THE IMPACT OF CO-TEACHING ON MATHEMATICS ACHIEVEMENT OF MIDDLE SCHOOL GENERAL EDUCATION STUDENTS

by

Jarrod Bingham

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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ABSTRACT

To accommodate the presence of special education students in general education classrooms, many schools have implemented collaborative teaching or co-teaching, a model in which two or more teachers share responsibility for a group of students. While myriad research has demonstrated that this model benefits special education students, very little researchers have examined the effect of co-teaching upon the general education student, who often outnumber the special education students. The purpose of this quantitative causal-comparative study was to investigate co-teaching's impact upon the mathematic achievement of general education students. The independent variable in this study was students' placement into either a) co-teacher classrooms or b) single teacher classrooms. The dependent variable was students' scores on the STAR® assessment by Renaissance Learning®. Students' scores on a previous administration of the test were covariates in the study. In addition to making the aforementioned comparison, the researcher looked for significant differences between the test scores of cotaught females and cotaught males. The researcher used an ANCOVA to run these analyses and observed no significant difference between the test scores of the treatment and control groups. The results also failed to yield a significant difference between the males and the females. While there was no significant difference among the general education students, the researcher implied that the fact that general education students did not perform at a significantly lower level might actually validate the collaborative teaching model. Future researchers should consider either duplicating this study with a larger, more diverse sample or conduct a similar study that also examines the efficacy with which collaborative teaching is being implemented.

Keywords: co-teaching, collaborative teaching, middle grades, mathematics, special education, inclusion

Copyright Page

Dedication

This document is dedicated to my wife, Brandi Bingham, and my two children, Avery and Aiden, who provided the support, encouragement, and inspiration that I needed to make it through this difficult process.

Acknowledgments

This dissertation would not have been possible without the support of my family. My parents provided all of my early education from kindergarten through twelfth grade, instilling in me a strong work ethic and well-developed foundation of background knowledge. Their continued financial and emotional support throughout my time in college has made it possible to persevere and finish each of my degrees. My wife, Brandi, and children, Avery and Aiden, have graciously given up time with me so that I could work on this document. Furthermore, they have inspired me and given me motivation to keep working when I wanted to give up.

I appreciate the contributions of the dissertation committee. Dr. Michelle Barthlow, my dissertation chair, has graciously provided support and guidance throughout this process. Likewise, Dr. Stephens and Dr. Beavers have given helpful feedback throughout the dissertation process.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

Students with Disabilities (SWD)

Individuals with Disabilities Education Act (IDEA)

Free and Appropriate Public Education (FAPE)

No Child Left Behind (NCLB)

Standardized Test for the Assessment of Reading (STAR®)

Autistic Spectrum Disorders (ASD)

Zone of Proximal Development (ZPD)

CHAPTER ONE: INTRODUCTION

Overview

As a result of societal pressures and government mandates, the field of special education has changed drastically over the last few decades. Very few researchers have focused upon the academic implications of the shift towards inclusion upon general education students. After reviewing both the ways in which special education has changed over the last few decades and the research that has supported or opposed those changes, this chapter will introduce a study that sought to determine the ways in which inclusion and co-teaching might impact the academic achievement of general education middle school students in a rural school district.

Background

Despite the literature suggesting that co-teaching benefits all students academically by lowering the student-teacher ratio so that students receive more teacher attention (Shin, Lee, & McKenna, 2015; Shrogren, Gross, Forber-Pratt, Francis, Satter, Blue-Banning, & Hill, 2015; Friend, Cook, Hurley-Chamerlain, & Shamberger, 2010; Gromisch, 2012), most of the research on the impact or experience of co-teaching has focused on social—rather than academic—outcomes (Mastropieri & McDuffie, 2007). Students, both special education and general education, in Shrogren et, al.'s study reported some of the perceived social benefits of inclusion and collaborative teaching. Those benefits included a greater sense of belonging, greater levels of access to their teachers, and more behavioral and instructional support. Because the ability, focus, and motivation of peers has been shown to have an effect upon student academic achievement, parents may worry about the placement of their general education children in co-teaching classrooms (Justive, Logan, Lin, & Kaderavek, 2014), While teachers often believe that collaborative teaching within the context of inclusive education benefits students academically,

there is relatively little research regarding the direct effect of such instruction upon the academic achievement of students, particularly general education students (Shin et, al.). Furthermore, collaborative teaching is not always implemented with fidelity using evidence-based best practices (Strogilos & Tragoulia, 2013), which means that the few studies examining the impact of collaborative teaching under ideal conditions might not be generalized to the average classroom. The evidence base for co-teaching's impact upon general education students needs to be researched and expanded so that parents, teachers, administrators, and other school stakeholders will better understand how to implement a quality special education program that meets the social and academic needs of all students, both with and without disabilities.

Osgood (2005) explained that the practices of the asylums, which were the primary facilities of special education, came under intense scrutiny as the American public became more accepting of mental disabilities in the mid to late sixties. As a result of this shift in thinking combined with population growth and the development of new special education taxonomies, the number of school districts with special education programs increased from 3,641 to 6,711 in only eight years (Osgood). While those programs generally educated students with disabilities (SWD) in separate classrooms, Dunn (1968), who suggested that most SWD students should be included in the general education classroom, provided an early discussion and rationale of the concept of inclusion as it is practiced in today's schools.

The shift towards educating SWD students in public schools was further established with the passing of Public Law 94-142, which was the first draft of what would become known as the Individuals with Disabilities Education Act (IDEA) (Wright, 2010). The precedent of federal involvement in special education that was set by the Johnson and Kennedy administrations, explained Osgood (2005), culminated in IDEA, which directed public schools to provide a Free

and Appropriate Public Education (FAPE) to all students, regardless of their disability. Soon, other researchers and advocacy groups became involved in encouraging a shift of FAPE services away from segregated schools and classrooms towards models of full or partial inclusion (Reynolds, Wang, & Walberg, 1987) because segregated programs were not preparing students to succeed outside of the school building (Powell, 2012). Both the Advocacy Center for the Elderly and Disabled (1986) and the 1990 World Conference on Special Needs Education of 1990 (Rodriguez & Garro-Gil, 2014) published official statements which suggested that SWD students be included in general education classrooms.

The 2001 No Child Left Behind Act (NCLB) coupled with the 2004 reauthorization of IDEA marked an official shift in federal policy towards inclusive models of special education (Seligmann, 2002; Quigney, 2008; Boser, 2009). NCLB established accountability guidelines for SWD students, making those students responsible for understanding the general education curriculum (Quigney). NCLB also directed that teachers of all students, including SWD students, be highly qualified in the subject that they were teaching. The reauthorization of IDEA mandated that all SWD students be educated in their least restrictive environments (LRE), or the environments as similar to the general education classroom as possible, given their disabilities (Seligmann). In order to provide the NCLB mandated access to a highly qualified subject matter expert who was teaching the general education curriculum and the LRE that was mandated by IDEA, schools began to increasingly rely on inclusion for the delivery of most of their special education services.

Socially, inclusive education has received mixed support among school stakeholders. Proponents of inclusion suggested that, when co-teaching is implemented with fidelity where both teachers share an active, equal role in all phases of instruction, the reduced student-teacher

ratio should allow students to get more help in class (Friend et al., 2010). In a study of seventh grade general and special education students' attitudes towards inclusion, Conderman (2011) said that students reported access to more help as their favorite part of having two teachers. The social benefits of inclusion and co-teaching have also been frequently acknowledged by those who support inclusive education (Gromisch, 2012). Treating all students with dignity, suggested Rodriguez and Garro-Gil (2014), involves placing them in normal environments that respond to their unique needs. This social responsibility may be especially important given the disparate impact of special education placement (Boser, 2009). Because minority groups are often overrepresented in SWD populations, pulling all SWD students from the general education classrooms, in some cases, may result in segregated classrooms. The movement towards inclusion of special education students in general education classrooms may therefore be understood as a social justice victory (Cobb & Manu, 2015).

While nearly all of the literature recognizes that some SWD students may belong in the general education classroom, not all of society supports inclusion to the same extent as its most adamant supporters (Solis, Vaughn, Swanson, & McCulley, 2012). Roberts (2008) suggested that considering each child's unique needs in a disaggregated manner is perilous. It is not possible, she said, to place students in their true LRE because their needs often conflict with each other. One of Roberts key conclusions was that the parents of general education students should have the right to advocate for their children's needs when the parents feel like the inclusion of SWD students is inhibiting their children's academic progress. Roberts was not alone in her beliefs about inclusion. In a survey of 498 early childhood teachers, Lee, Yeung, Tracey, and Barker (2015) reported that no more than half of the sample agreed that students from the following groups should be included in the general education classroom: intellectual disability,

physical disability, visual impairment, hearing impairment, autistic spectrum disorder, and attention-deficit hyperactivity disorder.

The two variables in the present study, co-teaching and academic achievement, will be supported by a clear theoretical framework. According to Bandura's (1989) Social Cognitive Theory, human growth and development is influenced to a great extent by an individual's environment. Individuals exhibit plasticity, which means that they can change as a result of interactions with other people. Vygotsky (1990) also suggested that a rich social environment was critical in determining cognitive development. As students talk with each other, said Vygotsky, they develop the intrapersonal dialogue that is necessary to complete new tasks. Taken together, the work of Bandura and Vygotsky suggested that children learn best in collaboration with peers in rich social environments that feature an exciting curriculum. The research on inclusion and co-teaching suggested that inclusion provides a richer and more exciting environment to SWD students and co-teaching offers the opportunity for all students to collaborate more frequently with their peers (Friend et al., 2010).

The academic achievement variable will be measured using an adaptive assessment, an assessment tool that is also supported by a well-defined theoretical framework. According to the Northwest Evaluation Association (2015), "to actually teach each student where he or she is, today, the teacher needs to know where the starting line is…adaptive tests, which adjust with each test question, provide the clearest picture of the starting line" (p. 3). The large item bank increases the validity of the test and allows the test questions to be matched to each student's exact ability level (Northwest Evaluation Association). Because the test is customized based on students' answers, it is able to more accurately measure student growth and achievement (Kingsbury, Freeman, Nesterak, 2014).

Problem Statement

The impact of co-teaching on SWD students has been an important topic of study. While effectively implemented collaborative teaching in inclusive classrooms has been associated with small academic gains, much of the research has lacked a methodology that would have led to firm conclusions and broader generalizations (Solis et al., 2012). Research has suggested that included SWD students feel like they receive more help in co-taught classrooms (Conderman, 2011; Dieker, 2001) and are more accepted by general education peers (Horne & Timmons, 2009). Embury and Kroeger (2012) also presented research evidence suggesting that their sample of urban middle school students held mostly positive opinions of co-teaching. Justice et al. (2014) also demonstrated that being in a classroom with higher functioning peers was correlated with improved reading achievement. This supported part of Tremblay's (2013) results, which suggested that inclusion positively impacted both reading scores an attendance rates of first grade learning disabled students. Even among this population, however, research has not reached a consensus. Ghandi's (2007) study demonstrated that there was no significant difference between the academic achievement of co-taught SWD students and resource SWD students.

The impact of inclusion on general education students has been discussed and researched less frequently. While Dessemontet and Bless' (2013) quasi-experimental research involving the inclusion of intellectually disabled students in general education primary school classrooms suggested that inclusion led to no significant difference in the test scores of general inclusion students, much of the sparse research regarding inclusion and general education students has focused upon the negative perceptions of school stakeholders. Negative attitudes towards inclusion by both parents of general education students and teachers have been cited as major

barriers to the successful implementation of inclusive education and co-teaching (Glazzard, 2011). Teachers, may not be able to simultaneously manage so many different student needs (Roberts, 2008). Very little empirical research has worked to silence or confirm these fears by focusing on the ways in which inclusion, particularly inclusion that involves co-teaching, impacts the general education students who represent the majority of the classroom population. The problem is that there is a gap in the existing literature regarding the academic impact of co-teaching on general education students (Dessermontet & Bless, 2013; Friend et al., 2010; Ruins, Peetsma, & Veen, 2010).

Purpose Statement

The purpose of this quantitative causal-comparative study was to investigate the impact of co-teaching on the academic growth of general education mathematic students in grades six through eight. Friend (2008) defined the independent variable, placement in a co-taught classroom environment, as "…a general education teacher and a specialist…work[ing] as partners to teach a diverse group of students" (p. 9). The dependent variable, academic achievement, was measured by comparing spring scores on the STAR Math® test, which was administered at the beginning, middle, and end of the school year. Each student's academic level prior to the spring STAR Math® administration, which was measured using the scores from the fall administration of the STAR Math® assessment, was a covariate in this study.

Significance of the Study

Effective co-teaching requires a significant amount of common planning time, teacher training, and administrative support (Nierengarten, 2013). Before taking these often difficult and tedious steps towards full implementation of co-teaching models, education decision makers need access to a research base which indicates that inclusion, in general, leads to positive or at

the very least, neutral, outcomes for all students. While some researchers, like Gromisch (2012), have listed common sense benefits of co-teaching to general education students, very few researchers have actually looked at the academic achievement of general education students in co-taught classrooms.

