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The Effects of an Online Coaching Model on Secondary Co-teaching Teams in Algebra

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THE EFFECTS OF AN ONLINE COACHING MODEL ON SECONDARY CO-TEACHING TEAMS IN ALGEBRA

by

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ABSTRACT

Students with disabilities are included into general education classrooms to receive instruction with increasing frequency. To facilitate this inclusion, co-teaching is frequently used as a service delivery model (Friend, 2016; Murawski & Bernhardt, 2016). Co-teaching is a service delivery model where a general and special education teacher work in a collaborative environment to instruct students with and without disabilities (Friend, 2007, 2016). In using this approach, teachers are not always provided with the professional development (PD) necessary to effectively facilitate the co-teaching partnership.

In this study, the researcher conducted a quasi-experimental study to examine the effects of a 10-minute online coaching PD intervention on student achievement, co-teachers' use of different models of co-teaching, and opportunities to respond in secondary math classes. The researcher observed 30 minutes of instruction in co-taught and solo-taught classes at the beginning and the end of the intervention. The results indicated a change from pre- to post-observation of students being more engaged, student talk increasing, and teachers using multiple models of co-teaching. Additionally, the researcher collected student growth scores for both solo and co-taught classes. The results of the analysis indicated students' scores improved significantly in the co-taught compared to the solo-taught classes after the coaching intervention. The researcher discusses the findings, implications, and best practices for use with secondary co-teaching teams.

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For pushing past any challenges, you might have encountered and for teaching us all,

what it means to love unconditionally without question.

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"All I see is sky…for forever"

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Bug in Ear	BIE
Classroom Teaching Scan	CTS
Colorado Assessment of Co-teaching	Co-ACT
Council of Chief State School Officers	CCSSO
Council for Exceptional Children	CEC
English Learners	EL
Every Student Succeeds Act	ESSA
Evidence Based Practices	EBP
Individuals with Disabilities Education Improvement Act	IDEIA
Individualized Education Program	IEP
Institutional Review Board	IRB
Learning Policy Institute	LPI
Least Restrictive Environment	LRE
National Council on Teacher Quality	NCTQ
National Longitudinal Transition Study-2	NTLS2
No Child Left Behind	NCLB
Opportunities to Respond	OTR
Professional Development	PD
Science, Technology, Engineering, and Mathematics	STEM
Students with Disabilities	SWD
Three Term Contingency	TTC
University of Central Florida	UCF

CHAPTER ONE: INTRODUCTION

According to the 37th Annual Report to Congress (U.S. Department of Education, 2015a) over 90% of students with disabilities (SWD) are educated for at least part of their school day in a general education classroom. Since 2004, the percentage of SWD receiving 80% or more of their education in the general education setting has grown by over 10% (U.S. Department of Education, 2015a). With an increased emphasis on educating SWD in the least restrictive environment (LRE), teachers need to incorporate strategies to address the diverse student population. One of the more common strategies for meeting the needs is co-teaching (B. G. Cook, McDuffie-Landrum, Oshita, & Cook, 2011; Dieker & Murawski, 2003; Magiera & Zigmond, 2005). Despite the growing popularity of co-teaching, general and special education teachers, alike, are not always provided with the level of professional development (PD) needed to achieve successful learning gains for SWD in co-taught settings (Ploessl & Rock, 2014; Pugach, Blanton, & Correa, 2011).

The need for PD is critical as the co-teaching model was created to ensure positive learning outcomes for SWD including that they have the skills for access to future college and career options. All students should be provided with high quality opportunities to achieve in core subject areas that prepare them for college and career readiness (Ball & Forzani, 2011; Council of Chief State School Officers, 2010); including the critical skills obtained in mathematics. Students need to be proficient in mathematics to pursue postsecondary options, and if they want to compete for global positions in

science, technology, engineering, and mathematics (STEM; Adams, Miller, Saul, & Pegg, 2014; Pasko, Adzhiev, Malikova, & Pilyugin, 2013; Rissanen, 2014). Despite this need for strong skills in mathematics for SWD, 24% of all 8th grade students perform below the basic level on the National Assessment of Educational Progress in Mathematics (U.S. Department of Education, 2015b).

Algebra is considered a gateway to post-secondary opportunities and economic equity in the workforce (Impecoven-Lind & Foegen, 2010; King-Sears, Brawand, Jenkins, & Preston-Smith, 2014; Witzel, Mercer, & Miller, 2003). The majority of states and districts across the United States require a course in algebra for high school graduation (National Center for Education Statistics, 2012). Typically, graduation requires taking and passing an end of course exam.

