher, instructional coach, tutor).
- Radical Constructivism – teaching method based on building cognitive learning structures based on self-view of reality. The framework is designed around dialogue between teacher and student with the goal of understanding the instructional material and promoting insightful learning.
- Constructivism and Math Standards – is largely problem-based where students are encouraged to reason their way through the problem. Framed around students and teachers exploring answers to relevant real-world challenges using case studies and some sought of format to aid in discovery.
- Persuasive Pedagogy – is like social constructivism patterned after the scientific method of inquiry, this method involves higher-order thinking skills, reasoning, conjecture, and testing hypothesis.

- Discovery Learning – very similar to inquiry learning in that students manipulate their environment, exploring different views, debating, problem-solving, experimenting, and analyzing data.
- Problem-based Learning – is presenting authentic answers to real-life problems based on many solutions. This learning method is contrary to traditional methods of instruction where students are preloaded with facts, skills, and guidance before approaching the problem. Problem-based learning attacks the problem first using prior knowledge, competencies, and skills.

This study connects with my study in identifying effective evidence-based learning approaches that have proven to improve academic achievement. The CCSSM require instructors to know several learning approaches for implementation with a variety of learning styles. The present study on learning interventions seeks to improve students with MD acquisition of math concepts, thereby improving their numerical competencies, and academic achievement scores. Table 2 offers a consolidated look at some of the dependent and independent variables used by other researchers during their investigation on various instructional interventions. These studies offer value to my investigation based on the variables used in their studies, the focus of the studies, and/or the instructional settings employed.

Table 2

Summary of Current Studies and Focus

References	Dependent Variable	Variable(s)	Focus
Doabler et al. (2014)	ELM	Inclusion	Numerical
Fuch et al. (2014)	Specialized	Inclusion	Num/Cog
Mulcahy et al. (2014)	Standardized test	Inclusion	Numerical
Jimenez and Staple (2015)	Task-analysis	Inclusion	Num/Cog
Cieino et al. (2013)	Standardized test	Inclusion	Num/Cog
Watt et al. (2014)	Math Standards	Inclusion	Num/Cog
Bottge et al. (2014)	Math Standards	Inclusion	Numerical
Harrell-Williams et al. (2014)	Survey	Preservice	Numerical
Sforza et al. (2016)	Math Standards	Inclusion	Cognitive
Brady et al. (2014)	Math Standards	Inclusion	Numerical
Powell et al. (2013)	Process Standard	Case Study	Num/Cog
Lee (2012)	Perform Standards	Inclusion	Numerical
Croteau (2014)	Formative Test	Inclusion	Cognitive
Polikoff (2015)	Math Textbooks	Inclusion	Num/Cog
Turan & Goktas (2016)	Theories	Inclusion	Cognitive

Note. Settings include classrooms; ELM = early learning in mathematics; Num/Cog = numbers skills and cognitive skills; Specialized = self-contained classroom; Standards = common core or state math standards.

Critiques of Previous Findings

Over the past decade substantial research has been conducted on inclusive classrooms and interventions available for instruction with children who have special needs. These studies are comprised of, but not limited to inclusion, cognitive strategies, numerical competencies, and classroom interventions. However, not many studies have related cognitive processes, numerical competencies, and classroom interventions that will be measured by the PARCC assessments at the high school level.

Some qualitative studies found educators were unsure of their abilities to effectively teach parts of the CCSS statistics curriculum and others described the impact of inclusion and high stakes assessments with children who have special needs as very troubling (Harrell-Williams et al., 2014; Norwich & Ylonen, 2015). Some quantitative studies analyzed achievement scores, student's performance, and assessments to determine to what extent the inclusion teaching models are effective academic interventions, are supported by empirical evidence, and improve learning outcomes for SWD (Brady et al., 2014; Doabler, et al., 2014). Continued research may provide rich evidence that can be used to improve instructional outcomes for children with special needs by investigating this topic more in-depth at the high school level.

One goal of this present study i**s** to identify academic knowledge about various interventions and effective teaching models that address many issues in mathematics experienced by students with MD. The CCSSM require all students to use of a host of cognitive processing skills and numerical competencies to access the more rigorous mathematics curriculum. For example, identifying potential barriers to curricular access and instruction that affects classroom performance (e.g., perception, math expressions, problem solving, math computations) is significant to the intervention selection. Additionally, an understanding of the cognitive processing requirements (e.g., comprehension, working memory, self-regulation, sustaining effort) associated with various interventions can inform lesson planning, intervention selection, and framework design during the selection process (Watt et. al., 2014).

The present literature review found that several researchers investigated the competencies and employed statistical comparisons of two or more math classrooms (independent variables) against various assessment responses (dependent variable), however, most of these studies were conducted at the elementary and middle school levels (Fuchs et al., 2014; Powell, et al., 2013; Watt, et al., 2014). An investigation of these competencies, at the high school level, will offer a contrast to the elementary and middle school level studies available concerning servicing students with MD in an inclusive environment. Both studies are crucial to better understanding deficits in numerical competencies and patterns of cognitive performances that emerge as barriers to curricular access and instructional challenges at the high school level (Cirino et al., 2013; Powell et al., 2013).

Researchers agree, more studies are needed to better understand human learning in diverse classrooms of the 21_{st} century (Graybeal, 2013; Powell et al., 2013). Thus, the rational for selecting these variables has to do with addressing factors associated with foundational numerical competencies and the learning difficulties experienced by this subgroup at the high school level. One goal of the CCSS is to guide students to a deeper understanding of fewer mathematics concepts and away from the traditional pathways that focus on a variety of content information and less on depth of content knowledge (CCSSM, 2010). This study will provide insight into helping to accomplish this goal.

Synthesis of Research Findings

There are several studies available on inclusion and cognitive competencies for children with disabilities that have conducted over the past few decades. Various inclusive models have been implemented across the United States for different reasons. Recent review of current literature yielded several articles that included inclusion classrooms, self-contained classrooms, curriculums, teacher beliefs, and the impact of standardized testing on student achievement (Bottge et al., 2014; Powell & Stecker, 2014; Sforza et al., 2016). Quantitative and qualitative studies have responded with results to various research questions concerning students with MD and academic achievement. The number of quantitative and qualitative investigations, that include elementary and middle school special education programs far exceed those investigations at the high school level.

Research on numerical competencies have been conducted more at the elementary and middle school level, than with high school students. Due to the infancy of the CCSSM and the recent roll out of the PARCC assessments, research is limited with regards to academic performance and achievement levels for students with MD. I found two existing studies that investigated MD and Common Core task-analysis in conjunction with grade level assessments (Jimenez & Staples, 2015; Sforza, et al., 2016).

Furthermore, no additional research was discovered that indicated a perspective other than the ones reported by the current study. Further review of the literature revealed two things. First, the relationship between academic achievement and foundational numerical competencies is unclear. Second, we really don’t know why students with MD are having difficulty relating to the new mathematics standards, nor do we understand the impact of standardized testing on achievement levels (Brady et al., 2014; Powell et al., 2013). Table 3 list the various interventions that were identified during this study and implemented with inclusion classrooms, self-contained classrooms, modified classrooms, and other teaching models. The list in Table 3 is not exhaustive.

Table 3

Summary of Interventions and Conditions of Instruction

Intervention (type)	Dependent Variable(s)	Setting	Focus
Explicit instruction	Pretest/posttest	Inclusion	NF
Enhance anchored instruction	Computation skills	Inclusion	P/S
Direct instruction	Number correct	Inclusion	P/S
Self-regulation	Academic accuracy	Inclusion	S
iPad math applications	Number correct	Inclusion	P/S
Contextual instruction	Posttest	Inclusion	P
High preference sequence	Accuracy per minute	Separate	S
Team assisted individualization	On-task behavior/posttest	Remedial	S
Self-instruction	Accuracy of computation	Inclusion	S
Token economy	Percentage correct	Separate	P/S/NF
Cover, copy, and compare	Number correct	Separate	S
Data based instruction	Pretest/Posttest	Inclusion	OA
Traditional instruction	Pretest/Posttest	Inclusion	NO
Universal design for learning	Posttest	Inclusion	EE/OA
Response to intervention	Pretest/Posttest	Inclusion	P/S
Computer-assisted instruction	Posttest	Inclusion	NF
Teachers: planning/procedures	Professional Development	Inclusion	NF
Self-monitoring	Accuracy	Separate	S

Note. NO =number operations; NF = number fractions; PS = primary/secondary; EE = expressions/equations; S = separate.

Summary and Conclusions

I presented throughout Chapter 2 evidence that evidence-based interventions are important tools for helping children with special needs to succeed in the general education curriculum. Additionally, research supports the need to examine and support professional development for teachers, the role of foundational competencies, and student achievement as factors to consider when investigating interventions that will be used with children who have special needs. Various themes emerged such as explicit instruction, the impact of foundational numerical competencies, the impact of self-efficacy, and the difficulties of selecting effective evidence-based interventions to be used with student who have learning MD. One additional theme that emerged during the literature review concerning students with special needs. There was a clear indication that the rigorous framework of the CCSSM and the interventions proposed contained a disconnect that resulted in lower math achievements scores, and expectations for children with special needs (Lee, 2012).