The results of this study will help math teachers, administrators, and other school stakeholders better understand the ways in which co-teaching may impact general education students. Because the study will involve ex-post-facto analysis of the data, it should give a true picture of co-teaching as it is currently being practiced, without manipulating the fidelity with which the co-teaching is being implemented. Implementing evidence based practices involves trial and error over a period of time (Cook & Cook, 2011). Studies like the current study inform the trial and error process by providing needed data on co-teaching's impact on general education students. This study informs the discussion of what works and what does not work in special education for the purpose of improving the educational outcomes of every student.

Research Questions

RQ1: Does co-teaching impact the mathematic achievement of general education students?

RQ2: Does the impact of co-teaching on the mathematic achievement of general education students differ based on students' biological sex?

Definitions

1. *Inclusion* – Teaching SWD students in the same classroom as general education students (Idol, 2006)
2. *Co-teaching* – The partnering of a general education teacher and a special education teacher or another specialist for the purpose of jointly delivering instruction to a diverse group of students, including those with disabilities or other special needs, in a general education setting and in a way that flexibly and deliberately meets their learning needs (Friend et al., 2010).
3. *Adaptive Assessment* – Assessment that begins with a large pool of questions and then selects individual questions for test takers, depending on their responses as they go along (Kingsbury, Freeman, & Nesterak, 2014).

CHAPTER TWO: LITERATURE REVIEW

Overview

After establishing a theoretical framework, this paper will briefly review the historical development of special education and inclusion, examine research-based guidelines for implementing inclusive instruction, discuss the manner in which collaborative teaching is currently being practiced in public schools, discuss school stakeholders' reaction to inclusive education, and present research on the academic and non-academic outcomes of inclusion.

Introduction

The number of students who are being served in the special education programs of public schools increased from 11.4% in the 1990-1991 school year to nearly 13% in the 2011-2012 school year (National Center for Education Statistics [NCES], 2013). The NCES also reported that the number of students in specific categories like specific learning disabilities (SLD) and autistic spectrum disorders (ASD) has increased dramatically over the last 30 years. While the achievement gap between students with disabilities (SWD) and general education students has narrowed slightly over the last decade, general education students continue to consistently outperform SWD students on criterion and norm-based assessments.

As the number of SWD students has increased, school stakeholders and politicians have launched various reform efforts to decrease the achievement gap and increase high school graduation rates among SWD students. One reform that has gained a considerable amount of traction is the inclusion movement, in which SWD students are given access to the general curriculum by being included in the general education classroom (Wright, 2010). Inclusion students are often given additional support by a special education teacher or paraprofessional who works—not in a separate classroom—but alongside the general education teacher (Friend,

2008). In addition to tracking special educations students' progress and drafting IEPs, the special education teachers are responsible for providing additional evidence-based instruction to all of the students in the inclusive classroom—not just for the special education students (Friend).

Theoretical Framework

The work of Vygotsky (1930) and Bandura (1989) form the theoretical underpinning for this literature review. Vygotsky wrote about the dual roles that language and social environment play in learning. According to Vygotsky, "…as soon as speech and the use of signs are incorporated into any action, the action becomes transformed and organized along entirely new lines" (p. 9). Speaking of the process through which children use speech to guide themselves through challenging tasks, Vygotsky continued, "when children develop a method of behavior for guiding themselves that had previously been used in relation to another person…they succeed in applying a social attitude to themselves" (p. 13). He seemed to be drawing a line between the development of interpersonal speech in social situations and the intrapersonal speech that is needed to guide thinking. Indeed, Vygotsky repeatedly connected children's social environment with learning. To understand a child, Vygotsky taught that looking at the child alone was insufficient. Instead, one needs to look at the child in his or her social setting. According to Vygotsky, "what children can do with the assistance of others might be in some sense even more indicative of their mental development than what they can do alone" (p. 78).

Murphy, Scantlebury, and Milne (2015) applied the concept of the zone of proximal development (ZPD), a critical component of Vygotsky's theory, directly to the practice of collaborative teaching. A simple description of the ZPD is that it describes the skills and understandings that an individual can perform or develop only with the assistance of another individual. Murphy, Scantlebury, and Milne asserted that ZPD provided an explanatory model

for the development of pre-services teachers when they were co-teaching with teaching professionals. Furthermore, Kerin and Murphy (2015) asserted that co-teaching provided an effective vehicle for scaffolded instruction based upon students' ZPDs. Collaborative instruction and Vygotsky's concept of ZPD are very interrelated concepts (Kerin & Murphy).

According to Bandura's (1989) Social Cognitive Theory, individual development is influenced by a variety of environmental factors including one's interactions with other people. A characteristic of humans, Bandura explained, is plasticity, which means that people have the ability to change based upon the factors that influence their lives. Taken together, the work of Vygotsky (1930) and Bandura suggested that learning and development are best facilitated by placing children into rich social environments with an exciting curriculum alongside peers who are able to collaborate and model appropriate dispositions and behaviors while working. The movement towards the inclusion of SWD students has promised to benefit students by moving them from the more socially uniform special schools and resource rooms, characterized by watered down curricula, to the more socially diverse and complex learning environment of the general education classroom.

Adaptive assessments like the STAR Math® test are underpinned by Item Response Theory (Chang, 2015). Item response theory differs from classical testing theory in the manner in which the difficulty of the test questions relates to the ability of the students who are taking the test (Mahmud, 2017). According to Mahmud, students who are taking a test that is built upon classical theory risk being under challenged or challenged above their ability levels. A single question, for example, might be very difficult for a low performing student but far too easy for a high performing student. In contrast, a test that is built upon item response theory would provide students with test questions that are matched to their ability levels, so that the questions are

neither too hard nor too easy for each individual student. Item response theory gives teachers and medical practitioners a more complete understanding of students' actual ability levels (Mahmud).

Related Literature

The Development of Special Education in the United States

Moving Towards Inclusion. The nature of special education has changed dramatically over the last few decades. Indeed, it has taken several state and federal laws, court decisions, and civil rights initiatives to ensure that SWD students are given equal access to educational opportunities (Cantu, 2015). Former special education practice involved placing SWD students into asylums or special schools (Powell, 2011). Schools at the time were not universally inclusive, and most SWD students were among those excluded from public education (Cantu). Furthermore, compulsory education laws did not apply to SWD students, so even students who might have been able to be enrolled in an educational program were not required to do so (Cantu).

Cantu (2015) explained that the absence of SWD students in the public education system led to a lack of social awareness. Cantu described two important historical events, Brown v. Board of Education and the launching of the Sputnik Satellite, that inadvertently promoted a shift in the public's understanding of disabilities. Although the Brown v. Board of Education decision of 1954 addressed racial discrimination, its declaration that separate facilities were naturally unequal provided a legal basis for future calls to end disability-based discrimination. The launching of the Sputnik Satellite in 1957 also benefited SWD students indirectly by ushering in a time of increased funding for public education, making it easier for schools to provide services for disabled students.

Still, states lacked much of the funding that they needed, which led to the placement of SWD students in less than ideal settings (Cantu). According to Powell (2011), students were transferred from the environments of asylums and special schools into special education classrooms within public schools. Boser (2009), however, stated that many of the special education students were not acutely disabled and "the majority of students with disabilities should be able to perform at grade level and graduate from high school with a regular diploma" (para. 2). As early as the 1980's, people began to accept the principals of inclusive education (Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010). Inclusion, as a special education model, was first formally championed by the World Conference on Special Needs Education in the Salamanca Statement in 1990 (Rodriguez & Garro-Gil, 2014). According to Cantu, however, the widespread adoption of inclusive education would requirement federal involvement and, most importantly, federal funding.

Two key pieces of federal legislation, No Child Left Behind (NCLB) and The Individuals with Disabilities Education Act (IDEA), effectively ushered in an era in which schools in the United States would include those students who were not acutely disabled into the general education classroom. NCLB, signed into law in 2001, held most SWD students, along with their schools, accountable for understanding the same curricula as their non-disabled peers and required that all students be taught by highly qualified teachers (Allday, Neilsen-Gatti, & Hudson, 2013; Friend et al., 2010; Carpenter & Dyal, 2007). Many special education teachers, however, were not highly qualified in the subject that they taught (Friend, 2008). For many schools, transitioning SWD students to inclusion-based classrooms provided access to both the general education curricula to which all students would be held accountable and highly qualified teachers in each subject area (Friend, 2008; Conderman, 2011).

When discussing inclusion, the most important contribution of the 1990 and 2004 reauthorizations of IDEA was the concept of least restrictive environment (LRE). IDEA specified that all SWD students had to be educated in as close an environment to the general education classroom as the students' disabilities would allow (Friend, 2008; Conderman, 2011; Burke & Sutherland, 2004). Seligmann (2001) explained that IDEA also required all schools to provide individualized instructional plans to help all students reach their potential in their least restrictive environments. Steep service costs could no longer justify excluding a student from public schools (Seligmann). Schools in the 21st century, therefore, were required to serve students with increasingly diverse disabilities.

Special Education Students in the Modern American Classroom. In 2001, one in ten public school students received at least one special education service (Seligmann, 2001). According to Boser (2009), this number remained mostly steady through 2006. The distribution of students who are being served varied across states. In Georgia, for example, only 8.3 percent of the student population was classified as SWD. In West Virginia, however, 12 percent were classified as SWD. Boser suggested that this discrepancy most likely resulted from the flexibility that IDEA gives to each state in choosing how they will identify disabilities in students.

While the nature of each disability may vary greatly from one student to another, IDEA recognized the following broad categories of disability: autism (ASD), deaf-blindness, deafness, developmental delay, emotional disturbance (EBD), hearing impairment, mental retardation (MR), hearing impairment, specific learning disability (SLD), speech or language impairment (SLI), traumatic brain injury, visual impairment, multiple disabilities, and other health impairments (OHI) (Boser, 2009; Seligmann, 2001). To be served in any of those categories, the

student's impairment must interfere with his or her ability to succeed in the classroom or perform major life tasks. Boser presented the following breakdown of the SWD population by type of disability: 40 percent are SLD, 20 percent are SLI, 9 percent are MR, 8 percent are EBD, 8 percent are OHI, 4 percent are ASD, 2 percent have multiple disabilities, and less than half of a percent have traumatic brain injuries.

Classifying Inclusion and Co-teaching. Burke and Sutherland (2004) said that inclusion simply involves supporting the needs of special education students within the general education classroom. According to Burke and Sutherland, "inclusive education suggests that all students in a school…become a part of the school community [and] feel a sense of belonging among other students, teachers, and support staff" (p. 164). After making reference to the concept of LRE, Seligmann (2001) said that "this merger of special education with regular education is seen in part as a moral imperative designed to avoid segregation of children with disabilities into a separate but unequal system" (p. 776).

According to Boser (2009) and Seligmann (2001), certain minority groups have historically been overrepresented in special education programs. African American students, for example, made up only 15 percent of the school-aged population but represented a full 20 percent of all special education students. American Indian and Hispanic students were, likewise, significantly overrepresented. Some of this disproportionality, said Boser, might be explained by economic inequality and the issues that come from growing up in poor neighborhoods, "but societal misconceptions might be part of the problem as well" (para. 25). Harry and Penton (2016) agreed that the overrepresentation of minorities in special education programs was a complex problem involving both economic inequality and cultural differences and misunderstandings. Proponents of inclusion might caution against removing a group that is

composed of a disproportionally large number of minority students and placing them into a special classroom. Today, over 50 percent of SWD students are served in inclusive classroom environments, which is a twenty-five percent increase from the number served inclusively in the mid-1980s (Allday et al., 2013).

Until recently, inclusion was justified using community-based arguments such as those described in the preceding paragraphs (Friend et al., 2010). Recently, explained Friend et al., the advent of collaborative teaching has led many to believe that inclusion might benefit students in other ways. Co-teaching, explained Conderman (2011), "involves two or more educators working collaboratively to deliver instruction to a heterogeneous group of students in a shared instructional space" (p. 24). While the non-general education teacher is often a special education teacher, the additional teacher(s) may also be reading specialists, speech/language therapists, or bilingual educators (Friend, 2008). Co-teaching provides SWD students with both a highly qualified general education teacher to provide access to the general education curriculum and a specialist who is an expert in differentiating content to meet each student's needs (Friend et al.; Friend; Carpenter & Dyal, 2007).

The aforementioned access to two teachers may be correlated with other instructional benefits for students. Sweigart and Landrum (2015), for example, studied samples of students in elementary, middle, and high schools in both single-teacher and two-teacher classrooms. Students in the elementary subgroup of the sample were observed to have more opportunities to respond and increased positive feedback. They also had more opportunities to work in small groups. These benefits, however, did not all extend to the middle and high school participants. While those students had more opportunities to respond in collaborative classrooms, co-taught

students were significantly less engaged than students in single-teacher classrooms (Sweigart & Landrum, 2015).

Teaching and Learning in the Modern General Education Classroom.