Despite students having to pass high stakes exams in mathematics, special educators are rarely required to prove mathematical proficiency themselves to be certified to teach, especially at the secondary level (National Council on Teacher Quality, 2015). Many states require content teachers to have 18 to 36 credits in content at the secondary level, but this same expectation is not uniformly required for special education teachers. In contrast, general education teachers often have limited preparation in working with SWD (Dieker & Berg, 2002; Pancsofar & Petroff, 2013; Zigmond & Kloo, 2011). The art of co-teaching is putting these teachers together to build upon their strengths and their deficits, yet both teachers might still have limited knowledge in each other's content as well as on how to effectively work as a team through co-teaching (Friend, 2016; Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010; Isenberg & Walsh, 2015; Pratt, 2014).

When teachers are not provided preparation in their pre-service experiences, PD then is needed to compensate for gaps in skills. This PD is typically provided by a state, district, college, or school (Archibald, Coggshall, Croft, & Goe, 2011; Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; L. M. Desimone & Garet, 2015; Sample McMeeking, Orsi, & Cobb, 2012). The content of the PD delivered is important as is ensuring quality PD is aligned with effective practices (Archibald et al., 2011; Guskey, 2002, 2003). Researchers suggest, when teachers are provided with high quality professional learning opportunities, student learning is positively affected (Darling-Hammond et al., 2009; J. R. Desimone & Parmar, 2006; L. M. Desimone & Garet, 2015; Garet, Porter, Desimone, Birman, & Yoon, 2001). The five principles of high quality PD include: (a) alignment with school goals, (b) focus on core content and modeling, (c) opportunities for active learning, (d) opportunities for collaboration, and (e) embedded follow-up and feedback (Archibald et al., 2011; Sample McMeeking et al., 2012). According to the National Center for Educational Statistics Student and Staffing Survey, 99% of teachers received some type of PD in 2011 (U.S. Department of Education, 2011). Of these educators, 59% claimed the PD was useful with only 37% of teachers receiving PD focused on teaching SWD (U.S. Department of Education, 2011). A need exists to bridge the gap between effective PD for general and special education teachers aligned with highly effective outcomes (Waitoller & Artiles, 2013).

This PD needs to build a bridge between general and special education teachers to impact the academic achievement of SWD in the LRE. An effective PD model where achievement in algebra for SWD is the direct result is needed. This PD should also

include evidence based practices (EBP) to raise student learning in math and co-taught settings, including practices such as increasing structured opportunities to respond (OTR; Haydon et al., 2010; Haydon, Marsicano, & Scott, 2013; MacSuga-Gage & Simonsen, 2015; Sutherland & Wehby, 2001). The objective of this study was to provide effective PD in to co-taught algebra teams through (a) online coaching, (b) coaching on EBP including OTR, and (c) encouraging more effective use of both co-teachers by using a variety of co-teaching models.

The researcher provided ongoing coaching to teachers who co-taught algebra. The researcher analyzed student learning outcomes in mathematics, and demonstrated and evaluated how the coaching process impacted the interactions of the co-teachers.

The following research questions were addressed in this study:

RQ.1 Is there a statistically significant difference on how students in co-taught secondary math classes perform on progress monitoring assessments when teachers are provided with coaching related to co-teaching practices as compared to solo-taught high school algebra classes?

- Independent Variable – Ten-minute online co-teaching coaching sessions.
- Dependent Variable – STAR 360® math assessment
- Hypothesis – When teachers are provided the online coaching, students will have greater gains in co-taught high school algebra assessments than those students in solo taught algebra classrooms.

RQ.2 To what extent does an online coaching program impact co-teachers' use of multiple co-teaching models (e.g. one lead/one support, parallel teaching) as

measured by 30 minutes of observation of content material using the CTS (see Figure 6) in co-taught high school algebra classes.

- Independent Variable – Ten-minute online co-teaching coaching sessions
- Dependent Variable – Recording of method of co-teaching (see Table 1) implemented by the team.
- Hypothesis – When teachers in co-taught settings are provided with online coaching sessions, there will be more variance in the models of co-teaching utilized in the classroom.

RQ.3 To what extent does online coaching influence teachers' use of OTR in co-taught high school algebra classrooms in a 30-minute lesson using the Classroom Teaching Scan, Version 1.8.1 (CTS).

- Independent Variable – Ten-minute online co-teaching coaching sessions
- Dependent Variable – Change in OTR
- Hypothesis – When teachers in co-taught settings are provided the online coaching program, they will have more OTR than teachers who are in a solo-taught setting.

The researcher coached and evaluated co-teaching teams across four high schools in a large school district in southwestern Florida. Teams were recommended to the researcher by district level administration. After initial meetings with the teacher teams, the researcher observed each co-teaching team and subsequently observed the general education team member in a similar solo-taught class. To provide teacher teams with coaching, the researcher met with each team for 10-minute coaching sessions. The

coaching intervention was developed through a pilot study with three co-teaching teams. During the pilot study, the researcher provided ongoing coaching to teams while conducting daily classroom observations of OTR.