What is known about the standards for mathematics are that educators will need to have full knowledge and understanding of CCSSM curriculum and the accompanying assessments that will be used to measure mastery of the standards. It is clear that the standards establish a framework of high expectations, real world relevance, and prerequisite skills for college and career endeavors after high school. Current research suggests, in the 21_{st} century classroom, instructors are not only disseminators of knowledge, but facilitators of the prerequisites of competencies that are necessary for students with MD to access the standards (Graybeal, 2013; Powell & Stecker, 2014).

Students with MD are either lacking or are so weak in these skills that remediation of their foundational skills are imperative if they are expected to meet and master the standards.

Current research was also limited with regards to the effect's technology has had on students with MD learning grade-level standards and how using this technology has translated into overcoming barriers associated with CCSS. For example, misaligned textbooks and instructional materials, using manipulatives, and demonstrating proficient or adequate computer skills are a concern. Additionally, there may be other pitfalls due to teachers not having a clear grasp of how to interpret the standards and extend the learning for children with special needs as required by the mathematics standards (Croteau, 2014; Polikoff, 2015).

This study will fill at least one gap in the literature by providing a deeper understanding into the relationship between MD, mathematics standards, and achievement. Many of the studies reviewed during this investigation looked foundational numerical competencies at the elementary and middle school levels, but few at the high school level. There are no studies that address these two independent variables and this dependent variable, in association with cognitive processing strategies and foundational numerical competencies as measured by the PARCC exam at the high school level.

This literature review demonstrates that the CCSSM require the use of cognitive skills and evidence-based interventions in order to make proficient progress in the area of mathematics for children with special needs and to gain access to the general education curriculum. The literature reviews revealed evidence that there are several teaching models, that address cognitive human learning, being implemented with students who have MD and were consistent with implementing the overarching framework for information processing theory. Thus, the frameworks described in this literature review should be viewed as multiple methods of instructional interventions that will enable teachers to provide evidence-based practices and equitable learning opportunities for students with MD. Moreover, the goal of identifying a criterion for cognitive performances and foundational numerical competencies to be measured on the posttest intervention assessments was identified. In Chapter 3, I discuss the research design, the methodology, the participants in the study, the data analysis plan, threats to validity, and ethical procedures.

Chapter 3: Research Method

METHODOLOGY

Introduction

The purpose of this quantitative group comparison study was to explore to what extent the AF intervention inclusion teaching method is more effective on the end-of-year PARCC mathematics assessments compared the RA nonintervention inclusion teaching method. This study was limited to a school district located in the mid-Atlantic region of the United States. The participants completed the PARCC assessments in order to demonstrate mastery, or lack thereof, of the grade level CCSSM.

My aim with this study was to measure the disparity, or lack thereof, in achievement levels based on test scores. The sections of the chapter will include the introduction, research design, the methodology, and population. In this chapter, I will also discuss the procedures for recruitment, participation, and data collection associated with the use of archival data. The chapter will also contain discussions of an operational definition for each variable, the data analysis plan, threats to validity, and ethical procedures, before concluding with a summary. The IRB approval number for this study is 04-03-18-0030818.

Research Design and Rationale

In this quantitative study, I used a comparative group study design to analyze and collect data on the pretest/posttest results for the AF intervention inclusion method and the RA nonintervention inclusion method. This research design allowed me to make comparisons and generalize the research findings from these two groups to the accessible population (see Frankfort-Nachmias & Nachmias, 2008). To examine Research Question 1, I used an ANCOVA design to measure the difference in the mean and standard deviation of performance scores for the two groups after adjusting for the pre-test scores. To address Research Question 2, an ANCOVA design was used to measure the difference in the mean and standard deviation of achievement levels after adjusting for the pre-test scores. To examine Research Question 3, I used an ANCOVA design to measure the statistical significance of the relationship between the intervention methods and the cognitive and numerical competencies level for the two groups after adjusting for the pretest. The quantitative group comparison design also allowed me to analyze numerical data using descriptive statistics to provide descriptions through numerical calculations, graphs, or tables for data clarity. Additionally, the use of inferential statistics permitted me to make inferences about the accessible population from the data.

I sought to advance knowledge in human learning theory and information processing theory and use a quantitative group comparison approach to describe the theoretical underpinnings for this study. Creswell (2003) argued that quantitative approaches have been used to test or verifies theories as well as relationships between and among groups. The AF intervention group employed a variety of evidence-based interventions that included two teachers, additional instructional time, and student-centered teaching strategies as part of the intervention framework, while the RA nonintervention inclusion group employed the traditional method of teaching instruction, including one teacher and a teacher-centered instructional framework. The design notation structure for the pretest/posttest group design was depicted in Table 4 as follows:

Table 4

Research Design: Pretest/Posttest Group Design

Sources	Group Design		
AF - Intervention Group	O	X	O_1
RA - Nonintervention Group	O		O_1

Note. Pretest = O; Intervention = X; Posttest = O_1

Methodology

Population and Sampling Procedure

The accessible population for the study consisted of ninth grade students enrolled in a public-school inclusion setting in a school district in the eastern part of the United States with an overall enrollment of approximately 150,000 students. The demographics for the accessible population were approximately 54% African American, 26% European American, 8% Hispanic, 7% Multiracial, 3% Asian, and all others were less than 2%. The school district began implementing CCSSM during the 2012 – 2013 academic school year. Unfortunately, the PARCC examination was not complete and ready for execution in the same year. During the 2013 – 2014 school year, the school district implemented testing of the CCSS using the old and unaligned previous standardized high school assessments.

The first PARCC assessments on the CCSSM standards began with the 2014 – 2015 end-of-the-school year assessments. Insights from the testing results were used for ninth grade class assignments, professional development, and instructional purposes. The PARCC examination was comprised of two types of responses: performance scores and achievement levels and mathematics task type answers that incorporated reasoning and computation skills. The PARCC examination was written on-grade-level and local test scores for this group were below the achievement levels set for freshmen taking ninth grade algebra. Archival notes reported the test to be difficult, challenging to follow, and complicated to navigate. Also, during testing some students reported becoming frustrated, guessing on answers, or not completing the examination at all (Center on Education Policy, 2013).

All seven high schools in the school district met the criteria for this current research based on their usage of the accelerated standards-based curriculum, inclusion of students with MD, and two ninth-grade mathematics inclusion models. The ninth-grade classroom assignments were based on previous assessment scores and classroom grades collected at the middle school level. The seven high schools, based on recommendations, and eighth-grade assessments scores, assigned all incoming ninth-grade students to the AF intervention or RA nonintervention inclusion teaching model and required them to participate in the PARCC assessments at the end of year.

Determining the efficacy of the AF intervention inclusion model versus RA nonintervention inclusion model provided, in addition to PARCC achievement scores, insights into student's mathematics thinking processes and the impact of foundational numerical competencies as measured by the PARCC exam, after adjusting for the pretest scores. The AF intervention inclusion model used two teachers and had approximately 14 - 18 students per class. This model of inclusion received an additional block of instructional time as part of the intervention's framework. The AF intervention model was comprised of regular education students as well students with MD. The makeup of the RA nonintervention inclusion model was similar to the AF intervention model in that there were regular education students and SWD being instructed in the same classroom. The RA nonintervention inclusion teaching model was different with regards to the on-grade-level instructional approach and the fact that the approximate number of students for this class was 22 - 26, had the model used one teacher, and there was one block of algebra.

All high schools in the study offered AF intervention and RA nonintervention inclusion algebra classes to incoming ninth grade students. All ninth-grade participants, based on 2015 - 2016 data, were assigned, based on assessment scores and classroom grades collected at the middle school level, to either the AF intervention inclusion class or the RA nonintervention inclusion class. I selected this school district because it offered two distinct inclusion models to ninth grade algebra students. The assessable population included students from both instructional models for the 2015 - 2016 and 2016 - 2017 school years.

The PARCC assessments measured students' progress on the CCSSM standards. In this study, I examined test scores and achievement data from these assessments in order to establish student's mastery of the CCSSM. Participants included all ninth grade students enrolled in ninth grade algebra inclusion classes. I collected data for this study from archival records for the 2015 - 2016 and 2016 - 2017 school years. The 2015 - 2016 data acted as the pretest and the 2016 - 2017 data acted as the posttest. Students data were depersonalized.

Archival Data Collection

I submitted an independent research request form, with the specific course numbers for the two inclusion methods, to the school district's Department of Research and Assessment for permission to access the student's data files. I collected the data files from the school district’s research administrator that included students’ performance scores, achievement levels, and mathematics task type scores for the 2015 - 2016 and 2016 - 2017 school years as measured on the PARCC assessments. The independent variables in this study were the AF intervention inclusion instructional method and the RA nonintervention inclusion instructional method, and the dependent variable was the PARCC end-of-year exam.

Instrumentation

In this study, I requested approval to conduct research and evaluation from the school district. I was granted approval to conduct research upon providing the school district with all the necessary documentation which included and ensured (a) the protection of student’s privacy and rights, (b) no disruption of instructional time, (c) the research supported continuous improvement in student achievement, (d) the research supported the school district’s current framework for mathematics instruction, and (e) the research supported the school district’s mission to improve the quality of education within the district. By meeting those regulations, I was able to analyze the Grade 9 PARCC assessment mathematics scores for the AF intervention inclusion model and the RA nonintervention inclusion model from the 2015 - 2016 and 2016 - 2017 school years.