The Evolving General Education Classroom. Best practice in the modern American general education classroom has evolved to support the inclusion of students with myriad special needs and cultural backgrounds. Tomlinson (1999) and Tomlinson (2010), whose research provided a framework for a major push towards widespread differentiated instruction and still informs the practice today, asserted that all children, both general education and special education students, should be provided with instruction that is differentiated to their unique learning needs. Research has suggested that most students benefit from having access to the high quality curriculum of the general education classroom (Tomlinson, 1999). Because students learn at different paces and in different ways, teachers should use differentiation strategies including flexible grouping, tiered assignments, and scaffolding to give all students equal access to a high quality curriculum (Tomlinson, 2010). Building upon Tomlinson's work, Maeng's (2017) qualitative examination of technology-driven differentiated instruction in a secondary science classroom led her to suggest that teachers use the technology that is available in their schools to provide differentiated instruction. Because the modern American classroom has become so diverse, differentiated instruction is not a fad that will fade away—it will continue to support all students' learning needs (Birnie, 2015).

Gender Differences in Mathematics Achievement. Stewart, Root, Koriakin, Choi, Luria, Bray, Sassu, Maykel, O'Rourke, and Courville (2017) used the Kaufman Test of Educational Achievement—Third Edition to examine the number of mathematical errors made by students aged six through nineteen. Stewart et. al's sample demonstrated no significant

difference in most mathematical concepts including basic computation and mathematical and geometric concepts. The only significant difference was found in the area of complex problem solving in which the males significantly outperformed the females. This contrasts with the findings of a study of the relationship between gender, metacognition, and mathematical achievement because one might expect metacognitive awareness to be heavily associated with complex problem solving. Baltaci, Yildiz, and Ozcakir (2016) presented data suggesting that metacognitive awareness levels, which were significantly higher in their study's female subgroup, are associated with higher levels of overall mathematics achievement. Their study did not, however, attempt to describe the magnitude of this association.

Cunningham (2015) studied gender differences in the Ontario school district. According to Cunningham, males were clustered more heavily at both ends of the achievement extremes meaning that there was a higher percentage of male students at the lower end of the achievement spectrum as well as at the higher end while female achievement data were spread more evenly throughout the middle of the achievement spectrum. Cunningham asserted, however, that achievement should not be used as the only metric when evaluating gender differences in the field of mathematics. His study also revealed that female students were significantly more likely to enroll in ninth grade programs that required more mathematics classes than male students, even though they performed significantly lower on mathematics ability tests. Cunningham claimed that voluntary enrollment in additional math courses indicated a greater propensity toward math than the ability tests. Because a higher percentage of the female students had voluntarily opted to enroll in the higher level math courses, they seemed to be more likely to succeed in the field of mathematics.

Effectively Implementing Inclusion

Teacher Development. Many teachers have been observed to have a less than positive view of inclusion. "Successful implementation of effective inclusion," however, "very much depends on the attitudes of educationalists and the critical agent for successful inclusion is undoubtedly the teachers" (Lee et al., 2015, p. 85). Because research has shown that teacher knowledge about student disabilities is directly related to their willingness to work in inclusive classrooms (Lee et al.; Desimone & Parmar, 2006; Burke & Sutherland, 2004; Tzivinikou, 2015), teacher development and support must be key components of an inclusive school. Allday et al. (2013) reviewed a large sample of university curricula and determined that very few classes were dedicated to general education teachers working with special education students. There were also very few classes that taught about key evidence-based strategies like differentiated instruction, classroom management, and collaboration that are necessary for effective inclusive instruction. Allday et al. recommended that more university classes emphasize inclusion and collaborative teaching. Researchers like Kine, Ryan, and Faulkner (2016) have studied the implementation of collaborative teaching in student-teacher settings and determined that this type of new teacher development facilitates increased understanding of collaborative teaching techniques in teacher candidates.

Burke and Sutherland (2004) inferred from their study that providing adequate professional development might increase teachers' positive attitudes toward inclusion. Teachers who received collaborative teaching and inclusion-related professional development were significantly more likely to collaborate with more fidelity (Panscosofar & Petroff, 2016). It follows that professional development should be a key component of an effective inclusion program. In-service teachers and graduating teacher candidates will continue to need staff

development in order to most successfully implement inclusion in their classrooms. Still, a common complaint among teachers is the lack of administrative support and professional development in the area of inclusion (DeSimone & Parmar, 2006). Principals must be proactive in outlining expectations and providing staff development for inclusion in their schools (Carpenter & Dyal, 2007). Collaborative teachers should be provided with professional development before the school year begins so that each co-teaching team can begin building a relationship upon common understandings (Conderman & Hedin, 2017). Collaborative teaching teams also need ongoing professional development that specifically relates to their grade level and content needs (Pratt, 2014). Morgan (2016) suggested that some amount of professional development be dedicated to teaching communication and collaboration skills to co-teaching partners.

Nierengarten (2013) synthesized co-teaching research in order to list themes related to evidence-based implementation guidelines. Schools should begin implementing co-teaching programs by nurturing inclusive attitudes within the school building. Prior to implementing a co-teaching program, suggested Nierengarten, both administrators and teachers need to be trained to implement co-teaching successfully. Nierengarten also suggested that schools develop staff buy-in in co-teaching by allowing teachers to choose to co-teach instead of making co-teaching assignments without teacher input. Conderman and Hill (2017) confirmed that collaborative teaching is generally more successful when teachers volunteer to co-teach. Administrators should also try to pair teachers who work well together (Pratt, 2014).

The researchers in the preceding few paragraphs described the manner in which teachers should be prepared before attempting to implement co-teaching. Brendle, Lock, and Piazza (2017), on the other hand, examined the self-perceived knowledge level of teachers who were

actually involved in the co-teaching process. They gathered qualitative data using interviews, classroom observations, and rating scales in two elementary school classrooms in an attempt to better understand their sample's knowledge and perceptions of co-teaching. They determined that the teachers lacked the skills and understanding that they needed in order to effectively implement co-planning, co-instructing, and co-assessing.

Collaborative Teaching Models. Co-teachers should clearly understand their role in the classroom, which may change depending upon the objectives of the lesson and needs of the students (Friend, 2008). Friend et al. (2010) identified the following collaborative teaching structures that co-teachers may use in their classrooms: one teach, one observe, in which one teacher delivers instruction while the other teacher gathers data; station teaching, in which students rotate through three or more stations where they work independently or with one of the two teachers; parallel teaching, in which each teacher presents identical content to their half of the class; alternative teaching, in which one teacher works with the majority of the class while another teacher works with a small group; team teaching, in which both teachers share instruction with the whole group; and one teach, one assist, in which one teacher leads the instruction while the other teacher circulates and helps students individually.

While collaborative teachers should generally select instructional models that lower the student-teacher ratio, each model has a particular purpose. The selection of one model over the others should be dictated by the nature of each lesson (Chandler-Olcott, 2016). Much of the foundational research on each of the six collaborative teaching structures was conducted by Cook and Friend (1995). While the one teach, one observe and the one teach, one assist structures can be used to effectively gather data or provide intense support to a few individual students, their overuse can make one teacher, usually the special education teacher, seem like a

teacher's assistant with little actual power in the classroom (Cook and Friend). The majority of less prepared teachers primarily use the one teach, one observe and one teach, one assist models, but the most effective collaborative teachers understand and use multiple models to reduce the teacher-student ratio and provide differentiated instruction (Dieker, 2010).

The remaining structures' main benefit is that they reduce the student-teacher ratio by either distributing the students between the two teachers or equally involving both co-teachers throughout the teaching process (Friend, 2010). Station teaching works well when the teachers want to simultaneously achieve more than one instructional goal in which the order of instruction does not matter (Cook & Friend, 1995). One teacher, for example, may present new content in one station while the other teacher guides students through a test review activity. Station teaching also makes it easier for both teachers to work on students' specific IEP goals without separating them from their peers (Friend, 2015). Cook and Friend (1995) cautioned that teachers should be able to accurately pace instruction for station teaching to work. Otherwise, conflict might arise when one teacher consistently finishes instructing after their allotted time.

When using the parallel teaching structure, both teachers present identical content to half of the class (Cook & Friend, 1995). This structure, said Cook and Friend, is ideal for instructional goals that require close supervision such as drill work, project-based instruction, and discussion groups. Teachers also use parallel teaching to provide two distinct instructional pedagogues and differentiate to meet their students' unique learning needs (Friend, 2015). Team teaching's use is similar to parallel teaching. Both teachers present the same content from their own perspective just as they do in parallel teaching (Cook & Friend, 1995). Instead of working with two groups, however, teachers who are team teaching work equally with the entire group of students (Cook & Friend, 1995).

Alternative teaching is often used when teachers recognize that several students might benefit from small group instruction (Friend, 2015). Teachers should use alternative teaching to introduce vocabulary, reteach or pre-teach an important lesson, providing enrichment, facilitating opportunities for students to pursue interests, and similar other tasks (Cook & Friend, 1995). Friend cautioned that the alternative teaching structure could stigmatize students with disabilities if they are consistently pulled into the smaller group.

Defining Roles and Responsibilities. Regardless of the structure that is used to facilitate collaborative instruction, effective co-teachers need to develop and model parity in their relationship with each other (Conderman & Hedin, 2017; Chandler-Olcott, 2016; Morgan, 2016). Administrators should begin to promote parity from the beginning of the school year by listing both teachers' names on students' schedules and giving both teachers equal access to student data (Conderman & Hedin). Morgan asserted that students benefit when teachers are expected to equally share responsibilities related to planning and implementing instruction and assessing and grading students' performance. Even teachers who primarily use the one teach-one assist and one teach-one observe collaborative structures may build a sense of parity in their relationship by alternating the teaching and assisting or observing roles (Chandler-Olcott, 2016). According to Pancsofar and Petroff (2016), professional development might be correlated with parity. The sample of teachers in their study who had received professional development related to collaborative teaching were significantly more likely to express feelings of equality in their co-teaching relationship.

Developing Cooperation in the Co-teaching Relationship. Once co-teaching assignments have been made, school administrators should uphold the efficacy of the collaborative process by respecting the co-teaching team (Nierengarten). First, the team should

have common planning time to ensure that both educators are able to contribute equally to the development and implementation of each lesson. Second, co-teachers should not be reassigned to cover other classes or responsibilities (Nierengarten). Despite myriad research suggesting that common planning time was a critical component of effective collaboration (Friend, 2008; Morgan, 2016; Conderman & Hedin, 2017; Pratt, 2014; Chandler-Olcott, 2016), many teachers have reported that finding time to plan together was a major challenge of collaborative teaching (Morgan). Morgan explained that, when two teachers equally share instructional responsibilities, the two individuals cannot simply show up to class and "wing it" (p. 52) when delivering instruction. Both educators must work together before class in order to understand their roles and responsibilities.

Teachers who plan effectively meet early in the school year to begin discussing their philosophy, approaches to classroom management, concerns, and other instructional practices (Conderman & Hedin, 2017) and continue to meet regularly throughout the school year to plan instruction and resolve issues (Chandler-Olcott, 2016; Pratt, 2014). Throughout the co-teaching partnership, teachers need administrative support to ensure that they have a consistent and protected common planning time (Scruggs & Mastropieri, 2017). Indeed, Principals should facilitate teacher development by providing a common planning time no less than once a week where co-teachers might define roles and plan each day's lesson (Friend, 2008). All collaboration should have clear goals and a known purpose (Morgan, 2016). Until they are more comfortable working together, teachers who are new to collaborative teaching should consider developing formal, well-defined lesson plans that enumerate the exact responsibilities of each teacher (Pratt). While face-to-face interaction during a common planning time is ideal, Morgan

suggested that teachers who lack a time to plan together use technological resources like Google docs to communicate and plan together.

Trust is another critical characteristic of an effective co-teaching relationship (Pratt, 2014; Morgan, 2016). Trust in a collaborative relationship grows as teachers learn to care for and respect each other (Pratt). Pratt recommended that collaborative teachers develop trust by being open-minded, communicating openly, compromising, using humor, asking for help, and being selfless. Developing trust between teaching partners is a challenge, but it is a critical part of developing a healthy and productive co-teaching relationship (Morgan). Administrators should frequently communicate with collaborative teachers to help them resolve issues and learn to trust each other (Conderman & Hedin, 2017).

The Actual Implementation of Inclusion and Collaborative Teaching in Public School Classrooms

Having discussed research-based guidelines for collaborative teaching, it is equally important to examine the extent to which actual inclusive programs have adhered to those guidelines. The preceding section of this paper described Friend's (2008) collaborative teaching structures and suggested that, while each structure served a particular purpose, the strategies that lowered the teacher-student ratio were generally more effective than the strategies in which one teacher provided most of the instruction. Kinne, et. al (2016) reported that the majority of teachers in their sample, an average of 86% of participants, generally used the one teach-one assist collaborative teaching structure. Over 50% of the group also reported frequent use of the one teach-one observe collaborative structure. Very few teachers in Kinne, et al.'s study used parallel teaching, station teaching, alternative teaching, or supplemental teaching. Pancsofar and Petroff's (2016) study of one hundred twenty-nine teachers across five school districts supported

the findings of Kinne, et al. The sampled teachers primarily used one teach-one assist, a structure that did not effectively lower the student-teacher ratio. While King-Sears, et al. (2014) did not discuss particular collaborative structures by name, they said that the general education teacher in their study provided two-thirds of the new instruction and was responsible for 68% of teacher-student interactions. This description clearly indicated that the teachers were primarily using the one teach-one assist approach to collaborative teaching. A common theme across the aforementioned literature was that the sampled teachers were consistently relying on collaborative teaching structures that did not take advantage of the contributions of both educators.