Teaching teams provided student level data from the STAR360® assessment administered electronically by the teacher to students at the beginning and end of the intervention. The assessment, a progress monitoring assessment aligned to state standards, is used as a predictor of state level testing outcomes (Renaissance Learning, 2016).

Observations in the current study were completed at the beginning and end of the coaching intervention. Each observation lasted 30 minutes and included a frequency count of OTR offered by each teacher and a notation of type of co-teaching models used in the co-taught classrooms. The researcher used the Classroom Teaching Scan to gather data (see Appendix A)

The researcher conducted different levels of statistical analysis to evaluate each research question. For research question one, the researcher calculated a gain score for each student test score and used an ANOVA to determine a statistically significant difference existed between student gain scores in co-taught and solo-taught settings. Descriptive data were collected to answer research question two in relation to co-teaching models used. Finally, research question three was evaluated using a descriptive t-test to determine if a difference existed in number of OTR from pre to post observations in each class setting.

While not all statistically significant, several outcomes came out of this study. A statistically significant outcome was found in student learning gains with students in co-taught classes having higher growth scores than students in solo-taught classes. New models of co-teaching emerged in co-teaching teams' practices from pre to post observations. However, opportunities to respond (OTR) across teaching teams did not yield a significant change.

Operational Definitions

To establish consistency, terms used were operationally defined (Gall, Gall, & Borg, 2007). The following definitions are provided as a guide for the reader defining terms used throughout this dissertation.

Co-teaching

Co-teaching is defined as a general and special education teacher working together providing instruction to students with and without disabilities sharing space and responsibilities for all aspects of instruction (Bauwens, Hourcade, & Friend, 1989; Friend & Cook, 2013). The rationale behind co-teaching is to increase opportunities for all students, improve program intensity and continuity, reduce stigma for SWD, and increase support for related service specialties (Bauwens et al., 1989; Friend & Cook, 2013; Mastropieri, Scruggs, & Mills, 2011; Scruggs, Mastropieri, & McDuffie, 2007). The models for co-teaching observed are described in Table 1.

Table 1

Co-teaching models

Model	Description
One-Teach/One-Assist	One teacher leads the delivery of content while the other teacher assists the lead teacher by clarifying questions, providing additional tools to help students understand the concepts or cognitive strategy instruction.
Station Teaching-	The co-teachers are teaching separate content to groups of students at separate stations. The groups of students then rotate with each teacher leading the instruction of a different component or even a different standard being taught at each station.
Parallel Teaching	The co-teachers teach two equal heterogeneous groups of students at the same time during an instructional lesson with both teachers teaching in their own styles but ensuring the mastery of the same objective in each group.
Alternative Teaching	One teacher provides instruction to a (majority) large group of students while the other teacher provides instruction to a smaller group of students. This model is typically used where one teacher pulls out a small group of students during independent practice time to do either remediation or gifted enrichment.
Team Teaching	Two teachers teach a whole group of students at the same time with both teachers having an equal voice and an equal role in instruction.

(Dieker & Murawski, 2003; Friend, 2016; Friend & Cook, 2013)

Solo-taught class

A solo-taught class is a class instructed by one teacher on a regular basis. This type of instruction is different from a co-taught class as there is only one educator of record for the class. Solo taught classes might include students with and without disabilities.

Opportunities to respond

Opportunities to respond are the moments when a teacher elicits a response from either to a whole class or to an individual student (Ferkis, Belfiore, & Skinner, 1997; MacSuga-Gage & Simonsen, 2015; Sutherland & Wehby, 2001). Either the general or special educator can elicit an OTR.

Content material

Instruction of content material is teaching of concepts designated by the teachers as new or a review to the class. This instruction is time after attendance, bell work, or housekeeping issues are completed in class and prior to packing up of materials at the end of class.

AdobeConnect

AdobeConnect is an online, subscription-based platform and allows for individuals or groups of individuals to "meet" remotely. The platform allows for real time audio and video. An administrator, in this case the researcher, set up meeting rooms for the participants to enter, and provided the participants (i.e. the teaching team) a unique website to log into. Upon entering the "room" the administrator raised the level of access to the participant to that of presenter allowing the participants to use audio and video with the administrator. The administrator had the ability to record sessions, pose survey questions and elicit response, take notes, share documents, and send messages to the participants.