The PARCC assessments were adopted in 2010 and mandated by the Maryland State Department of Education (MSDE) to measure students’ performance on the CCSSM and gauge students’ transition to CCR status. Maryland was one of several states to adopt the PARCC assessments to assess the CCSSM and the high expectations established by the state (Center on Education Policy, 2013). The PARCC assessments provided the data that established whether students were receiving the required instruction to meet proficient levels of achievement and CCR status.

Maryland follow strict testing guidelines for administering the PARCC examination (Center on Education Policy, 2013). In an effort to increase reliability, the MSDE provides each school district with a schedule of professional development sessions available throughout the year for the testing coordinators (Center on Education Policy, 2013). Each session includes testing updates, new testing protocols, and other pertinent information about the examination (Center on Education Policy, 2013). The MSDE mandates that the PARCC exam is administered at the end of the school term to any student enrolled in Grade 9 algebra (Center on Education Policy, 2013).

To maintain security and reliability, each box that contains a PARCC examination is sealed with a security label and shipped directly to the testing coordinator at each high school. The MSDE requires each school to follow strict security protocols before, during, and after the test has been administered. All personnel involved with testing are mandated to attend training on test security protocols before administering test. Testing security protocols included tracking all testing materials: administrative manuals, testing booklets, and answer sheets. Accountability requirements included procedures for each test administrator to complete a checklist before and after test administration, and report directly to testing coordinator upon completion of the test.

The PARCC assessments were adopted to test the CCSSM content standards, as outlined by MSDE. The reliability of the test results and substantial content validity was achieved by using a cohort of educators, testing specialist, and other academic professionals throughout the state added credibility and confidence in the test. The job of the team was to review test items for curriculum alignment, content appropriate items, and sensitivity issues. Test items were then tested in the field and reviewed for appropriateness and approval; the approved test items appear on the test.

Student performance on the PARCC assessments are described through scale scores according to the performance levels achieved on the assessment. Students earned one of five performance levels (Center on Education Policy, 2013):

- Performance Level 1 - did not yet meet expectations; scores are below 699.
- Performance Level 2 - partially met expectations; scores range between 700 - 724.
- Performance Level 3 - approached expectations; scores range between 725 - 749.
- Performance Level 4 - met expectations; scores range between 750 - 809.
- Performance Level 5 - exceeded expectations; scores range between 810 - 850.

Validity

Validity is a key part of the research process when reporting findings from the study. Frankfort-Nachmias and Nachmias (2008) defined validity as “the degree to which an instrument measures what it is supposed to measure” (p. 149). It was important that I provide supporting evidence that the instrument was, in fact, measuring the variable it appeared to measure. Creswell (2003) suggested researchers identify the threats to validity that relate to the type of research design proposed in the study. Internal threats related to inadequate research procedures, application of intervention, or comparison groups talking to each other. These factors could threaten my ability to draw correct conclusions from the data. External threats must also be acknowledged. These threats appear when the researcher draws incorrect inferences from the sample data to other populations or settings. External validity was defined as “the extent to which the research finding can be generalized to larger populations and applied to different settings” (Frankfort-Nachmias & Nachmias, 2008, p. 101). Creswell stated the following about inaccurate inference, “Statistical conclusion validity arises when experimenters draw inaccurate inferences from the data because of inadequate statistical power or violation of statistical assumptions (p. 171).

While educational research has a higher propensity to experience threats to internal validity, this present study compensated for that tendency by the selection of a comparative group design for data collection. This procedure eliminated the internal threat to the greatest extent possible. The accessible population was based upon naturally occurring factors that prevented randomization. External validity was limited because the population examined was specific to one school district in the eastern part of the United States. The population was not representative of a large population, meaning the results could be narrowed.

The PARCC assessment validity is directly related to the test content, criterion, and construct. The content validity was established during the development process, in which test items were aligned with the CCSSM and field-tested. The criterion validity of the PARCC assessment is a measure of the level of knowledge and skills required to achieve high levels of performance in the content area. Construct validity is when the measuring instrument reflects the concepts and assumptions of the theoretical framework selected for the study (Nachmias & Nachmias, 2008).

Reliability

According to Trochim and Donnelly (2007) reliability is “the degree to which a measure is consistent or dependable; the degree to which it would give you the same result over and over again, assuming the underlining phenomenon is not changing” (p. 80). I adhered to the research guidelines established by Walden University and the school district’s guidelines to conduct research. Names of the participants were depersonalized in the data base. To ensure reliability, data collection was supervised by the coordinator of evaluation and research for the school district.

The PARCC assessment has maintained a high level of reliability, with regards to testing results, and content validity by collaborating with educators and testing professionals throughout the state, which adds to the credibility and confidence of the test. According to MSDE, test questions are routinely reviewed to ensure that they are clearly written, appropriate to the specific content area, and aligned with the CCSSM. Test questions were examined and revised when appropriate. The PARCC assessment questions also represent the level of content proficiency a student should obtain to demonstrate consistent progress in the content area and to show progress towards CCR.

Operationalization of Variables

Webb’s (2007) DOK framework was adapted to the CCSSM framework and then aligned with the adapted framework from the PARCC assessment scoring guide and rubric in order to categorize different levels of cognitive processing competencies and foundational numerical skills for this present study. The framework from the PARCC assessment scoring guide rubric was adapted to fit the framework of this present study. I reviewed the PARCC assessment guide and rubric and 90% of the questions on the PARCC examination are considered task type 1 questions. This level includes performances of basic conceptual skills and procedures, mathematics fluency, and application of numerical skills. This level also may contain any or all math sub-standards. Under the DOK framework, Level 1 includes recall of basic math facts, procedures, simple algorithms or formulas, describe, explain, and execute at this basic level. Example: Algebra standard: (A-APR-1.) - Understand that polynomials form a system analogous to the integers, namely they are closed under the operations of addition, subtraction, and multiplication. For example, students will add, subtract, and multiply polynomials.

Additionally, 5% of the questions on the PARCC examination fall in the task type 2 questions category. These types of questions included expressing mathematical reasoning, written justification, precession responses, and modeling. This level may also include any or all math standards. Key terms in Level 2 of the DOK framework includes the application of some cognitive processing skills past the habitual response level. Interpretation of information from charts and graphs requiring visualization skills, probability skills, and conclusions. Demonstrate conceptual understanding of content, as well as classify, organize, estimate, make observations and display data. Algebra standard (A-APR.7) - Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication and division by a nonzero rational expression. For example, students will compare and order rational numbers.

Finally, 5% of the questions on the PARCC exam were task type 3 questions that included modeling and application of real-world scenarios. Student's must demonstrate a range of approaches to solving problems. These questions are consistent with Level 3 of the DOK framework for strategic thinking, reasoning, planning, using evidence, and applying higher-order thinking strategies beyond the first two levels. The use of abstract and complex perspectives must be demonstrated at this level as well. Drawing conclusions, citing evidence, and making logical arguments are included and require demonstration of knowledge at this level. Algebra standard (A-SSE-4.) - Seeing structure in Expressions ask the student to derive the formula for the sum of a finite geometric series and use the formula to solve problems. For example, using a real-world event, students will calculate the number of car payments over 5 years.

There were 0% of the PARCC questions that were rated CCSSM advanced or Level 4 (extended thinking) in the DOK framework for ninth grade algebra. Adapting the DOK's framework and the PARCC assessment scoring guide was appropriate for categorizing the foundational numerical competencies and cognitive processing skills into different levels. The variables were operationalized according to the specified range of achievement levels and levels of performance scores as reported in the school districts data file. The dependent variable in this study was the end-of-year PARCC assessments. The dependent variable was operationalized with data from each student that participated and received a score on the PARCC assessments. The data I collected included performance test scores, student's demographics, achievement levels, and mathematics task type data for the 2015 - 2016 and 2016 - 2017 school years. I then entered the school district's data into the SPSS Version 21.0 for windows.

The focus of this study was to determine the extent of the most effective inclusion instructional model between the AF intervention inclusion method and the RA nonintervention inclusion method, as measured on the PARCC assessments, adjusting for the pretest. I employed a ratio level measurement test to interpret the data file. Measures of association were then categorized into a single statistic, which provided me a value for the relationship (covariation) between two variables. I conducted additional levels of measurements that indicated the strength of the relationship and the direction of the relationship between the two variables (Sforza et al., 2016).

Second, for the independent variables, I calculated the performance and achievement levels to describe the level of achievement a response demonstrated for each point scored. I aligned the scoring rubric to the levels of DOK math understanding and modeling and reasoning components adapted for this study from the PARCC assessments scoring guide. Third, I measured the independent variables on three mathematics task type questions and three DOK mathematic levels that were aligned with the PARCC examination achievement levels. The first level I measured were performance levels that included computation skills and numerical competencies. The second level I measured included achievement levels, critical thinking, mathematics reasoning, and the ability to apply skills and knowledge to real world problems. The third level I measured the cognitive and numerical relationships achieved with each inclusion method.

Finally, I operationalized the dependent variable with data from the independent variables. The data I collected included 2015 - 2016 and 2016 - 2017 end-of year data PARCC assessments from the AF intervention inclusion method and the RA nonintervention inclusion methods.