Rivera, et al. (2014) looked at collaborative teaching teams across five schools, searching for evidence of the following eight characteristics of effective collaborative teaching: support from administration, co-planning time, training, culture of sharing, flexibility in general educators, content mastery in special educators, parity in the collaborative teaching relationship, and matching philosophies. None of the schools consistently demonstrated all eight of the characteristics. Only three schools consistently demonstrated five to six of the characteristics; six of the schools achieved marks for two to three of the characteristics; the last three schools demonstrated between zero and one of the characteristics. While the schools, in general, did not adhere to many of the given characteristics of effective collaborative teaching, most of the schools provided common planning time. This contrasted with the findings of other researchers. Morgan (2016), for example, asserted that lack of common planning time was often a barrier to effective collaboration. Pancsofar and Petroff (2016), likewise, asserted that the teachers that they sampled infrequently had time to plan together.

Parity and trust were two other characteristics of effective collaborative teaching. The teachers who were studied by Rivera, et al. (2014) cited teacher inequality as a major barrier to effective collaborative teaching in their schools. According to many of the special educators, the general educators at the schools were often inflexible and unwilling to give up control of the classroom. In another study, Prizeman (2015) said that, although they may have begun their co-teaching relationship with a lack of parity and trust, teachers' confidence in each other increased as they spent more time teaching together. Teachers who had spent more time teaching together shared roles more equally. Parity between those teachers was so well established that their students could not differentiate between the distinct role each teacher (Prizeman). Pancsofar and Petroff (2016) supported Prizeman's findings. The teachers who had been working together longer were more likely to plan together and equally divide instruction. Taken together, the literature on teacher parity and trust suggested that both characteristics, while difficult to achieve early in a co-teaching relationship, are strengthened as collaborative teaching teams spend more time working together

Reaction to Inclusion Among Researchers and School Stakeholders

Full Inclusion for All Students. For many professional educators and researchers, inclusion is not a simple yes or no question. Opinions towards inclusion generally vary according to each type of student disability. Lee, Yeung, Tracey, and Barker (2015) surveyed 498 early childhood teachers about their acceptance of children with different types of special needs in the general education classroom. Over 70 percent of the sample agreed or strongly agreed that SLD students, students with speech or language difficulties, and gifted students should be included in the regular classroom. Only about half of the sample, however, agreed that the following student groups should be included in the general education classroom: intellectual

disability, physical disability, visual impairment, hearing impairment, ASD, and attention-deficit hyperactivity disorder (ADHD). At an acceptance rate of only 39.1 percent, visual impairment was the lowest ranked disability.

While educators may argue about which student groups cannot be appropriately serviced in the general education classroom, many researchers seem to agree that schools must offer other special education service delivery models (Dieker, 2010; Carpenter & Dyal, 2007). According to Powell (2011), "the main concern is that current special education programs practicing full inclusion do not have the resources to support the needs of all students" (p. 186). Carpenter and Dyal also warned that "the failure to choose educational settings that meet the individual needs of students with disabilities lays the foundation for serious problems for the students with disabilities, the classroom teacher, and general education students" (p. 348).

Other Research on Teacher Attitudes Toward Inclusion. Desimone and Parmer (2006) used a sample of 228 middle school mathematics teachers to examine teachers' beliefs and self-reported knowledge regarding inclusion. Specifically, they asked about the inclusion of SLD students, which represent the largest group of SWD students who are being served in public school classrooms. Prior to discussing the results of their study, which involved teacher surveys and interviews, it should be noted that the survey response rate of 63 percent was relatively low. The researchers also created their own survey and either failed to conduct a validation study or failed to present the validation data. While just over 80 percent of the respondents stated that they believed that SLD students should have access to the general curriculum, only 41.6 percent agreed that the students should be taught mathematics in an inclusive classroom. More than half of the teachers believed that they were able to effectively provide instruction to SLD students, but only 43.9 percent agreed that SLD students taught in inclusion would have a better chance of

succeeding than students taught in resource rooms. When asked about the most challenging part of teaching SLD students, the teachers most often described motivation and attention as being their biggest struggles.

Burke and Sutherland (2004) described very similar sentiments in their study. The active teachers in their study generally had a more negative opinion of inclusion. Burke and Sutherland, however, also gathered data on pre-service teachers. In contrast to the in-service teachers, the pre-service teachers were overwhelmingly positive about students' ability to succeed in inclusive classrooms. Burke and Sutherland asserted that pre-service teachers might feel this way because they are relying on a college curriculum that has been updated to include strategies for inclusive classrooms. In-service teachers, on the other hand, most often rely only on their own experience, which may have been more negative. As new teachers begin entering into the field of education, schools may experience an increased number of positive attitudes toward inclusive education. Kinne, Ryan, and Faulkner (2016) supported the conclusion that teachers who are new to the profession might be more likely to have positive attitudes towards inclusion and collaborative teaching by reporting that the student teachers who were working collaboratively in their study had overwhelmingly positive views of co-teaching and the inclusion of SWD students in the general education classroom. Chityo (2017), who surveyed seventy-seven teachers in the North Eastern region of the United States, confirmed many of the finding in the aforementioned studies. The teachers that were surveyed by Chirtyo suggested that they lacked the training and resources that they needed to successfully implement co-teaching in their classrooms.

Not all of the research, however, has exposed negative attitudes towards inclusion and collaborative teaching. An in depth qualitative study conducted in a fifth-grade classroom in

Ireland, for example, exposed overwhelming positive teacher and student attitudes towards inclusion (Prizeman, 2015). According to Prizeman, the teachers reported that collaborative teaching benefited students by lowering the student-teacher ratio and allowing teachers to collaborate to best meet the needs of the students in their shared classroom. These characteristics of collaborative teaching benefited students by building self-confidence, fostering stronger teacher-student relationships, and providing more opportunities for instruction that was targeted to students' needs (Prizeman). Morgan (2016) reported very similar teacher-perceived benefits of collaborative teaching in a small sample of elementary school teachers. The only negative perception that was noted in Prizeman's study was the challenge of finding adequate non-pupil contact time in which to plan instruction.

King-Sears, Brawand, Jenkins, and Preston-Smith (2014) used the following three qualitative sources of data to research the nature of and perceptions toward inclusive education and collaborative teaching in a single collaborative teaching team: teacher observations, student survey responses, and teacher survey responses. Similar to the findings of Prizeman (2015) and Morgan (2016), the teachers in King-Sears, et al.'s study expressed overwhelmingly positive views towards collaborative teaching. Both the general education teacher and the special education teacher agreed that the co-teaching relationship was strong and positive. When responding to the prompt regarding parity in their teaching relationship, however, the two teachers' perceptions diverged. The general education teacher claimed that the two teachers had an equal role in planning and delivering instruction; the special education teacher reported that they did not equally share roles and responsibilities. This sharing of roles is critical because a lack of parity has been associated with increased negative attitudes towards inclusion (Pancsofar & Petroff, 2016).

Student Attitudes Towards Inclusion. One of the most comprehensive studies of student views towards inclusion and collaborative teaching was conducted by Shogren, Gross, Forber-Pratt, Francis, Satter, Blue-Banning, and Hill (2015). For their study, Shogren et al. selected five elementary schools and one middle school that exemplified quality, evidence-based inclusive education. The researchers were thus able to gather student perceptions of ideal inclusive educational environments, which may or may not have been a reflection of inclusive practice in the average public school. After conducting focus group sessions and individual interviews with both general education and special education students, the researchers discovered the following three themes regarding students' attitudes towards inclusion and collaborative teaching: sense of belonging, inclusion, and school and classroom practices that offered support to all students. Students in ideal inclusive schools reported that they felt like the positive culture of each of their schools was one that promoted cooperation and reduced incidences of bullying. Furthermore, they attributed this to the schools' inclusive models. The general education students reported that they accepted SWD students, asserting that they were not "really different from anybody else" (p. 250), but that they just needed a little more help. Likewise, the SWD students reported that they preferred to receive special education services in the general education classroom to being pulled into separate classrooms. Both general education and SWD students described more access to instructional supports as a benefit of their schools' inclusive models.

A key limit of the preceding study was that the researchers only reported on the perceptions of students in ideal inclusive settings. Morgan (2016) and Prizeman (2015) both gathered student-perception data in less than ideal situations. The second-grade students who participated in Morgan's study unanimously agreed that they enjoyed having two teachers in their math classroom and nearly every student, fifteen out of nineteen, said that they wanted to

have two teachers in their other classrooms. The students in both Morgan and Prizeman's samples nearly all said that they enjoyed the variety of activities that the two teachers were better able to facilitate. Prizeman's sample also stated that having two teachers made each lesson more interactive. Taken together, the research of Shogren et al. (2015), Morgan, and Prizeman revealed overwhelmingly positive student attitudes towards inclusion. While these results supported the implementation of inclusive education and collaborative teaching, they should be approached with caution due to either (a) their ideal setting (Shogren et al.) or (b) their small sample size (Morgan; Prizeman). Larger scaled quantitative studies using more diverse samples and settings would be needed to make broader inferences regarding student perceptions of inclusion and collaborative teaching.

Non-Academic Outcomes of Collaborative Teaching

The Peer Effect. Anastasiou and Kauffman (2011) directly challenged the special education application of the social learning theories upon which this paper was written. Referring to the social constructionist view of education, the researchers said that "…[they] have depicted special education as segregationist and discriminatory" (p. 379). Rather than viewing traditional special education models in this way, Anastasiou and Kauffman suggested that special education was "special" (p. 379) because of the unique needs of SWD students—not for discriminatory purposes. SWD students, continued the researchers, do not necessarily need access to the general education curriculum; instead, they need a curriculum that matches their unique needs. The unique needs of SWD students often warrant the students' exclusion from the general education classroom.

Justice, Logan, Lin, and Kaderavek (2014) directly examined the peer effect in a sample of early childhood students in order to determine whether placing students with lower ability

levels in heterozygous classes might improve student outcomes. Aligning closely with Bandura's social-learning theory (1989), their results showed that early childhood students with low language skills showed significantly higher levels of improvement when they were grouped with students who had superior language skills than when they were grouped with other low language skills students. While additional research with more diverse samples would be needed before making broad inferences, the results of Justice et al. seem to contradict Anastasiou and Kauffman's (2011) assertion that lower performing students, like SWD students, do not benefit from being placed with higher performing students.

School Culture. Rivera, et al. (2014) studied school leaders, teachers, and students with disabilities to learn more about the potential benefits of collaborative teaching. The research was set in several low income, highly diverse middle and high schools who were meeting some, but not all, of the evidence-based best practices for effective inclusive education. The SWD students from the schools with more collaborative teaching reported significantly higher levels of school satisfaction, a greater sense of school belonging, and increased self-efficacy with new social situations. Rivera et al. asserted that students' increased self-efficacy was a "critical finding given that self-efficacy has been found to be lower among students with LD" (p. 82). This research was later supported by Morgan (2016), whose sample cited a decrease in the stigma that was often directed towards SWD students and the resulting development of a stronger sense of community as benefits of inclusion and collaborative teaching. It is likely that the manner in which SWD students relate to both the school and their peers is directly influenced by reduced stigma and development of community. Building off of the contrasting personalities of two distinct teachers may also foster this understanding of diversity in the classroom (Simpson, Thurston, & James, 2014).

Reducing the Student-Teacher Ratio. Effective collaborative teaching has the potential to benefit all students, both general education and students with disabilities, by reducing the student teacher ratio (Morgan, 2016; Tschida, Smith, & Fogarty, 2015; Hamdan, Anuar, and Khan, 2016; Rahmawati, Koul, & Fisher, 2015; Sweigart & Landrum, 2015). A teacher from Morgan's research remarked that the "special educator does not only have to be with [SWD] students" (p. 51). He continued by explaining that the special educator could work with every student. Hamdan, Anuar, and Khan determined that all of the students in their samples benefited from the increased focus afforded by collaborative teaching. Because the teachers in Rahmawati, et al. were better able to work with smaller groups of students after adopting a collaborative model of inclusion, student behavior improved dramatically. Another result of the reduced student-teacher ratio was noted by Tschida, et al., who observed that teachers were better able to differentiate instruction and meet their students' academic needs in two-teacher classrooms. Hurd and Weilbacher's (2017) findings confirmed Tscida et al., suggesting that reducing the student-teacher ratio in a cotaught classroom allowed teachers to focus more on the individual needs of their students.

Sweigart and Landrum (2015) quantitatively examined the assumptions regarding the relationship between collaborative teaching and the benefits of reducing the student-teacher ratio. They sampled from an extant data set of observations of inclusive, co-taught classrooms and single teacher classrooms in order to determine the effect of having two teachers upon opportunities to respond, positive feedback, negative feedback, the use of small group and one-on-one instruction, student active engagement, and student disruption. Students at the elementary level were significantly more likely to have an opportunity to respond, receive positive feedback, and engage in small group or one-on-one instruction when there were two adults in the

classroom. These differences, however, were small, resulting in an average of only one additional contact when compared with single teacher classrooms. The differences were even less significant in secondary students. In fact, secondary students in collaboratively taught classrooms were slightly less likely to be engaged than secondary students in single teacher classrooms. While Sweigart and Landrum suggest that this unexpected difference might be the result the types of students who are placed in inclusive classrooms rather than a result of collaborative teaching itself, the research dictated that the benefits of collaborative teaching should be studied more carefully.

Academic Achievement Outcomes of Collaborative Teaching

While myriad research has focused on perceptions and best practices of inclusion and collaborative teaching, comparatively little research has directly examined student assessment data from inclusion classrooms (Friend et al., 2010). According to Sweigart and Landrum (2015), "there is a dire need for experimental research that compares co-teaching with other service delivery models" (p. 28). One study demonstrated that collaborative teaching was associated with academic growth in at-risk students (Hamdan, Anuar, & Khan, 2016). Other research, however, has drawn on the positive narratives of teachers, parents, and students to validate inclusion (Seligmann, 2001). The achievement gap between students with disabilities and students without disabilities continues to be quite large (Bouck, Kulkarni, & Johson, 2011; Boser, 2009), but recent reforms like inclusion seem to be slowly closing that gap (Boser). Vaughn and Swanson (2015) described a less direct outcome of inclusion by attributing inclusive education with the development of the response to intervention process, differentiated instruction, systematic instruction, and the more widespread use of mnemonic devices, all of which they claim have benefited all students.

Very little research has examined the effects of inclusion and collaborative teaching upon the academic achievement of general education students. Dessemontet and Bless (2013), however, examined the effect of inclusion upon a sample of general education students in Swiss primary schools. The special education students in each of the classes received between 4.5 and 6.5 hours of instructional support from a special education teacher each week, which meant that collaborative teaching was not continuously implemented throughout the study. The researchers in this study determined that there was no significant difference in the academic achievement of general education students when placed in inclusive classrooms, regardless of their academic level (low, medium, or high achieving). Because the general education students in Dessemontet and Bless's study were not significantly affected by the inclusion of intellectually disabled students, despite having little access to a collaborative teacher, one may expect that more consistent collaborative teaching might significantly and positively affect the academic achievement of general education students. Studies by Rahmawati, Koul, and Fisher (2015) and Tschida, Smith, and Fogarty (2015) both observed academic growth in both general education students and students with disabilities. In both cases, however, growth was measured through classroom grades and non-validated classroom assessments. Similar studies with valid and reliable instruments are needed to support Rahmawati, et al. and Tschida, et al.

Summary

Inclusion, as a special education service model, has grown in popularity over the last two decades, primarily as a result of the No Child Left Behind and Individuals with Disabilities Education acts. While some opponents suggest that special education is, indeed, "special" and should be kept separate, the supporters appeal to the social learning theories of Vygotsky and Bandura and suggest that special education students will benefit more by being placed, whenever

possible, in heterogeneous groups. Inclusion is commonly paired with co-teaching, which involves placing a special educator or other support person with a general education teacher. In addition to providing special education accommodations in the general education classroom, the special educator shares responsibility with the general education teacher for meeting the learning needs of the entire group of students. Because the special educator is tasked with working with all students, co-teaching proponents have suggeseted that the instructional model might benefit all students—both special education and general education.

While teachers' opinions of inclusion vary greatly, teachers and pre-service teachers who are more familiar with special education students and pedagogue are generally much more accepting of inclusion. As teachers become more familiar with special education students, their attitudes towards inclusion see to become significantly more positive. Schools that wish to implement inclusion or improve existing inclusive education should, therefore, provide extensive training and support to all teachers and co-teachers so that they become more familiar with special education students and inclusive education models. While empirical data regarding the effectiveness of inclusion is scant, inclusive education seems to benefit at least some groups of special education students.

Considering the prevalence of inclusion and co-teaching in today's public schools, comparatively little research has examined the model's impact upon the academic achievement of the general education students in the inclusion classroom. Researcher like Friend (2008) have asserted that co-teaching benefits all students by reducing the student-teacher ratio, but little empirical research has confirmed those claims. Furthermore, many teachers may not be using instructional models that actually reduce the students-teacher ratio; instead, using the co-teacher as a teacher's aide who is uninvolved in most of the instruction. According to King-

Sears, Brawand, Jenkins, and Preston-Smith (2014), "future research that continues to examine learning outcomes for students with and without disabilities…can help further distill the critical elements that may impede or enhance co-teaching experiences for both students and co-teachers" (p. 679). Furthermore, the teachers who were surveyed by Chityo (2017) expressed doubt over using an instructional model that was supported by so little empirical research. According to Chityo, "Besides making sure that teachers have adequate training in co-teaching, the results of this study provides a basis to call on researchers to conduct more research on co-teaching to demonstrate its effectiveness" (p. 63). Additional research regarding the relationship between co-teaching and general education students is necessary in order to ensure that the learning needs of all students are being met in the inclusive classroom. The current study will seek to fill that gap in the literature.

CHAPTER THREE: METHODS

Overview

This section will introduce the methodology of this study that was designed to observe the impact of collaborative teaching upon the mathematic achievement of general education students in grades six through eight. After presenting a rationale for the research design, the section will list the research questions and hypotheses. It will then provide a detailed description of the study participants, setting, and instrumentation before enumerating the research and data analysis procedures.

Design

The researcher used a quantitative causal-comparative design to study the impact of collaborative teaching on general education mathematics student in grades six through eight. According to Gall, Gall, and Borg (2007), causal-comparative research follows an ex post facto nonexperimental design that may be used to investigate the relationship between a categorical independent variable and a continuous dependent variable. In the current study, the independent variable, instructional environment, was at the nominal level; the dependent variable, student test scores, was composed of continuous numeric data. Because the placement of general education students into co-taught classrooms was randomly processed by computers at the beginning of each school year, the researcher was unable to randomly assign students into the treatment and control groups. A characteristic of causal-comparative research is that the independent variable is hard to control, which means that the groups cannot be randomly assigned as they are in true experimental research (Gall et al.). This characteristic further justified the use of causal-comparative research in the current study.

The specific relationship that the researcher explored involved the placement of general education students into either co-taught classrooms or single-teacher classrooms. Those two placements formed the study's independent variable. Specifically, the researcher wanted to understand the effect of the co-taught environment upon student spring STAR Math® test scores, which formed the dependent variable. Because the groups were not randomly assigned, it was possible that they were nonequivalent prior to their placement at the beginning of the school year. The researcher controled for differences between groups by analyzing each student's fall pretest STAR Math® score as a covariate.

The treatment group in this study was composed of general education students in co-taught classrooms. The control group was composed of general education students who were placed into non-advanced single-teacher classrooms. Because the purpose of this study was to examine the impact of co-teaching solely on general education students, data from SWD and gifted students were not included in the analyses.

Research Questions

The following research questions guided this study:

RQ1: Does co-teaching impact the mathematic achievement of general education students?

RQ2: Does the impact of co-teaching on the mathematic achievement of general education students differ based on students' biological sex?

Hypotheses

The researcher posed the following null hypotheses:

$H_0$1: There will be no statistically significant difference between the academic achievement of general education students who were taught in co-teaching classroom

environments and general education students who were taught in single-teacher classroom environments as measured by the spring administrations of the STAR Math Assessment when controlling for pretest scores.

$H_0$2: There will be no statistically significant difference between the academic achievement of general education males and general education females who were taught in co-teaching classroom environments as measured by the spring administrations of the STAR Math Assessment when controlling for pretest scores.

Participants and Setting

The researcher used extant data from the only three middle schools of a rural school district in Georgia. To protect the privacy of the students, the schools, and the school district, pseudonyms will be used for the names of all people and places throughout the description of this study. The total population of Middle School A (MSA) at the time of the study was N = 475 students across 6th, 7th, and 8th grades. The largest demographic group at this school was White (62%), followed by Hispanic (28%), Multiracial (3%), and Black (2%). 63% were economically disadvantaged (ECD) and 8% were English Language Learners. The total population of Middle School B (MSB) at the time of this study was N = 454 6th, 7th, and 8th grade students. The majority, or 88%, of students at MSB were White. The remainder of the students were Hispanic (8%) or Multiracial (3%). 52% of the students were ECD. A small majority of Middle School C's (MSC) N = 407 students were White (53%). The remaining students were Hispanic (40%), Multiracial (3%), or Black (2%). 69% of MSC's students were economically disadvantaged and 11% were English Language Learners.

While there were a couple of newer teachers at each of the schools, most of the math teachers had between 7 and 20 years of teaching experience. The average number of years of

teaching experience among the math teachers at MSA, MSB, and MSC were fifteen, twelve, and thirteen, respectively. Nearly all (90%) of the math teachers at the three schools had at least three years of experience in collaborative mathematics classrooms. The majority of math teachers at each of the schools held either a Master's or Specialist level degree. As a whole, the teachers at each of the schools were similar enough to facilitate meaningful comparisons for the purpose of this study.

While students' placement in each group was randomly assigned using computers at the beginning of the school year, the choice of each school and classroom was based on convenience. Convenience samples, while not as desirable as random samples, may be used in research where it would not be possible to draw a random sample (Gall, Gall, & Borg, 2007). Because this study was based on a convenience sample, its results may only be generalized to similar populations. According to Gall, Gall, and Borg, the minimum sample size for a 3 group ANCOVA with medium effect size at the .7 level and a = .05 is 66. The total sample of 572 students exceeds the size that was recommended by Warner (2013).

Instrumentation

The Standardized Test for the Assessment of Reading® (STAR®) was developed by Renaissance Learning®, Inc. The STAR Math® test is tied to mathematic content standards, but it is adaptive to give teachers a more complete picture of students' exact levels of understanding, regardless of their grade level. The Star Assessments for Math Abridged Technical Manual (2016) provided information related to the instrument's development, validity and reliability, and scoring scale. The STAR Math Assessment® was developed, first, by analyzing mathematics standards across the country. Next, content experts wrote thousands of questions that were tagged to varying standards, difficulty levels, and prerequisite skills. The questions were then

field tested on a sample of more than a thousand students across all grade levels and assigned appropriate difficulty levels (Star Assessments for Math Abridged Technical Manual).

The STAR Math® Assessment is administered via a computer so that the questions can be adapted to each student's readiness level. Scaled scores on the STAR Math Assessment® can range from 0 to 1,400. The 2011 norming study reported that the range of scores for middle school students were 68 to 1,112 for students in 6th grade, 125 to 1,187 for students in 7th grade, and 123 to 1,318 for students in 8th grade. Each scaled score correlates with a grade equivalency level to aid in the interpretation of scaled scores. According to the aforementioned norming statistics, the mean STAR Math® scaled scores for students in 6th grade was 645 in the fall and 763 in the spring; the mean scaled score for students in the 7th grade was 711 in the fall and 785 in the spring; the mean scaled score for students in the 8th grade was 747 in the fall and 813 in the spring.

To measure this study's variables, the researcher compared the fall pretest scaled scores to the spring posttest scaled scores of the STAR Math Assessment®. According to the Star Assessments for Math Abridged Technical Manual (2016), the scaled scores are informed by the weighting and difficulty level of each question. These difficulty levels were assigned to each question after the field test. The manner in which each question is weighted allows the scaled scores to indicate students' academic levels along a learning continuum that stretches from early elementary to high school senior level mathematical understandings. Because "STAR Math's® learning continuum is research-based, robust, and supported by experts in the field of mathematics" (Star Assessments for Math Abridged Technical Manual, p. 4), its scaled scores, which represent individual points within that learning continuum, are ideal for academic research.

Both generic reliability and split half reliability tests were used to demonstrate the internal consistency of the STAR Math Assessment®. The reliability coefficients for each grade level ranged from 0.82 to 0.94. A meta-analysis of the STAR Math Assessment's® correlation with other major state and national assessments resulted in a validity estimate of 0.74 for students in 6th, 7th, and 8th grade with a 0.00 standard error measurement (The Star Assessments for Math Abridged Technical Manual, 2016). Shapiro, Dennis, and Fu (2015) compared the computer adaptive STAR Math Assessment® to AIMSweb, a curriculum based progress-monitoring tool and determined that the STAR Math Assessment® is more sensitive to measuring student growth in mathematics. Ysseldyke, Scerra, Stickney, Beckler, Dituri, and Ellis (2017) used the STAR Math Assessment® to measure the academic status and growth of students with behavior disorders. According to the STAR® Technical Manual, twenty-one independent research publications have favorably reviewed the STAR Math Assessment®.

All three middle schools administer the STAR Math® test three times each school year, once in the fall, winter, and spring. Only the fall and spring administrations were considered for the current study. The exam was administered and scored online using desktop computers and Chromebooks. Because the exam is adaptive and consistent across grade levels, it facilitated accurate comparisons for all of the students in this study's sample, regardless of their grade level. Permission to use the STAR Math Assessment® is located in Appendix A.

Procedures

The researcher began the project by discussing the goals and research design with the host school district. After receiving their feedback, the researcher submitted the complete proposal for institutional approval from both Liberty University and the host school district. After receiving approval from both groups, the researcher requested and received approval from

the Institutional Review Board (IRB) at Liberty University (see Appendix B). The IRB approval letter is located in appendix B. During this time, the host school administered the STAR Math® test in both the fall and spring semesters. The schools were already using the STAR® test to measure student progress, so these administrations were not necessarily related to the research. After receiving IRB approval, the researcher gathered the extant STAR Math® test data from the host schools.