Data Analysis Plan

The SPSS analytical software employed the ANCOVA test with the AF intervention inclusion method, the RA nonintervention inclusion method, dependent variable, and covariate. I adhered to all assumptions related to conducting an ANCOVA analysis. The first assumption required that the variable to be normally distributed in the population for any specific value of the covariate and for any one level of a factor. The second Assumption required that the variance of the dependent variable for the conditional distributions described in Assumption 1 was equal. Assumption 3 required a random sample from the population and that the scores on the dependent variable were also assumed independent of each other. For this study I used the accessible population. In Assumption 4 the covariate was linearly related to the dependent variable within all levels of the factor, relating the covariate to the dependent variable were equal across all levels of the factor. I conducted the test of homogeneity-of-slopes assumption to test whether the population slopes were homogeneous before conducting the study.

The data collection for this study included 2015 - 2016 pretest data and 2016 - 2017 posttest data retrieved from the school district's data file for ninth grade AF intervention inclusion method and the ninth grade RA nonintervention inclusion method. I used the data cleaning and screening software by the SPSS. I double checked the data for typos, misused characters, and digits. I took an additional step by loading each variable into the frequency domain of SPSS and the program ran a frequency analysis to reveal any abnormalities in the data set. Each variable was measured by SPSS based on numerical values calculated on mean and standard deviation scores calculated by SPSS software. For example, test scores represented the numerical portion of achievement levels based on end of year test scores. I conducted a Pearson's correlation (PMCC) test of strength on the association between the two variables in the ANCOVA model. The PMCC shows a strong positive correlation at values of 0.5 to 1.0, and strong negative correlation at values of -1.0 to -0.5. This was followed by either a medium correlation, weak correlation, or no correlation interpretation.

Research Questions

RQ 1: Is there a difference in the performance assessment scores on the posttest means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

H_{01}: There is no statistically significant difference in the performance assessment scores on the posttest means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

H_{a1}: There is a statistically significant difference in the performance assessment scores on the posttest means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

RQ 2: Is there a difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

H_{02}: There is no statistically significant difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

H_{a2}: There is a statistically significant difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

RQ 3: Is there a relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination?

H_{03}: There is no statistically significant relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination?

H_{a3}: There is a statistically significant relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination?

The statistical test that was used to evaluate the null hypothesis was the ANCOVA design, which measured the difference in the adjusted means between groups as measured on the posttest after making adjustments for the pretest. This test was used to compare the means scores of each case on three variables: independent variables (AF intervention method, RA nonintervention method), the covariate (pretest), and the dependent variable (posttest). Conducting the statistical test for main effects to describe the difference on the dependent variable, the mean squares between, within, and among groups to determine if there is a statistically significance difference across levels of a factor. Based on the outcome, if the statistical significance of the *F* - test is greater than .05 or less than .05 will determine if there is a need to proceed to post hoc tests. The correlation relationship between the cognitive processes and numerical competencies was computed by using the *F* - test to describe the degree of the relationship between the cognitive processes and the numerical competencies. Based on these measurements the results are expected to fall somewhere between (-1.0 and +1.0) to indicate whether the relationship correlation is either positive or negative (Trochim & Donnelly, 2007).

The ANCOVA method was appropriate to evaluate the null hypotheses and measuring the equality of the means population across levels of a factor, while adjusting for the variance of the covariate. ANCOVA was used to measure data from the pretest on all cases, cases assigned to one of the inclusion groups based on pretest scores, different treatment for groups; additionally, all cases were measured on the posttest. An ANCOVA F-test was used on the dependent variable to evaluate the population means, adjusted for the differences, on the covariate across levels of a factor (Trochim & Donnelly, 2007).

Threats to Validity

Research validity is a major part of the overall investigation and findings of research. Trochim and Donnelly (2007) defined validity as "The accuracy of the inference, interpretations, or actions made on the basis of test scores" (p. 56). Researchers are responsible for providing empirical evidence to support the accuracy of the inference, interpretations, and results for each investigation conducted. While threats to the internal validity are of the utmost concern, this present study attempted to offset that tendency by the selection of a comparative group design for data collection. By using this procedure, the researcher was able to eliminate internal threats to the greatest extent possible. Content, criterion, and construct validity were established in the development of the instrument. Consistent monitoring, field-tests, and updates continue to support the internal validity of the instrument. Threats to external validity was limited due the accessible population that was examined was specific to one school district in the eastern part of the United States. The accessible population was based upon factors that prevented randomization and the population was not representative of a large population; thus, the results could be narrowed.

Ethical Procedures

The supervisor for research permitted me access to all student data that was pertinent to this study. The dataset was used for the purposes of dissertation development, presentation, and review only. Each step in the research procedure has been articulated in chapter 3 of this current study. Additionally, the research procedures and analyses included all possible measures to ensure all participants and school identities were not directly or indirectly divulged. The student's identities were always de-identified and data results remained anonymous with regards to all student's names and all references to participating schools. The school district's privacy, and data will remain stored in password protected folders securely for 5 years. No conflicts of interest exist nor was I employed or compensated by the school district. I have also articulated a specific plan for sharing the results with participants and community stakeholders. The data was post assessments which eliminated any risk of student's interactions from me. I retrieved the archival data from the school district's research and assessment department which stores the results of all high-school and MSA for the school district.

Summary

In Chapter 3, I discussed the research design and rational for the investigation. I also discussed the methodology that was used in the study and I defined the population and presented a description of the accessible population. I used the ANCOVA model as the design method to analyze the data from the AF intervention inclusion method and the RA nonintervention inclusion method. I presented an overview of the study with regards to archival data procedures, instrumentation, threats to validity, and ethical considerations. I will retain the data for 5 years from the completion of the project. In section four I discuss the analysis of the data collected from the study, the results, and summary.

Chapter 4: Results

Introduction

The purpose of this quantitative, group comparison study was to explore whether the AF intervention inclusion teaching method is more effective on the end-of-year PARCC mathematics assessments as compared with RA nonintervention inclusion teaching method. By using the theoretical frameworks of Bandura and Gagné, along with the concepts of cognitive learning, instructional interventions, and inclusion methods, I examined the relationship between student scores from AF intervention inclusion method and the RA nonintervention inclusion method, as measured by the PARCC end-of-the-year assessments. I used an ANCOVA design to measure the statistically significant difference of the relationship between the cognitive and numerical competencies for the two groups and to what extent the achievement scores differ between AF intervention inclusion method and RA nonintervention inclusion method.

I based the levels of performance on results from students' rankings on the-end-of-the-year MSA and performance levels as measured by the PARCC examination for both groups, after adjusting for covariate scores from the eighth grade. The relationship between cognitive skills and foundational numerical competencies were assessed by adapting Webb's (2002) DOK Levels for Mathematics and Conley's (2010) CCR framework to measure and categorize the levels of higher-order thinking and cognitive skills demonstrated on the CCSSM as measured by the PARCC examination (see Sforza et al. 2016). The four levels that comprise the DOK framework are: Level 1 (i.e., recall), Level 2 (i.e., skills/concepts), Level 3 (i.e., strategic thinking), and Level 4 (i.e. extended thinking). I conducted the study using students who participated in the 2015 - 2016 MSA end-of-the-year assessments and the 2016 - 2017 PARCC end of the year assessments. Valid scores were used as baseline data. In this quantitative, group comparative study, I compared two groups of ninth grade students who were assigned to either AF intervention inclusion or RA nonintervention inclusion methods. I used the following questions to guide my study:

Research Question 1: Is there a difference in the performance assessment scores on the post-test means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pre-test scores, as measured on the PARCC examination?

H_{01}: There is no statistically significant difference in the performance assessment scores on the post-test means of students taught in the AF intervention method compared to students taught in RA nonintervention inclusion model, adjusted for pre-test scores, as measured on the PARCC examination?

Ha_{1}: There is a statistically significant difference in the performance assessment scores on the post-test means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pre-test scores, as measured on the PARCC examination?

Research Question 2: Is there a difference in the post-test achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pre-test scores, as measured on the PARCC examination?

H_{02}: There is no statistically significant difference in the post-test achievement levels of students taught in AF intervention inclusion method l compared to students taught in RA nonintervention inclusion method adjusted for pre-test scores, as measured on the PARCC examination?

Ha_{2}: There is a statistically significant difference in the post-test achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pre-test scores, as measured on the PARCC examination?

Research Question 3: Is there a relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pre-test scores, as measured on the PARCC examination?

H_{03}: There is no statistically significant relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pre-test scores, as measured on the PARCC examination?

Ha_{3}: There is a statistically significant relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pre-test scores, as measured on the PARCC examination?

In this chapter, I will provide an analysis of the research questions guiding this study. I will also present insights learned from my analysis concerning students' performance levels and achievement levels as they relate to CCSSM and the AF intervention inclusion method and RA nonintervention inclusion method. To present the results from this section in a consistent manner, I will present the findings in four sections: descriptive data, data collection, results, and a summary.

Descriptive Data

The variables that I addressed in the study included pretest scores, posttest scores, performance scores, achievement scores, and CCR levels. I used data collected from five middle schools and five high schools located in a midsized suburban school district in the mid-Atlantic part of the United States. The school district also provided archival data for eighth-grade and ninth-grade students who participated in the AF intervention inclusion class and RA nonintervention inclusion class. The school district also provided me with the examination data for each student who had taken the MSA or PARCC examination in mathematics during the 2015 - 2016 and 2016 - 2017 school years. There were no discrepancies in data collection because the data used were archival data. The accessible population represented similar populations and may not have been proportional to larger populations.