The IRB guidelines for the current study mandated that all data be stripped of identifying information, including students' names. As such, the data that were provided by the school district only listed the information that was relevant to the study, including students' placement, students' biological sex, and students' scores on the fall and spring administrations of the STAR Math® Test. All digital data were stored on a password-protected computer and backed up on a password-protected external storage device. To further protect students' security, the hard copies of the data were placed into a locked safe to which the research had the only key.

The researcher concluded the project by conducting statistical analyses of the data and reporting his findings. The researcher will delete and shred the remaining data three years after the research report had been presented and approved.

Data Analysis

Initially, the researcher used descriptive statistics including the mean and standard deviations to look for patterns within the data. To analyze the data using inferential statistics, the researcher used an analyses of covariance (ANCOVA). The ANVOCA compared the spring STAR Math® scores of the co-taught treatment group and non-co-taught control group, while controlling for students' fall STAR Math® scores. The researcher used another ANCOVA to investigate the second research question. The second ANCOVA compared the spring STAR

Math® scores of the cotaught males with the scores of cotaught females, controlling for the students' fall STAR Math® scores. Gall, Gall, and Borg (2007) suggested that researchers use an ANCOVA to compare two or more data sets while controlling for one or more covariates. An ANCOVA was an ideal statistical procedure for this study because it allowed the researcher to compare the spring STAR Math® scores of the treatment and control groups while controlling for the Fall "pretest" scores.

Warner (2013) stated that, prior to reporting the results of an ANCOVA, the data should be checked for violations of statistical assumptions. The researcher first used a box-and-whisker plot to verify that there were no outliers excessively affecting the group means. The dependent variable was at the interval level of measurement and observations within each variable were independent. While a random sample would have been ideal for an ANCOVA, a convenience sample was used for this study, which is acceptable when a random sample cannot be generated (Warner). The researcher then used histograms to check the data for the assumption of normality. Pretest to post-test scatter plots were then used to verify that the assumptions of linearity and bivariate normality were not violated. Specifically, the researcher looked for the classic shape of a cigar to ensure that the assumption of bivariate normality had not been violated. The researcher checked the assumption of homogeneity of slopes by looking for interactions between the groups. The final assumption test was Levene's Test of Equal Variance, which was used to ensure that the population distributions had the same variance.

Prior to reporting inferential data, the researcher reported the data's descriptive statistics including the mean and standard deviation for each group. The alpha level for each hypothesis was set at $p < .05$. Eta squared was used to report each effect size. After running each of the preceding assumption tests, the researcher analyzed the ANCOVA and reported the results along

with the number (N), number per cell (n), degrees of freedom (df within and df between), observed F values (F), significance level (p), and power.

CHAPTER FOUR: FINDINGS

Overview

Chapter four will begin with a presentation of the descriptive statistics of the data set. Following that presentation, the researcher will outline the data screening procedures for the analysis of covariance (ANCOVA). The remaining sections of the chapter will be used to present the results of the null hypotheses, which will include a discussion of the ANCOVA for all students and for the male and female subgroups.

Research Questions

RQ1: Does co-teaching impact the mathematic achievement of general education students?

RQ2: Does the impact of co-teaching on the mathematic achievement of general education students differ based on students' biological sex?

Null Hypotheses

$H_0$1: There will be no statistically significant difference between the academic achievement of general education students who were taught in co-teaching classroom environments and general education students who were taught in single-teacher classroom environments as measured by the spring administrations of the STAR Math Assessment when controlling for pretest scores.

$H_0$2: There will be no statistically significant difference between the academic achievement of general education males and general education females who were taught in co-teaching classroom environments as measured by the spring administrations of the STAR Math Assessment when controlling for pretest scores.

Descriptive Statistics

Table 1 displays the student characteristics that are relevant to this study. Based on inconsistencies in the number of data points collected from each of the three middle schools, they appeared to have provided data that did not include all of their math classes. Because the data were stripped of all irrelevant identifying information, the researcher could not determine why some of the student data were unavailable. The central office contact suggested that the smaller than expected sample might have resulted from a large concentration of advanced students, whose data were not reported, in one of the schools. Out of 572 total students whose data were made available, 122 students were general education students in cotaught classrooms. The remaining 450 general education students were educated in traditional, single teacher classrooms.

Table 1

Frequency of Independent Variable and Covariate for Dissertation Methodology

Variable	Frequency (n = 572)
Classroom Placement	
Single Teacher	450
Co-teacher	122
Sex	
Male	284
Female	288

The dependent variable in the current study was student scores on the STAR Math® Test. The pretest scores for the entire data set ranged from 459 to 916 with a mean of 729 (SD = 81). The lowest and highest pretest scores for the cotaught subgroup were 505 and 864 respectively. That group had a mean of 724 (SD = 82). The single teacher subgroup's pretest scores ranged from 459 to 916 with a mean of 730 (SD = 80). The posttest scores for the entire data set ranged

from 513 to 885 with a mean of 758 (SD = 66). Posttest scores for the cotaught group of students ranged from 561 to 878 with a mean of 750 (SD = 64). The posttest scores for single teacher students ranged from 513 to 885. The mean for this group was 760 (SD = 66). Table 2 displays the mean scores for the entire data set and the relevant subgroups.

Table 2

Student Scores on the STAR Math® Test

Variable	Pretest Mean Scaled Score (n = 572)	Posttest Mean Scaled Score (n = 572)
Classroom Placement		
Single Teacher	730	760
Co-teacher	724	750
Sex		
Male	723	754
Female	734	763
All Students	729	758

Results

Data Screening

The researcher began screening the data by creating the following series of box and whisker plots: pretest by subgroup (see Figure 1), pretest for the entire group (see Figure 2), posttest by subgroup (see Figure 3), and posttest for the entire group (see Figure 4). The quartiles for all of the box plots appeared to be evenly spaced with no outliers. The data were further screened to ensure that the dependent variable was measured at the interval level with independent observations within each of the variables.

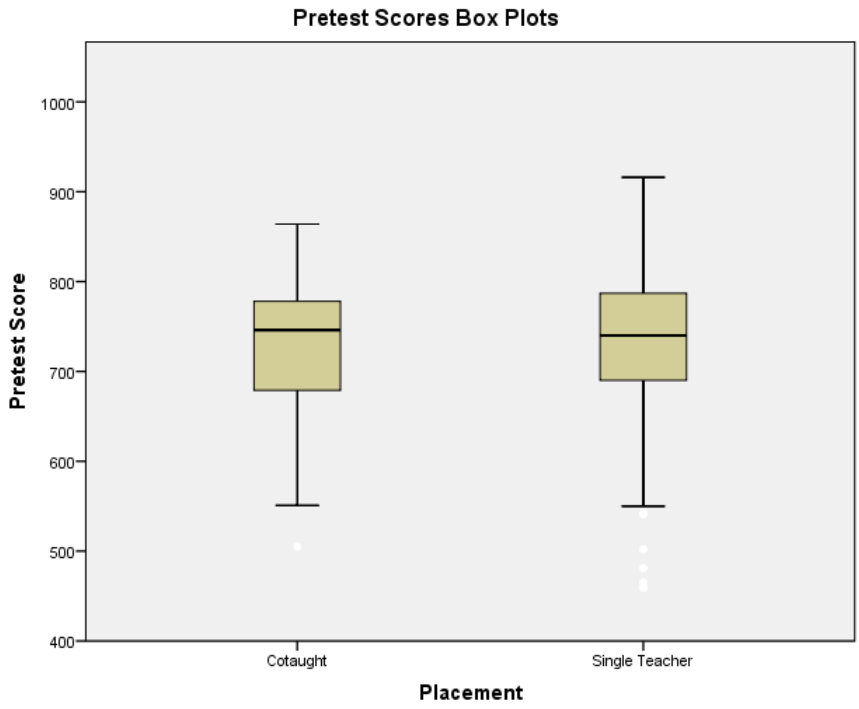

Figure 1. Pretest score box plots by placement group

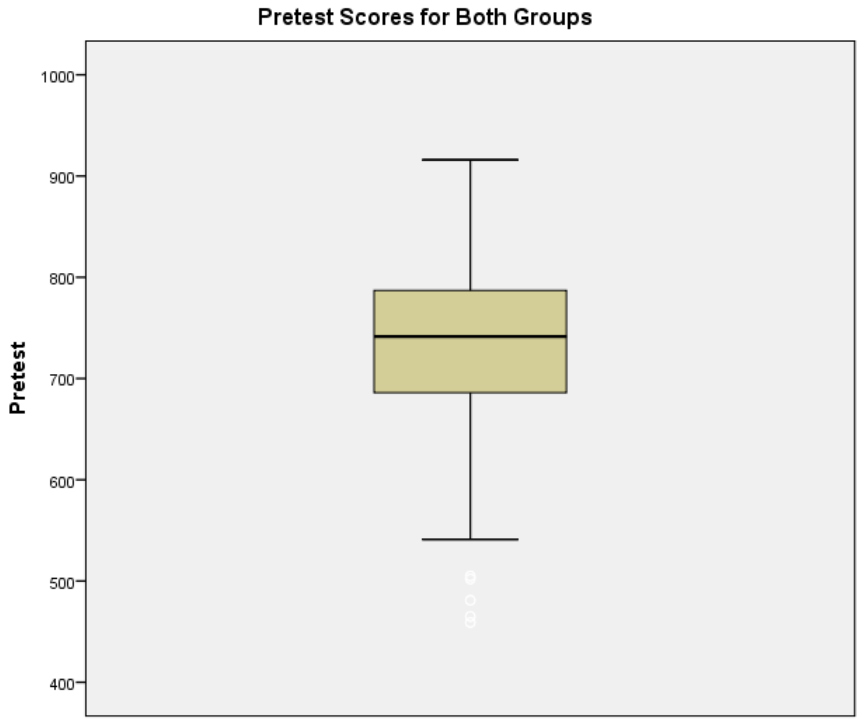

Figure 2. Pretest score box plot for all students

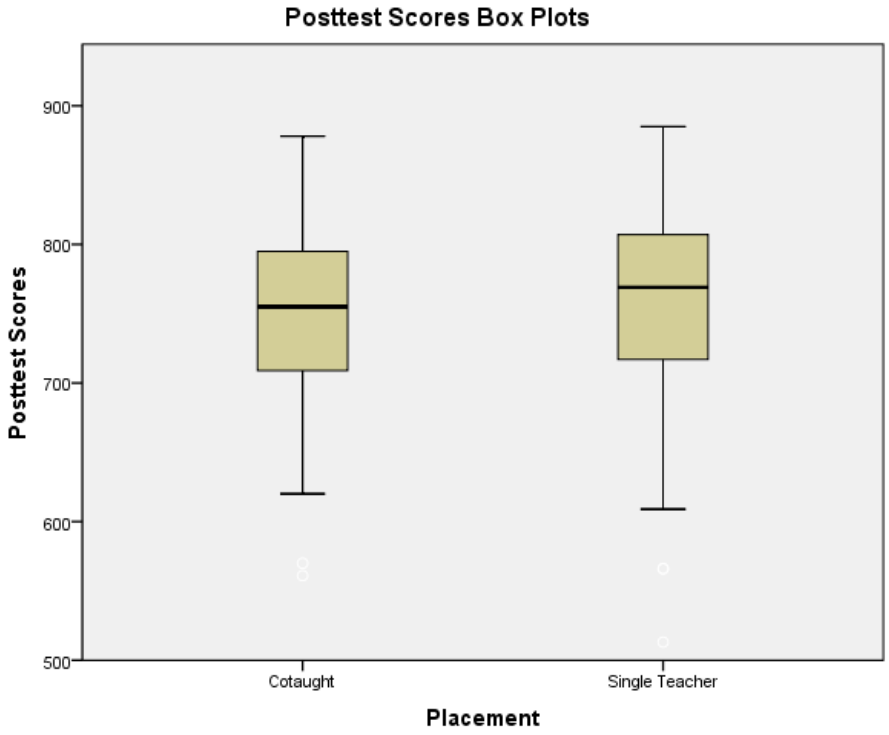

Figure 3. Posttest score box plots by placement group.

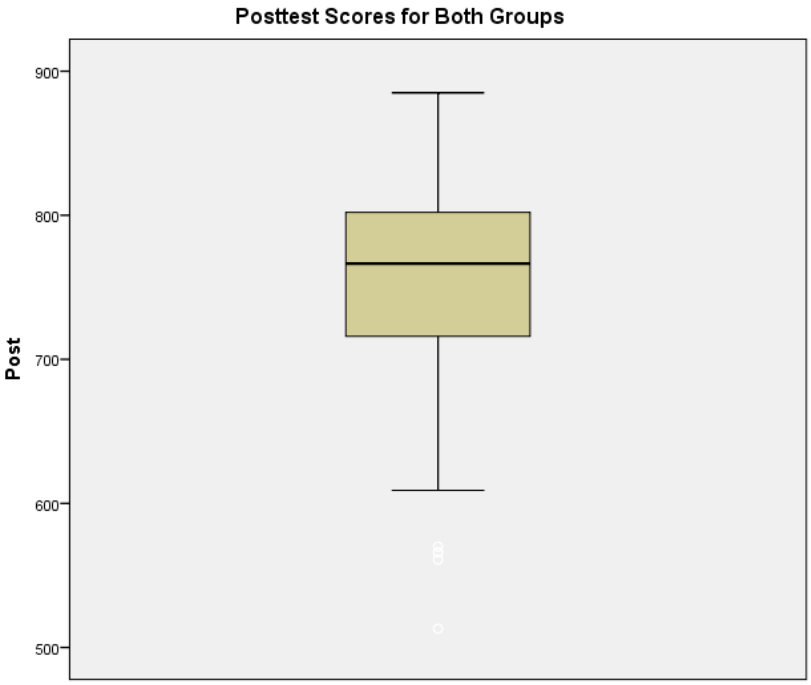

Figure 4. Posttest score box plot for all students.