Table 5 summarizes the number of general education students and SWD enrolled in mathematics during the 2015 - 2016 and 2016 - 2017 school years. The time frame for data collection in the study consisted of all students who were in the eighth grade during the 2015 - 2016 and 2016 - 2017 school years and were administered the MSA or PARCC assessment at the end of the year. This data served as baseline descriptive and demographic characteristics of the population.

Table 5

Middle School Population

Class Type	School A	School B	School C	School D	School E	Total
Mathematics	772	1610	1937	1999	1942	7560
SWD	125	162	151	154	141	934

Note. Middle school mathematics populations; SWD = students with disabilities.

Table 6 summarizes the number of AF intervention students, RA nonintervention students, and SWDs enrolled in high school algebra during the 2015 - 2016 and 2016 - 2017 school years. Th**e** time frame for data collection in the study consisted of all students who were in the eighth grade during the 2015 - 2016 and 2016 - 2017 school years and administered the MSA or PARCC assessment at the end of the year. Additionally, SWD promoted to ninth grade AF or RA algebra inclusion classes for the 2015 - 2016 and 2016 - 2017 academic school years are listed in Table 6.

Table 6

High School Population

Class Type	School F	School G	School H	School I	School J	Total
AF	1182	996	1200	1128	1202	5708
RA	198	426	248	198	301	1098
SWD	125	88	151	154	141	579

Note. AF = algebraic foundations; RA = regular algebra; SWD = students with disabilities.

The AF intervention inclusion method, RA nonintervention inclusion method, and the number of special education students enrolled in each type of algebra intervention method were listed in Table 6. I used the number of students enrolled in each class type as the baseline for the characteristics of the accessible population. Each method had several students from both grade levels. The highest percentage of students were enrolled in their correct grade.

Data Analysis

On the 2015 - 2016 MSA and 2016 - 2017 PARCC district assessments report card, the results were presented for each participant, which included scale scores, performance levels, and grade conversions. Analysis for all three research questions required the use of the ANCOVA test. I conducted an analysis to compare the mean scores, performance levels, and correlation of the students in the AF intervention inclusion method and the RA nonintervention inclusion method. This comparison was conducted to determine to what extent students in AF inclusion method demonstrated growth in the district's current AF intervention inclusion program. The population included in this study included five middle schools and five high schools from a school district located in the mid-Atlantic region of the United States. The participants completed the PARCC assessments to demonstrate mastery, or lack thereof, of the CCSSM. I investigated the following variables in this study: PARCC performance scores, math/algebra scores, achievement levels, cognitive skills and numerical competencies, and CCR skills.

Results

I conducted a one-way ANCOVA was conducted. The independent variables included the intervention method, nonintervention method, test of achievement, and test of performance. The dependent variable was the posttest and the covariate were the pretest given at the end of the eighth-grade year.

Evaluation of Statistical Assumptions

The dependent variable was normally distributed in the population for any specific value, for any specific value of the covariate, and for any one level of a factor. The variance of the dependent variable, for the conditional distributions described in Assumption 1, were equal. All cases represented assignment to factor levels based on the pretest scores from the accessible population and the scores recorded on the dependent variable were independent of each other. The covariate in my study was linearly related to the dependent variable within all levels of the factor and the slopes relating the covariate to the dependent variable were equal across all levels of the factor.

The first statistical assumption test I conducted was the Levene's test of homogeneity of variances to confirm the two populations were normally distributed. The null hypothesis for this test was that the population slopes for the two teaching methods are homogeneous. The alpha level for the nonintervention inclusion method and intervention inclusion method were based on $\alpha = .05$ and was statistically nonsignificant at a p - value of .07. This was an indication that the population means of the two groups were assumed to be approximately equal or homogeneous with a test statistic of $F(2,4) =$

5.456, *p* = .07. This result was statistically nonsignificant and therefore, I fail to reject the null hypothesis that there was approximately no difference in the variances between the two groups across all levels of the independent variable and dependent variable for the test of the homogeneity-of-slopes assumption.

The second statistical assumption I tested was homogeneity of regression slopes for the AF intervention method and the RA nonintervention method. The null hypothesis for this test was that the regression slopes for both populations are homogeneous. The alpha level for the AF nonintervention inclusion method and RA intervention inclusion method was based on $\alpha = .05$. The homogeneity test of regression assumption test statistic was $F(2, 7) = 3.774$, $p = .07$, these findings were statistically nonsignificant and therefore I fail to reject the null hypothesis that the regression slopes are homogeneous.

I then tested the linear relationship of the covariate to the dependent variable. I conducted a visual inspection of the pretest and the posttest scatter plot that indicated that a linear relationship exists between the pretest and posttest at the high school level and at the middle school level. My observation of the scatter plot revealed an elliptical shape beginning at the lower left corner and moving to the upper right corner of the scatter plot for the pretest and posttest variables on both the middle school and high school levels intervention and nonintervention inclusion methods. Therefore, I fail to reject the null hypothesis that a linear relationship exists between the pretest and posttest at the high school level and at the middle school level. The Levene's test of homogeneity was nonsignificant for each assumption, therefore I proceeded with the ANCOVA.

I tested whether there was a statistically significant difference in the pretest and posttest comparison of the mean scores on the performance assessment of students instructed in AF intervention inclusion method and those students taught in RA nonintervention inclusion method. The null hypothesis was that there is no statistically significant difference in the performance scores on the posttest assessment of students taught in the AF intervention inclusion method compared to students taught in the RA nonintervention inclusion method, adjusted for the pretest scores, as measured on the PARCC examination.

I conducted a comparison test to evaluate the relationship between the performance assessment scores and the dependent variable while controlling for the covariate. The mean score for the AF intervention inclusion method was (740.00) and the mean score for RA nonintervention inclusion method was (733.60) and revealed that the score variances were not statistically significant between the two groups, test statistics F (1,8) = 2.031, $p = .19$. The alpha level for the performance assessment was based on α =.05. Findings suggest the performance test scores of between-subjects' effects on performance scores were statistically nonsignificant at F (1,6) = 1.971, $p = .21$, with the performance assessment accounting for approximately 25% of the variance in the posttest scores. Therefore, I fail to reject the first null hypothesis that there is no statistically significant difference in the performance scores on the posttest assessment of students taught in the AF intervention inclusion method compared to students taught in the RA nonintervention inclusion method, adjusted for the pretest scores, as measured on the PARCC examination. I have summarized this data in Table 7. In Table 8, I summarize the estimated marginal means for the AF intervention inclusion method and the RA nonintervention inclusion teaching method. The estimated marginal means section of the output gives the adjusted means (controlling for the covariate) for each inclusion method group.

Descriptive Statistics

Table 7

Descriptive Statistics

Source	*N*	*M*	*SD*
AF	5	740.0000	5.95819
RA	5	733.6000	12.17785
Total	10	736.8000	9.64711

Note. Descriptive variables = AF = algebraic foundations inclusion method, RA = regular algebra inclusion method.

Table 8

Estimated Marginal Means

		95% *Confidence Interval*		
Dependent Variable: PARCC Scores	*M*	*SD*	*LL*	*UL*
AF	737.174[a]	1.813	732.990	741.610
RA	736.426[a]	1.813	731.990	740.861

Note: Covariates appearing in the model are evaluated at the following values: Math/Algebra Scores = 733.9000, Domain Scores = 36.5000. Descriptive variables: AF = algebraic foundations inclusion teaching method and RA = regular algebra inclusion teaching method.

I conducted a comparison test to evaluate the relationship between the performance assessment scores for SWD_HS and the dependent variable while controlling for the covariate. The performance assessment scores, for SWD_HS, was based on an alpha level of $\alpha = .05$. My findings suggest test of between-subjects' effects on performance scores were statistically nonsignificant at $F\ (1,5) = .058, p = .82$, with the performance assessment accounting for approximately 0.11% of the variance in the posttest scores for SWD_HS when controlling for the pretest. There was no statistically significant difference in the performance scores on the PARCC assessment of SWD_HS taught in the AF intervention inclusion method compared to students taught in the RA nonintervention inclusion method. I summarize the estimated marginal means for the AF intervention inclusion method and the RA nonintervention inclusion method for SWD_HS in Table 9. The estimated marginal means section of the output gives the adjusted means (controlling for the covariate) for each inclusion method group.

Table 9

Estimated Marginal Means SWD_HS

		95% *Confidence Interval*		
Dependent Variable: PARCC Scores	*M*	*SD*	*LL*	*UL*
AF	737.353^a	2.110	731.929	742.778
RA	736.247^a	2.110	730.822	741.671

Note: Covariates appearing in the model are evaluated at the following values: Math/Algebra Scores = 733.9000, Domain Scores = 36.5000, SWD_HS = 706.1000. Descriptive variables: AF = algebraic foundations inclusion teaching method and RA = regular algebra inclusion teaching method.