Hypotheses

An ANCOVA was used to test both of the null hypotheses. The data were entered into SPSS using a numerical code to classify the categorical data. For the classroom placement variable, the researcher used the number 1 to designate students who had been enrolled in cotaught classrooms and the number 2 to designate students who had been taught in single teacher classrooms. For the covariate, students' biological sex, the researcher used numbers to designate male (1) and female (2). The alpha level was set at .05 for each of the statistical tests.

Hypothesis One

Assumption Tests. Warner (2013) enumerated several assumptions that must be met before analyzing data using an ANCOVA. First, Warner stipulated that data must be normally distributed. To verify that the data met the assumption of normality, the researcher used pretest and posttest histograms. Figures 5 and 6 display the pretest and posttest histograms.

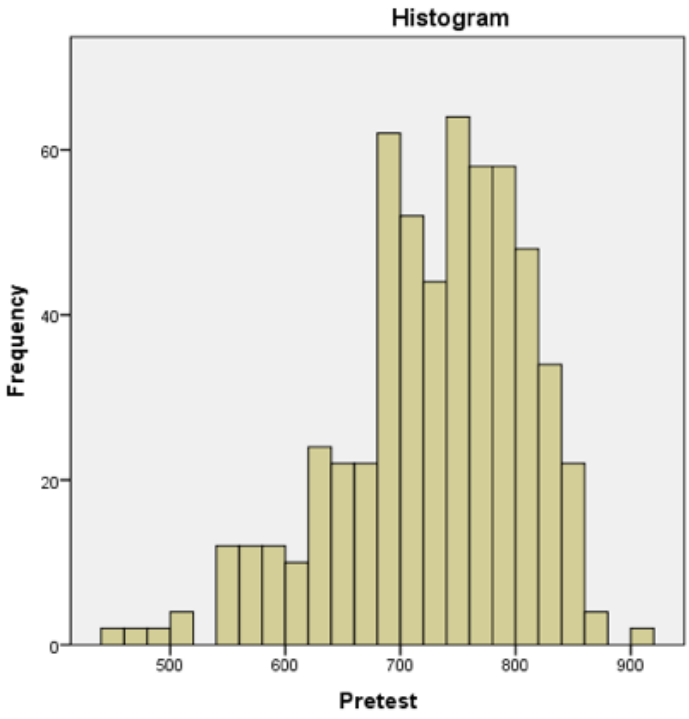

Figure 5. Histogram showing pretest scores for all students

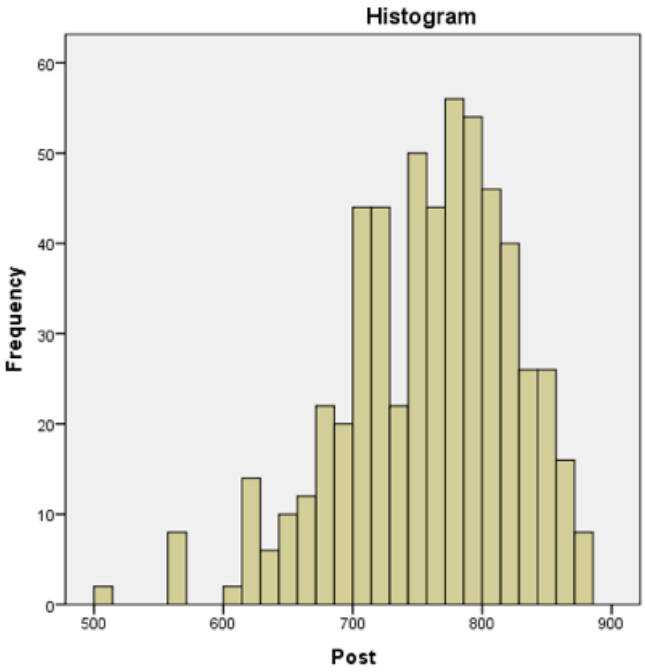

Figure 6. Histogram showing posttest scores for all students

The data for both administrations of the test was nearly normally distributed. Warner's second stipulation was that the data were approximately linear and free of extreme bivariate outliers. The researcher checked for violations of this assumption using pretest to posttest scatter plots for both the cotaught and single teacher subgroups. Both scatter plots exhibited a cigar shape, indicating that the assumption of linearity was tenable. The scatter plots for both groups are displayed in Figures 7 and 8.

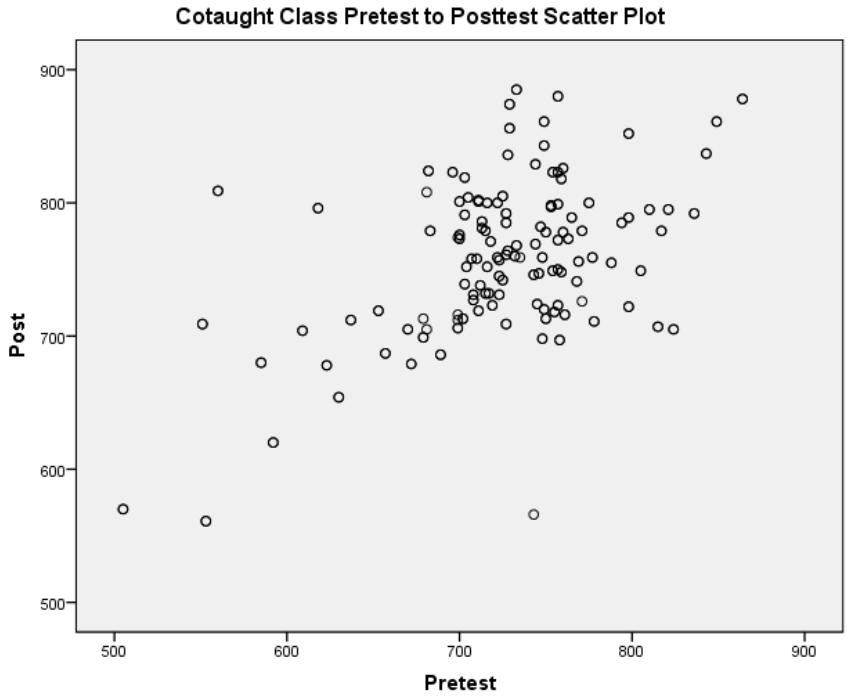

Figure 7. Pretest to posttest scatter plot for cotaught subgroup

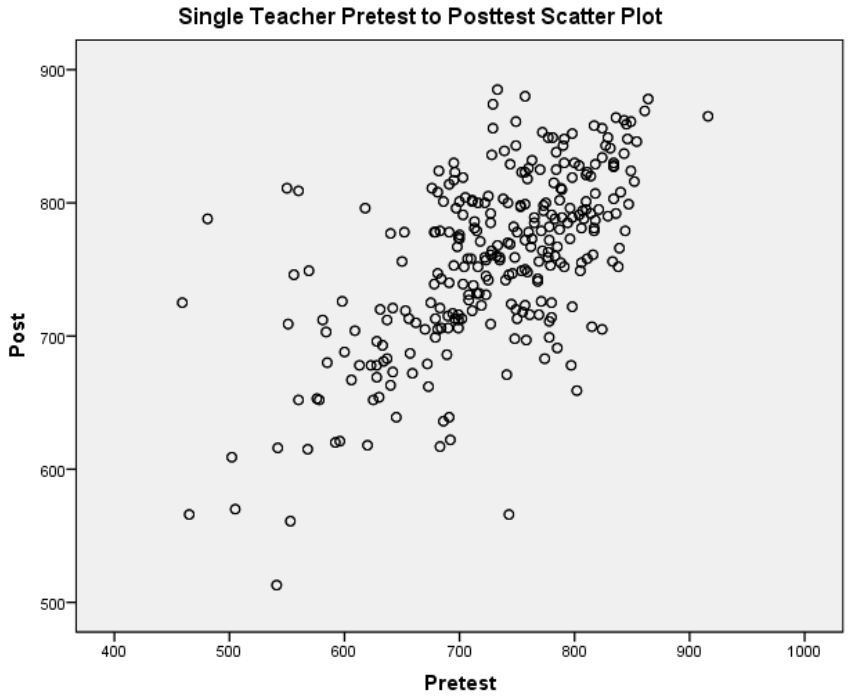

Figure 8. Pretest to posttest scatter plot for single teacher subgroup

The researcher used a one-way between subjects' analysis of variance ANOVA to verify that the data did not violate Warner's third assumption, the assumption of homogeneity of slopes. The interaction was not significant at the .05 level ($p = .873$). This indicated that the data did not violate the assumption of homogeneity of slopes. The researcher used Levene's Test of Equal Variance to check for violations of Warner's final assumption, the assumption of equal variance. The significance value of Levene's Test was not significant at the .05 level ($p = .737$), indicating that the data did not violate the assumption of equal variance. Because the data did not violate any of the assumptions that were listed by Warner, the researcher determined that an ANCOVA could be used to examine the study's research questions.

Results. The researcher used a One-way ANCOVA (see table 3) to determine the effect of the categorical variable of classroom placement, co-teacher or single teacher, upon student test scores on the spring administration of the STAR Math® test while controlling for the fall pretest scores of the same test. When controlling for pretest scores, there was no significant difference between the mathematical performance of the general education students in the cotaught subgroup and the general education students in the single teacher subgroup. The ANCOVA resulted in $F(1, 568) = .801$, $p = .372$ with a small effect size, $\eta_p^2 = .003$. The adjusted mean score for the cotaught subgroup was 752.9; the adjusted mean for the single teacher subgroup was 759.6. The researcher failed to reject the first null hypothesis.

Table 3

One-way ANCOVA to determine effect of classroom placement on posttest scores while controlling for pretest scores

Predictor	SS	df	Mean Square	F	P	Partial η^2
Corrected Model	478220.4	2	239110.2	90.5	.000	.390
Intercept	520379	1	520379	197	.000	.410
Placement	2115.6	1	2115.6	.801	.372	.003
Error	747730.7	586	2642.2			

Hypothesis Two

Assumption Tests. The researcher used the same assumption tests for this data set as he did for the previous hypothesis. Pretest and posttest histograms showed that the data were nearly normally distributed (see Figures 9 and 10). A pretest to posttest scatter plot for the cotaught subgroup of students revealed that the data were approximately linear and free of outliers (see Figure 7). The one-way ANOVA showed that the interaction between the independent variable, biological sex, and the covariate, pretest, was not significant ($p = .152$), which indicated that the data did not violate the assumption of homogeneity of slopes. The final assumption test, Levene's Test of Equal Variance, was not significant ($p = .876$), demonstrating that the data did not violate the assumption of equal variance.

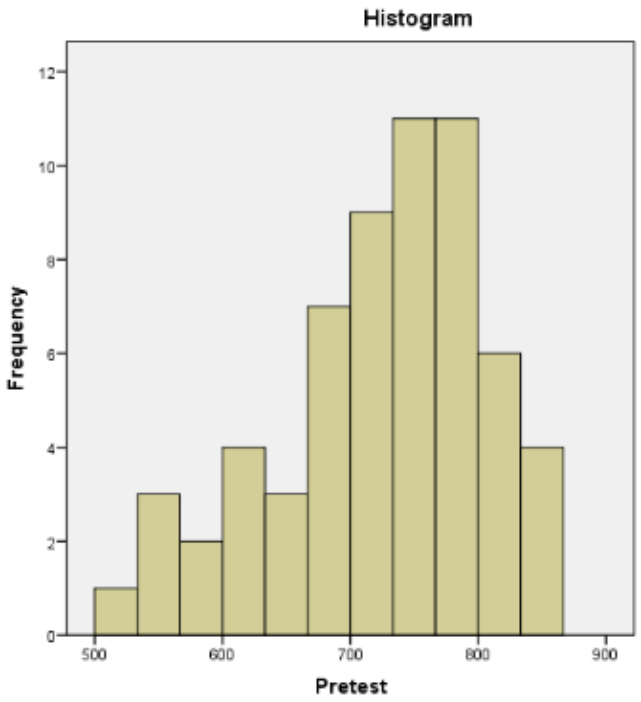

Figure 9. Pretest histogram for cotaught students

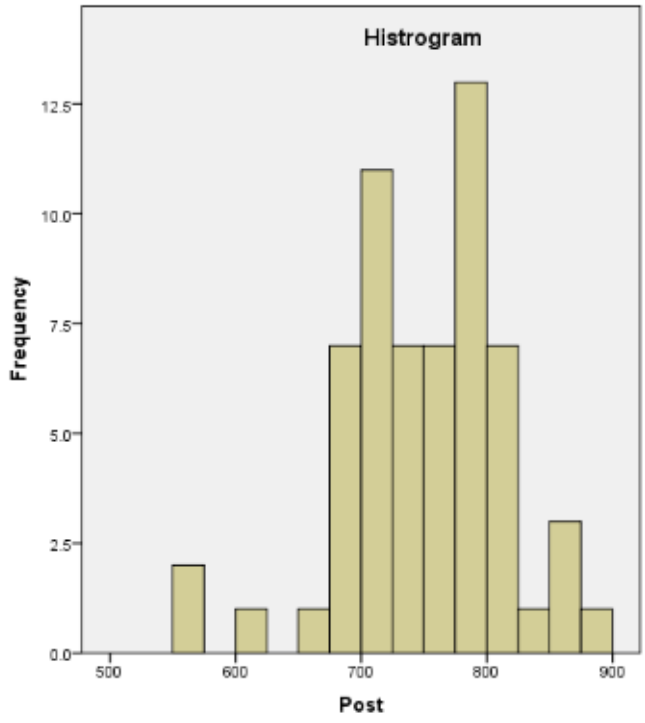

Figure 10. Posttest histogram for cotaught students

Results. A one-way ANCOVA (see table 4) was used to investigate the effect of the categorical independent variable, students' biological sex, upon the dependent variable, posttest scores, while controlling for students' pretest scores. This data set only included the general education students who were enrolled in a cotaught math class. When controlling for the pretest scores, there was no significant difference in the posttest scores of the males and the posttest scores of the females. The results of the ANCOVA were $F(1, 119) = .203$; $p = .654$ with a small effect size of $\eta_p^2 = .003$ and adjusted posttest means of 747.3 for the males and 753.4 for the females.