The second research question in this study was: Is there a difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for posttest scores, as measured on the PARCC examination? To address this research question, I investigated the following null hypothesis: There is no statistically significant difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for posttest scores, as measured on the PARCC examination. Mean scores for the AF intervention teaching method (740.00) and the mean scores for RA intervention inclusion teaching method (733.60) revealed that the score variances were not statistically significant between the two groups, test statistics F (1,8) = 1.098, p = .33. The alpha level for the achievement assessment was based on α =.05. The test of between-subjects effects analysis of the relationship between the posttest and the achievement levels was not statistically significant at F (1,6) = .540, p = .49, α = .05. Achievement scores attributed 8.3% of the variance on the posttest variable. Therefore, I fail to reject the second null hypothesis that there is no statistically significant difference in the achievement scores on the posttest assessment of students taught in the AF intervention inclusion method compared to students taught in the RA nonintervention inclusion method, adjusted for the pretest scores, as measured on the PARCC examination.

I conducted additional analysis on the strength of the relationship between achievement levels for SWD_HS, and the dependent variable PARCC scores. The variance on the dependent variable was equal across both groups with a test statistic of F (1,8) = .954, p = .357, α = .05. The achievement level scores, by SWD_HS, were statistically nonsignificant with a test statistic of F (4,6) = .035, p = .952, α = .05. The results were very strong for SWD_HS, as calculated by the partial eta square of 83.8% of the variance for SWD_HS on the posttest. There is no statistically significant difference in the achievement levels on the posttest assessment of SWD_HS taught in the AF intervention inclusion method compared to students taught in the RA nonintervention inclusion method, adjusted for the pretest scores, as measured on the PARCC examination.

The final research question examined in this study was: Is there a relationship between the AF intervention inclusion method, cognitive processing skills, foundational numerical competencies, and SWD_HS, adjusted for pretest scores, as measured on the PARCC examination? To address this research question, I investigated the following null hypothesis: There is a statistically significant relationship between the AF intervention inclusion method, cognitive competencies, foundational numerical competencies, and SWD_HS, adjusted for pretest scores, as measured on the PARCC examination. There was a statistically significant correlation with the independent variable domain scores ($r = .836$, $n = 10$, $p < .01$) to measure the relationship between SWD_HS and PARCC assessment. Therefore, I rejected the third null hypothesis in favor of the alternative hypothesis; there is a statistically significant relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination.

I conducted a Pearson correlation coefficient analysis to assess the relationship between the domain scores, CCSSM, SWD_HS, and PARCC assessment. Additional relationships between independent variables and the dependent variable were identified as well. There was a positive correlation in the standard deviations between the two independent variables, CCSSM (*M* = 52.0000, *SD* = 22.68137) and SWD_HS (*M* =706.1000*, SD* = 21.43958), $r = .92$, $p = .01$, $n = 10$. I displayed the results in Table 10

Descriptive Statistics

Table 10

Descriptive Statistics

Source	*N*	*M*	*SD*
Domain Scores	10	36.5000	12.19517
CCSSM	10	52.0000	22.68137
SWD_HS	10	706.1000	21.43958
PARCC Scores	10	736.8000	9.64711

Correlational analysis was used to examine the relationship between PARCC scores, domain scores, CCSSM scores, and SWD_HS scores on the PARCC assessments. Results of the Pearson correlation indicated the correlation between domain scores and PARCC scores was statistically significant, $r\,(8) = .84$, $p = < .001$ with a $R^2 = .698$. This explains 69.8% of the variance between these two variables. I computed the Correlation coefficients among the four variables scales. I used the Pearson approach to control for Type I error across each correlation and a *p* - value of less than .01 was required for statistical significance. The results of the correlation analysis presented in Table 11 below. The correlation between CCSSM and SWD_HS measure was statistically nonsignificant $r = 0.481$, $n = 10$, $p = .16$. In general, the results suggest that there was a positive correlation between the two variables and that if scores in CCSSM improve then scores for SWD_HS will improve as well.

Table 11

Correlation among the four variables

	PARCC	DS	CCSSM	SWD_HS
PARCC Scores				
Domain Score	.836**			
CCSSM Scores	-.194	-.224		
SWD_HS	-.437	-.398	.481	

** Correlation is significant at the 0.01 level (2-tailed).
Note. SWD_HS = students with disabilities high school level.

I conducted a multiple regression analyses among four variables to predict how well the PARCC criterion is predicted by CCSSM scores in the first set and how well the PARCC criterion is predicted by domain scores in the second set. One analysis included two assessments as predictors (CCSSM, domain scores) for cognitive skills and numerical competencies, while the second analysis included assessment scores associated with CCR (SWD_HS, math/algebra). The regression equation with the CCSSM and domain scores was statistically significant, $R^2 = .70$, adjusted $R^2 = .61$, $F\,(2,7) = 8.12$, $p = .02$; $\alpha = .05$. The regression equation with SWD_HS and math/algebra as predictor was not statistically significant, R^2 adjusted = .89, $F\,(2,5) = 4.32$, $p = .08$; $\alpha = .05$. Based on these results CCSSM and domain scores appeared to be better predictors of the PARCC assessment criterion. The previous analyses answered the research question; therefore, it was unnecessary to reverse the order of the two sets and reanalyze the data.

Finally, I conducted a multiple regression analyses with all four predictors. The linear combination of the four predictors as a group were statistically significantly related to the PARCC criterion, $R^2 = .89$, adjusted $R^2 = .801$, $F\ (4,5) = 10.07$, $p <.01$. which indicates the four predictors were related to the PARCC criterion. However, in the output data from the analysis the predictor variable *p* - value for math/algebra (.037) was less than $\alpha = .05$, which indicates that the predictor is statistically significant on the PARCC criterion. Conversely, the other three predictors were not statistically significant, *p* - value for domain scores (.238), *p* - value for CCSSM scores (.808), and SWD_HS (.981). Based on the results of these analyses only one of the four predictors were statistically significant as a meaningful predictor on the PARCC criterion.

Summary

The first research question I examined in the study was: Is there a difference in the performance assessment scores on the pretest means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for posttest scores, as measured on the PARCC examination? To address this research question, I investigated the following null hypothesis: There is no statistically significant difference in the performance assessment scores of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method as measured on the PARCC examination. The results of the ANCOVA were statistically nonsignificant, therefore I fail to reject the first null hypothesis for performance assessment scores (p = .19) α =.05.

The second research question in this study was: Is there a difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination? To address this research question, I investigated the following null hypothesis: There is no statistically significant difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination; the p - value = .49, α = .05. Therefore, I fail to reject the second null hypothesis that there is no statistically significant difference in the achievement scores on the posttest assessment of students taught in the AF intervention inclusion method compared to students taught in the RA nonintervention inclusion method, adjusted for the pretest scores, as measured on the PARCC examination.

The final research question examined in this study was: Is there a relationship between the AF intervention inclusion method, cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination? To address this research question, the study investigated the following null hypothesis: There is no statistically significant difference in the relationship between the AF intervention inclusion method, cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination. There was a statistically significant relationship in domain scores, $p = < .01$, $\alpha = .01$. Therefore, I reject the third null hypothesis in favor of the alternative hypothesis; there is a statistically significant relationship between the AF intervention inclusion method and the cognitive processing skills, foundational numerical competencies, and students with MD, adjusted for pretest scores, as measured on the PARCC examination.

This quantitative group comparative study utilized an ANCOVA design to analyze data from the pretest and posttest scores for ninth grade students taught in AF intervention inclusion method and the RA nonintervention inclusion method. My aim in this study was to measure the disparity, or lack thereof, in achievement levels based on test scores. Each question and hypothesis were addressed as deemed appropriate for the study. I conducted an analysis for the test of homogeneity of slopes, group statistics, cognitive competencies, numerical competencies, variable and descriptive statistics for correlation calculations. Based on the descriptive statistical analysis, the AF intervention inclusion method and the RA nonintervention inclusion method did not differ statistically significantly on the end of the year PARCC exam. The findings suggest, that there is a strong correlation between the AF intervention inclusion method and scores on the PARCC exam.

Students from both AF intervention inclusion and RA nonintervention inclusion methods demonstrated growth on the CCSSM standards according to the PARCC examination for the 2015 - 2016 and 2016 - 2017 school years. I conducted the study using students who were in the eighth grade in 2015 - 2016 school year participating in mathematics inclusion classes as the baseline data. This experimental descriptive inferential study was used to compare two groups of ninth grade students who were assigned to either AF inclusion class or RA inclusion class. The investigation included population samples from the two independent ninth grade algebra classes. This quantitative group comparative study was used to compare AF intervention inclusion method and RA nonintervention inclusion method for statistically significant differences in achievement levels.

I provided analyses addressing the research questions and hypotheses for this study. I measured the disparity in achievement scores on the common core mathematics assessments between AF intervention inclusion method and RA nonintervention inclusion method. I analyzed the data to determine if there was a statistically significant difference in the performance scores of students in AF and RA inclusion classes. The knowledge gained from this study will have an impact towards promoting social change for students with special needs.

In Chapter 5, I will summarize the research questions, the study's procedures, and purpose for the investigation. I will also discuss the interpretations, implications, and present my recommendations. My research findings will be presented and connected to the literature as part of the overall body of knowledge and implications for positive social change.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The CCSSM are a set of rigorous mathematics standards created to promote CCR for all students, including students who have disabilities in mathematics (Bottge et al., 2015; Fuch et al., 2014). Mathematics intervention methods and inclusive learning environments are reportedly adaptable to each student's cognitive skill level and mathematics competencies level at each student's academic level (Saunders et al. 2013). Additionally, local and district performance scores are accurate at the school level and the district level. The purpose of this study was to examine the disparity in scores on the PARCC examination for students participating in the AF intervention teaching method compared with the RA nonintervention teaching method.

The population had represented a school district in the eastern part of the United States. The school district had adopted the AF intervention teaching method for ninth grade algebra students several years prior to this study. This mathematics intervention method delivered instructional strategies that supported the general education curriculum, general educational students, and students with special needs. I conducted this study because of the curriculum shift to the CCR framework, which also represented positive social change for all students including students with special needs. I developed the following research questions to guide this quantitative study:

Research Question 1: Is there a difference in the performance assessment scores in the post-test means of students taught in the AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for the pre-test scores, as measured on the PARCC examination?

Research Question 2: Is there a difference in the posttest achievement levels of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method, adjusted for pretest scores, as measured on the PARCC examination?

Research Question 3: Is there a relationship between the AF intervention inclusion method and the cognitive processing skills and foundational numerical competencies as measured on the PARCC examination?

The results of the null hypothesis test for Research Question 1 indicated that there was a statistically nonsignificant difference in the performance assessment scores of the AF intervention inclusion method compared with RA nonintervention inclusion method. The test statistics for this event were F (1,6) = 1.971, p = .21and the alpha level was α = .05. The null hypothesis test for Research Question 2 resulted in the following test statistics F (1,6) = .954, p = .357, α = 05, which suggest that there was a statistically nonsignificant difference in the achievement levels for students enrolled in the AF intervention inclusion method. The findings for the hypothesis test for Research Question 3 suggest that there was a statistically significant relationship between cognitive processing skills and foundational numerical competencies for SWD_HS. The test statistics r = .836, n = 10, p < .01 indicated that a statistically significant relationship exists for SWD_HS. I will further discuss the findings from this investigation, including my interpretation of findings, limitations of the study, recommendations, implications for social change, and the conclusion.

Interpretation of the Findings

My goal with this study was to contribute to the body of knowledge that already exists for mathematics intervention teaching methods through the investigation of mean scores of students taking the mathematics pretest and the posttest PARCC assessments for the 2015 - 2016 and 2016 - 2017 school years. I used SPSS software to analyze the research data. Each question was analyzed based on the data provided from the office of evaluation and research for the school district. I will summarize the results in the conclusion. I developed the research questions in this study to examine the performance scores, achievement levels, cognitive skills, and foundational numerical competences levels of students participating in the intervention model.

Research Question 1

With the first research question I addressed the disparity in performance assessment scores on the posttest means of students taught in the AF intervention inclusion method and compared their scores to students taught in the RA nonintervention inclusion teaching method. After adjusting for the pretest, I measured the scores for variance on the PARCC examination. Descriptive statistics were used to answer the first question for ninth-grade AF intervention inclusion method and RA nonintervention inclusion method taking the PARCC examination during the 2015 - 2016 and 2016 - 2017 school years. I used an ANCOVA test to identify any statistically significant differences between the two mean scores on the PARCC examination. The mean test scores for the AF intervention inclusion method was *M* = 740.00 and *M* = 733.60 for the RA nonintervention inclusion method. However, the estimated marginal means, when considering the covariate for AF intervention inclusion method, was *M* = 737.174 for the AF intervention inclusion method and for the RA nonintervention inclusion method was *M* = 736.426. The test results failed to reject the null hypothesis for Research Question 1. There is no statistically significant difference in the performance assessment mean scores of students taught in AF intervention inclusion method compared to students taught in RA nonintervention inclusion method as measured on the PARCC examination. The scores were statistically nonsignificant at p = .21; α =.05.

I also conducted an evaluation to compare the performance scores for SWD_HS, who were being instructed in the AF intervention inclusion method and those being instructed in the RA nonintervention inclusion method. There was no statistically significant difference in the performance assessment mean scores for SWD_HS taught with the AF intervention inclusion method compared to students taught with the RA nonintervention inclusion method as measured on the PARCC examination. The mean scores were statistically nonsignificant at p = .82; α =.05. The estimated marginal means for SWD_HS instructed in the AF intervention inclusion method was *M* = 737.353 and for the RA nonintervention teaching method was *M* = 736.247. The results suggest that there was very little disparity in the estimated marginal means for SWD_HS and the estimated marginal means for the RA nonintervention inclusion method.

These findings align with the findings of other researchers (i.e., Croteau, 2014; Polikoff, 2015; Powell et al., 2013) that found similar results for students taught in a mathematics intervention classroom that were aligned with CCSSM standards and encouraged to use problem solving techniques and implement higher-order thinking strategies. Additional studies suggested that when the textbook was aligned with CCSSM standards and a persuasive pedagogy framework was implemented, students' performance on standardized assessments improved (Christinson et al., 2012; Doabler et al., 2013). The textbooks and instructional strategies used for AF intervention inclusion method were aligned with the CCSSM curriculum as demonstrated by the fact that approximately 25% of the variance in the PARCC tests scores were attributed to the AF intervention inclusion teaching method. However, for SWD_HS, the variance was approximately 0.11% of the scores that were attributed to the AF inclusion teaching method.

I did not identify any previous studies during the literature review process that directly compared the AF intervention method and the RA nonintervention method on the PARCC examination, after adjusting for pre-test scores on the performance assessment. Therefore, my findings were not reflective of duplicate studies and their results. In a quantitative study that examined the results of two algebra teaching models on standardized test scores for student with special needs, Bottge et al. (2015) found no statistically significant difference between students with MDs on their mathematics test scores from pre-to-posttest in comparison to students in the nonintervention teaching model. Their findings are reflective of the findings in this study in that after taking part in the AF intervention inclusion teaching method, mathematics scores for students in this model and students who have MD demonstrated improvement in their examination scores.

Research Question 2

The second research question was: Is there a difference in the post-test achievement levels of students taught with the AF intervention inclusion method compared to students taught with the RA nonintervention inclusion method. After adjusting for the pretest, I measured scores for variance on the PARCC examination. Descriptive statistics were used to answer the second question for ninth-grade students taught using the AF intervention inclusion and RA nonintervention inclusion methods taking the PARCC examination during the 2015 - 2016 and 2016 - 2017 school years. I used an ANCOVA test to identify any statistically significant differences between the mean scores in achievement levels on the PARCC examination after adjusting for the pretest. The mean test scores for the AF intervention inclusion method was $M = 740.000$ and was $M = 733.600$ for the RA nonintervention inclusion method. However, the estimated marginal means, when considering the covariate, for the AF intervention inclusion method was $M = 735.036$ and for the RA nonintervention inclusion method was $M = 738.564$. Additionally, there was no statistically significant difference with the achievement level scores for SWD_HS taught with the AF intervention inclusion method compared to students taught with the RA nonintervention inclusion method as measured by the PARCC examination ($p = .95$; $\alpha = .05$). The estimated marginal means for SWD_HS instructed in the AF intervention inclusion method was $M = 734.964$ and for the RA nonintervention inclusion method was 738.636. The test results fail to reject the null hypothesis for the second question. There was no statistically significant difference in the achievement level mean scores of students taught with the AF intervention inclusion method compared to students taught with the RA nonintervention inclusion method as measured on the PARCC examination.

I did not identify any previous studies during the literature review process that directly compared the AF intervention method and the RA nonintervention method on the PARCC examination, after adjusting for pretest scores on achievement levels. Therefore, my findings were not reflective of duplicate studies and their results. In a quantitative study to provide empirical evidence of the effectiveness of two mathematics instructional methods, Fuchs et al. (2014) found that both delivery models supported academic achievement levels for children with MD and students significantly improved their scores after1year in the intervention model.

Research Question 3

The third question was: Is there a relationship between the AF intervention inclusion method and cognitive processing skills, foundational numerical competencies, and SWD_HS, adjusted for pretest scores, as measured on the PARCC examination? I used descriptive statistics to answer this question for the relationship between cognitive processing skills, foundational numerical competencies (domain scores) and SWD_HS taking the PARCC examination during the 2015 - 2016 and 2016 - 2017 school years. A statistically significant difference of the mean scores on the PARCC examination was determined as a result of the ANCOVA test.

The test results did not support the null hypothesis for the third question. There was statistically significant difference in the mean scores for cognitive processing skills, foundational numerical competencies, and SWD_HS taught in AF intervention inclusion compared to students taught in RA nonintervention inclusion class as measured on the PARCC examination. Therefore, the null hypothesis was rejected, and the alternative hypothesis was accepted; there is a statistically significant relationship between the AF intervention inclusion teaching method and the cognitive processing skills, foundational numerical competencies, and SWD_HS. The results suggest that a statistically significance relationship (r = .836, p <.01, n=10) was present between the two independent variables and the dependent variable. The findings indicate that the relationship between cognitive processing skills and foundational numerical competencies and domain assessment scores were statistically significant on the dependent variable.

I conducted a Pearson correlation coefficient analysis to assess the relationship of domain scores (major content, supporting content, reasoning, modeling), CCSSM, SWD_HS, the PARRCC assessment. The first positive correlation was observed in the standard deviation between CCSSM M = 52.0000, SD = 22.68137 and SWD_HS (M = 706.1000, SD = 21.43958) on the PARCC assessment. Additionally, a positive correlation was observed between domain scores and PARCC scores; resulting in 69% of the variance on the PARCC scores to the domain scores for SWD_HS.