Table 4

One-way ANCOVA to determine effect of biological sex on posttest scores of cotaught students while controlling for pretest scores

Predictor	SS	df	Mean Square	F	P	Partial η^2
Corrected Model	95211.8	2	47605.9	18	.000	.383
Intercept	122996.8	1	122996.8	46.6	.000	.445
Biological Sex	535.8	1	535.8	.203	.654	.003
Error	153141.4	119	2640.4			

CHAPTER FIVE: CONCLUSIONS

Overview

The final chapter of this paper begins by discussing the results of this study and comparing those results with the literature that was presented in chapter 2. This discussion is followed by sections regarding the implications and limitations of the research. The final section of this chapter provides recommendations for future research.

Discussion

The purpose of this quantitative causal-comparative study was to investigate the impact of co-teaching on the achievement of general education mathematic students in grades six through eight. The researcher used students' end of year results on the STAR Math® assessment to measure the independent variable, mathematic achievement. STAR Math® results from the beginning of the year were covariates in the study. The dependent variable was composed of general education students in cotaught mathematic classes. Their results on the STAR Math® assessment were compared with the results of the single teacher control group.

The Star Math Assessment®, developed by Renaissance Learning®, Inc., uses an adaptive testing model to measure students' understanding of reading and mathematics content. The researcher, however, only retrieved and analyzed data from the mathematics section of the STAR® test. The STAR Math® assessment was nationally normed and has undergone several validity and reliability studies and is therefore recognized as an approved progress monitoring instrument within the state of Georgia (Star Assessments for Math Abridged Technical Manual, 2016). Because the district in which this study was set already used the STAR Math® assessment to monitor student progress, the researcher was able to use the STAR Math® data to answer both of the current study's research questions.

For research question one, the researcher sought to measure the impact of collaborative teaching on the academic achievement of general education mathematic students. The learning theories of Vygotsky (1930) and Bandura (1989) formed a theoretical framework for this investigation. Vygotsky, in particular, emphasized the importance of adults providing a scaffold to support students' individual learning needs. Murphy et al. (2015) related this concept directly to collaborative teaching, suggesting that by reducing the student-teacher ratio, the collaborative model of instruction facilitated the scaffolding process. The results of the current study demonstrated that this sample of students did not significantly benefit from their access to cotaught mathematics instruction when assessed with a district-wide, nationally normed test. There was no significant difference between the mathematical performance of the students in cotaught classrooms and students in single teacher classrooms. While Murphy et al.'s application of Vygotsky's theory to special education students was not challenged by the current study, their application of the theory to general education students was directly contradicted by this research.

The current study also contradicted Hamdan et al.'s (2016) findings, which suggested that collaborative teaching was associated with academic growth in at-risk students. Hamdan et al., Rahmawati et al. (2015) and Tschida et al. (2015) presented research that associated co-teaching with academic growth in both general education and special education students. Unlike the current study, however, those researchers measured growth using classroom grades and teacher assessments that had not been validated. Had those researchers used an assessment similar to the STAR Math® test, their results might have aligned more closely with the results of this study. In contrast to those studies, Dessemontet and Bless (2013) found no significant difference in the

academic achievement of general education students when compared with their peers in single teacher classrooms. The results of this research supported the findings of Dessemontet and Bless.

For research question two, the researcher wanted to determine whether the academic impact of collaborative teaching differed based upon students' biological sex. For this question, the researcher compared the STAR Math® test scores of the cotaught males with the STAR Math® test scores of the cotaught females, while controlling for students' scores from the beginning of the year. The researcher determined that there was no significant difference between the scores of the cotaught males and the scores of the cotaught females. Stewart et al. (2017) and Cunningham (2015) studied gendered differences in mathematics apart from the collaborative classroom setting. Taken together, the work of Stewart et al. and Cunningham both suggested that maels and females should not have significantly differed in the realm of mathematic achievement. This research supported those results. The work of Fredricks, Hofkens, Wang, Mortenson, and Scott (2017) suggested that, when compared with male students, female students were more engaged and performed at higher levels when they had more support from their teacher. This suggested that effective collaborative teaching might have better supported the learning needs of female students. The sample of females in the current study, however, did not benefit significantly more than the males from having two teachers.

Implications

The first chapter of this document referred to a critical consideration regarding the implementation of new instructional techniques in k-12 classroom settings. Namely, the high levels of planning, training, and administrative support that are fundamental components of effective collaborative teaching (Nierengarten, 2013) are only worthwhile if they lead to positive

learning outcomes for students. Prior to this study, there was a gap in the existing body of literature regarding the academic impact of co-teaching upon the learning outcomes of general education students (Dessermontet & Bless, 2013; Friend et al., 2010; Ruins et al., 2010). The current study was designed to address that gap in the literature.

Understanding the context of special education, in general, is critical for anyone who is attempting to interpret the results of a study on collaborative teaching. In that regard, the benefits of collaborative teaching for special education students have been well documented in myriad research projects, both quantitative and qualitative. Burks and Sutherland (2004) and Seligmann (2001) both stated that the inclusive environment, and by extension collaborative teaching classrooms, facilitated a sense of belonging among special education students. Special education students in another study reported higher levels of belonging and increased self-efficacy (Rivera, et al., 2014). Among general education students in inclusive, co-taught classrooms, Morgan (2016) documented a decreased stigma towards special education students. Justice et al. (2014) observed a "peer effect" among lower performing students when grouped in inclusive classrooms with higher achieving students. Those students demonstrated significantly improved language skills when compared with students who were grouped into homogeneous special education classrooms. Hamdan, et al. (2016) cited growth in at-risk students who were enrolled in cotaught instructional programs, and Boser (2009) suggested that co-teaching and inclusion were closing the achievement gap between general education and special education students.

Given the overwhelming amount of evidence suggesting that co-teaching and inclusion benefits special education students on multiple levels, the neutral results of the current study can easily be approached with a very positive framework. While schools who have invested time,

personnel, and resources into collaborative teaching might have preferred a significant positive difference between this study's treatment and control groups, the fact that both groups improved from pretest to posttest at comparable levels establishes the efficacy of collaborative teaching. While the cotaught variable did not significantly raise students' test scores, participating in a heterogeneous classroom environment with special education students also did not seem to negatively impact students' scores. Because co-teaching and inclusion have been associated with positive emotional and academic outcomes for special education students and, according to the current study, neutral outcomes for general education students, school administrators should feel confident in implementing collaborative teaching as their primary special education service delivery model.

It should also be noted that the literature has demonstrated that co-teaching may benefit general education students in a manner that cannot be directly measured with an academic achievement test. Sweigart and Landrum (2015), for example, reported that some parts of their sample of students in cotaught classrooms had more opportunities to respond during classroom discussions and more time to work in small groups. The presence of two teachers in a classroom might also facilitate more frequent use of differentiated instruction, a research-based strategy that is known to help students learn (Tomlinson, 2010). As a final example, another study documented a significant improvement in student behavior after teachers implemented an evidence-based collaborative teaching model (Rahmawati, et al., 2015). Because the inclusion of special education students into the general education classroom did not lower students' scores on the STAR Math® test, special education administrators should feel confident implementing a collaborative teaching-based inclusion program so that all students, both general education and special education, will be able to benefit from the non-academic benefits of co-teaching.

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Limitations

This study was limited by several key factors. First, the data set that was provided by the district administrators was smaller than the researcher originally anticipated. While they offered an explanation for the seemingly incomplete data set, it would have been ideal to have received data from every general education student in the three school buildings. Second, the sample was drawn by convenience from middle grades students in a single school district. The results of this study cannot be generalized beyond this population.

Perhaps the most defining limitation relates to the very nature of the casual comparative research design. Because of the design's ex post facto nature, the independent variable was not manipulated or observed by the researcher. The research has enumerated several guidelines that schools should follow when attempting to implement collaborative teaching with fidelity. The attitudes of teachers towards co-teaching (Lee, et al., 2015; Burke & Sutherland, 2004) and the type of administrative support and professional development (Desimone & Parmar, 2006; Tzivinikou, 2015) have all been shown to predict the level of success of an inclusive education program. Common planning time has also been shown to be correlated with improved collaborative teaching outcomes (Friend, 2008; Morgan, 2016, Conderman & Hedin, 2017). Practicing co-teaching with fidelity also involves a reliance on collaborative structures that lower the student-teacher ratio (Friend, 2010). Because this research project was concerned with the academic impact of co-teaching as it is being practiced—not as it should be practiced, the researcher cannot assume that the teachers and/or administrators implemented an evidence-based approach. In fact, a significant body of research has demonstrated that it is more likely that the

average school is not implementing an evidence-based collaborative teaching program (Kinne, et al., 2016; Petroff, 2016).

Recommendations for Future Research

The following are recommendations for further research:

1. Conduct a similar study with a larger, more diverse sample. Consider using a mixed-methods approach to qualitatively follow up on the quantitative results. Observe teachers directly to determine the level of fidelity with which they are implementing their collaborative teaching program and compare those notes with the results of the inferential statistics.

2. Conduct a similar study with a more controlled research method. Provide staff training and control key variables like common planning time prior to the beginning of the school year. This would allow the researcher to collect data on the results of co-teaching under ideal conditions.

3. Conduct a study that is limited to teachers who have been co-teaching for a defined number of years. Studying the results of only veteran co-teachers might yield different results than studying all co-teachers in a school building.

4. Design a study with two treatment groups and a single teacher control group. For one treatment group, only use students from classes whose teachers primarily use the one teach-one assist and one teach-one observe models. For the other treatment group, use students from classes whose teachers have been observed to use a variety of instructional models. Because girls may respond better to classrooms with more direct teacher support, which should be provided more easily in the second treatment group, continue to look for gender differences within these groups.

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APPENDIX A

RENAISSANCE®

November 7, 2018

Jarrod Bingham
North Habersham Middle School
1500 Wall Bridge Road
Clarkesville, GA 30523

Dear Jarrod:

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This letter formally grants you permission to use the Application and to make copies of portions of the technical manual for the Application. Our permission is limited and conditioned as follows:

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2. you comply with the contents of this letter, including the obligations on compliance with Privacy Laws, as described below;
3. your use, as well as the copying of any portion of the technical manual is solely to conduct your research (i.e., the Purpose);
4. in any publication related to your research, you credit Renaissance and its intellectual property rights as described below; and,
5. you agree to provide Renaissance with a final copy of any publication resulting from your research (i.e. the Purpose) to research@renaissance.com.

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You shall comply with all applicable federal, state, local and municipal laws and regulations applicable to privacy, student data and personal data, including, but not limited to, the Children's Online Privacy Protection Act and the Family Educational Rights and Privacy Act (collectively, the "**Privacy Laws**"). You agree that you shall provide any required notices and obtain all consents from your school and/or district and, if necessary, the users of the Application (or such user's parent) required under applicable Privacy Laws to collect, use, disclosure and transfer of the data to you via the Application for you to use for the Purpose and as set forth in Renaissance's privacy policy located at https://www.renaissance.com/privacy-policy/ or your district's and/or school's rules and regulations regarding use of student data and personal data.

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Best regards,

Signature removed for security purposes

Michelle Meller
General Counsel

APPENDIX B

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

May 16, 2018

Jarrod Bingham
IRB Application 3300: A Causal Comparative Study of the Impact of Co-Teaching on the Academic Achievement of General Education Students in Sixth Through Eighth Grade Mathematics

Dear Jarrod Bingham,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Your study does not classify as human subjects research because it will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued non-human subjects research status. You may report these changes by submitting a new application to the IRB and referencing the above IRB Application number.

If you have any questions about this determination or need assistance in identifying whether possible changes to your protocol would change your application's status, please email us at irb@liberty.edu.

Sincerely,

Signature removed for security purposes

[redacted]
Administrative Chair of Institutional Research
The Graduate School

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