I conducted a multiple regression analyses among four variables to assess which variables would best predict scores on the PARCC assessments. Descriptive statistics included math/algebra scores, domain scores, CCSSM scores, and SWD_HS scores. The second analysis included assessment scores associated with math/algebra and SWD_HS scores. In the first results CCSSM and domain scores were statistically significant as predictors on the PARCC exam with a significance value of p = .02; α=.05.

Results in Relation to Literature Review

One of the goals of educational research is to advance new knowledge in instruction, teaching and learning, and educational practices. I conducted research using two algebra inclusion teaching methods: the AF inclusion intervention method and the RA nonintervention inclusion method. The results indicated that there were numerical foundational competencies and cognitive processing competencies that presented barriers to accessing the general education curriculum for student with special needs. Hennessey et al. (2013) study on classroom interventions was designed to identify several learning theories and best practices for classroom instruction that also included cognitive and numerical benefits, along with closing the achievement gap. The results of their study suggest that effective-based learning approaches, contrary to traditional methods of instruction, improved access to the general educational curriculum for children with special needs.

Doabler et al. (2013) remarked in their study that, employing a viable teaching method to improve SWD achievement scores on the CCSSM is a difficult task. Their study looked at how effective various intervention models were and whether they were supported by empirical evidence that was designed to increase access to the general curriculum and improve the academic experience of special education for children with special needs. They found that, the conceptual framework for interventions in algebra were based on nontraditional methods of instruction, collaboration with peers, multiple opportunities to interact with the general education curriculum, and critical thinking strategies in course content. Fuchs et al. (2014) examined achievement scores for children who have a math disability and use two intervention service delivery models. The results of their study revealed that small gains were realized in closing the achievement gaps by the intervention group.

The theoretical indicators resulting from these studies show that mathematics interventions have a statistically significance relationship in closing the achievement gaps for children with special needs. Several studies found that many students with special needs who participated in a research-based intervention for mathematics test scores improved (Harrell-Williams, et al., 2014; Kleinert et al., 2015; Lee, 2012). A study conducted by Watt et al. (2014) extended the research knowledge, associated with effective algebra interventions and students with MD, by recommending five evidence-based interventions to address the complexities of CCSSM. Powell et al. (2013) reported children with special needs participating in inclusion classes, that used a mathematics intervention program increased their scores on state standardized test.

The literature reviewed for this study discussed the potential benefits of mathematics intervention programs for children with special needs, however, the research was limited in supporting the benefits of high school algebra intervention methods and CCR for students with special needs. As the inclusion environment continues to expand, more resources will be called upon to accommodate the various learning styles of children with special needs. Especially when considering that high-stakes assessments are being used as the main barometer of how well students with special needs have mastered the content standards. Harrell-Williams et al. (2014) provided evidence of teacher's self-efficacy and teaching with fidelity mathematics content effectively to children with special needs as reasons for access to the general education curriculum and improvement on high stakes assessment.

The school district employs an algebra intervention inclusion model that was designed to address potential barriers accessing the algebra curriculum experienced by children with special needs in the traditional algebra inclusion teaching environment. The literature examined during this investigation support the academic gains experienced by children with special needs using instructional math interventions and strategies. The school district represented in this study implemented an inclusion model that includes coteachers, additional hours of instructional time, differentiated instruction, and testing accommodations. Results from Powell et al. (2014) and Doabler et al. (2014) suggest that effective implementation of instructional delivery models did result in eliminating some potential barriers to curricular assess, along with improving test scores for student with special needs.

Limitations of the Study

The following limitations were confirmed from Chapter 1 and revised in the analysis of results and confined the generalization of the finding to this specific population:

- The student population was limited to a school district in the eastern part of the United States. The collection of archival data limited the ability to substantially take a broad view of the findings and may not be applicable in other school districts. Based on the use of archival data and the accessible population, generalizing the findings was limited to this student population. The AF intervention inclusion method is unique to this school district.
- The professional development that general education teachers received in developing strategies for the AF intervention inclusion setting was limited and may impact student achievement and the ability to take a broad view of the findings. I was unable to determine from the archival data the level of professional development each general educator received in preparation for the AF intervention inclusion class. Therefore, I was limited in taking a broad view of the impact of professional development on student achievement.
- There was no observation of the classroom setting, instructional practices, or classroom behaviors by me. This limited my ability to take a broad view of the findings. The use of archival data insured that I had no contact with the classroom setting, instructional practices, or students, therefore, the findings are limited to this student population.

Recommendations for Practice

Future practice, based on this study, should investigate:

- The school district may want to reconsider the method used for implementing on grade-level curriculum with off-grade level foundational numerical competencies. The preliminary findings of this study suggest students with MD participating in the AF intervention inclusion model did show modest gains because of participating in the intervention inclusion model.
- The school district should reassess the current placement process for incoming ninth grade students into the AF intervention inclusion and the RA nonintervention inclusion models. Stakeholders should work with special education programs to select the best academic environment for children with MD. The present method used for coding students for ninth grade algebra should be updated to reflect the use of new district-wide instructional practice.
- The school district should have state-of-the-art technology and support to produce a variety of data from assessments that reflect the cognitive and numerical strategies required by the CCSSM. This practice would provide consistency in addressing curriculum barriers faced be students with MD. Tracking the effectiveness of the instructional strategies within the intervention inclusion model will provide additional data on instructional implementation, student achievement, and intervention effectiveness.

Recommendations for Further Research

Further research, based on this study, should be conducted to investigate the practices described in this review, with focus on the CCSSM and instructional interventions methods being implemented. For example:

- School districts may need to focus on fidelity to implement algebra interventions that are effective for addressing potential barriers to accessing the general curriculum and the efficacy of implementation throughout the school the district. Much of the literature reviewed discussed strategies that are valuable for improving output on computation problems; future research should examine the effects of foundational numerical competencies and cognitive skills across a range of mathematical situations at higher grade levels. More research is suggested beyond ninth grade in order to monitor mathematics achievement levels subsequent to CCR.
- This study focused on ninth grade algebra students. Much of the current literature addressed math interventions methods crafted for middle and elementary age students. Future research should include students who have been identified as gifted. Additionally, new research should consider the high school levels above ninth grade as a follow up to this present study. Research could further examine the progress of this group at subsequent grade levels.
- Further research to consider should focus on the achievement of students considering ethnicities and English language learners in achievement levels for the CCSSM. Due to the limited studies available on the impact of CCSSM,

valuable data can be provided for improving instruction and professional development in these areas.

- A fourth recommendation for study would be a qualitative investigation on the impact of algebra interventions, grade level-expectations, and achievement gaps. Targeting grade-level expectations with math interventions have been effective as instructional approaches with regards to closing academic achievement gaps.
- For generalization purposes, new research could focus on testing results from a larger school district that have implement intensive mathematics intervention methods.
- Finally, the present study to provided evidence that the relationship between cognitive skills and foundational numerical competencies were significant in student's achievement scores on the PARCC. The district may need to reexamine the AF intervention inclusion model being implemented at this time. Additional professional development, for all stakeholders, may provide consistency of the algebra intervention across the school district.

Implications for Social Change

The potential impact for positive social change, not only for children with special needs, but for all students that were exposed to the AF inclusion intervention teaching method are included in the CCR promise. This is supported by Fuchs et al. (2015) research on intervention methods versus regular nonintervention methods suggest that the achievement gap grew smaller with each year of specialized intervention. The results of this study add significant value for the breadth of knowledge for mathematics intervention methods. First, having access to the general education algebra curriculum means that children with special needs will have equal opportunity to acquire the 21_{st} century skills necessary beyond high school. Additionally, taking mathematics classes beyond algebra will promote positive social change and may improve academic chances of acceptance into institutions of higher learning without the requirement for remedial courses.

In this study, the level of academic rigor obtained by the AF intervention inclusion method emerged as a positive intervention method according to the investigation. Students in the AF intervention inclusion model estimated marginal mean scores were close to the students' scores in the RA nonintervention inclusion method. The results from this investigation suggests the instructional practices from the AF intervention inclusion method benefited students by addressing foundational numerical competencies and cognitive skills in the ninth grade. As illustrated in the findings, there is a statistically significant relationship between access to the general educational curriculum, cognitive skills, and foundational numerical competencies.

Further findings suggest, the fact that the PARCC examination measure student's mastery of the CCSSM and CCR skills, it is essential that the achievement levels for children with special needs be accurately reported at the state level to reflect the overall benefit of the AF inclusion intervention method. Moreover, the implications of this present study reflect adequate accommodations and support for students with special needs in association with the effectiveness of the AF intervention inclusion method demonstrates that access to the curriculum was accomplished. The study's findings do not imply that the AF intervention inclusion model is perfect, rather the findings suggest the model needs to be refined to achieve greater curriculum access for children with special needs.

Conclusion

Investigating the effectiveness of instructional intervention models and targeting cognitive skills and numerical competencies were highlighted as supporting improved algebra outcomes for children with special needs who were enrolled in the AF inclusion intervention method. The findings in this study emphasize the necessity to identify and implement effective algebra intervention methods at the ninth-grade level for SWD. Additionally, the results underscore the critical need for students with MD to have equity access to the general mathematics curriculum to acquire the 21_{st} century skills that are necessary to have under CCR and the skills that will help to promote positive social change in students' lives. The findings in this study indicated that students that received the AF intervention method scores increase as well as student's SWD in the RA nonintervention method.

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