Online Coaching

Online coaching is a concept used to have one person (i.e. coach) work with an individual or team of individuals on a myriad of areas. For the purposes of this study, the coach was the researcher and the participants were the teaching teams (i.e. general and special educator). At a predetermined time, teaching teams logged into AdobeConnect to meet with the coach (researcher). Coaching sessions lasted 10 minutes and consisted of a review of the previous week, discussion of the big idea for the coming week, co-teaching models, OTR, and a wrap up. Sessions were recorded and validated for fidelity of implementation by a research assistant (see Appendix B).

Algebra and Pre-Algebra

Algebra is the branch of mathematics where letters and symbols represent numbers and values. Algebra 1 is a course that is taught in grades 8-10 dependent upon the school district or state. The course often is preceded by a Pre-Algebra course where foundational concepts are introduced. Additionally, Pre-Algebra requires students to move from a concrete model where values are known to an abstract model wherein numbers are replaced by variables which students must find the value (Moseley & Brenner, 2009). While there is some disagreement on the definition of pre-algebra, for purposes of this study, pre-Algebra is defined as a course where students must solve for unknown numbers and find equivalence (McMullen et al., 2017; Moseley & Brenner, 2009). For the purposes of this study, algebra instruction will be used to describe both algebra and pre-algebra classes.

Direct Instruction

Direct instruction is a practice where students are focused with attention to the teacher at the front of the classroom. This practice is frequently found at the beginning of the lesson when the teacher is presenting new information to students (Hunter, 1982; Rosenshine, 1995). During this point in the lesson, teachers provide the students with new information and examples for the students to follow. In mathematics courses, teachers frequently provide information to students in shortened steps and provide students opportunities to demonstrate their understanding (Rosenshine, 1995). For

purposes of this study, direct instruction is a point in the lesson where the teacher is providing instructions for an activity, teaching a new concept, or reviewing a concept with the entire class or in small groups or stations.

Guided Practice

Guided practice is defined as a practice wherein teachers present a small amount of material and then guide students through an example (Rosenshine, 1995). It was first introduced into the literature by Hunter (1982). The practice includes the teacher frequently checking for students' understanding. For the purposes of this study, guided practice is defined as a part in the lesson where the teacher guides the entire class through an example and checks for understanding or when a teacher is reviewing information with the class.

Independent Practice

Independent practice is a part in the lesson where students work independently on questions that are posed by the teacher. This practice occurs at a point after guided practice is completed. Students may receive assistance prior to starting an example and this level of practices is to continue until students develop automaticity (Rosenshine, 1995). For the purposes of this study, independent practice is considered a point in the lesson where students work individually on examples while teachers check for

understanding. This level of practice is not considered to occur during a time when a student is working with a partner or in a group.

Group Work

Group work or partner work is a point in the lesson where students are working in pairs or small groups on an assignment. This practice occurs after the teacher has provided the students with directions on the practice to be completed and expectations for their work. As in independent practice (Hunter, 1982; Rosenshine, 1995), students may receive assistance prior to starting the assignment but then groups should function independently of the class. Group work, for the purposes of this study, is considered time when students are working with one or more classmates.

Conclusion

Co-teaching continues to be a much debated, but widely used method of instructing SWD, specifically in math. While the research outcomes on co-teaching remain mixed, experts continue to push for additional research towards what makes co-teaching effective (Friend, 2016; Isenberg & Walsh, 2015; Murawski & Bernhardt, 2016; Murawski & Goodwin, 2014; Murdock, Finneran, & Theve, 2016). Through this study, the researcher attempts to shed light on the implementation of a targeted coaching model using the five characteristics of high-quality PD. The researcher in this study provides

results related to a gap in the literature on coaching as a tool for PD, on co-teaching and OTR in secondary algebra I classes.

CHAPTER TWO: LITERATURE REVIEW

As students with disabilities (SWD) are included in the general education setting with increased frequency (U.S. Department of Education, 2015a), co-teaching has emerged as a joint service delivery model involving both general and special education teachers delivering instruction in the general education setting (Friend, 2016; Friend & Cook, 2013; Thousand, Nevin, & Villa, 2007). Despite popularity of this model, the use of co-teaching has been questioned with regard to its effectiveness in meeting the academic needs of SWD, especially in mathematics (Almon & Feng, 2012; Barrocas & Cramer, 2014; Bottge et al., 2015). One of the struggles cited with co-teaching, especially at the secondary level, is the preparation of both teachers in teaching content and providing support to SWD (Harbort et al., 2007; Harris, Pollingue, Hearrington, & Holmes, 2014; Magiera, Smith, Zigmond, & Gebauer, 2005; Pancsofar & Petroff, 2013; Shaffer & Thomas-Brown, 2015). Recent research from the National Council on Teacher Quality (NCTQ; 2015) indicates a major indicator of teaching effectiveness in individual subject areas is teacher knowledge of the content. The current knowledge of both general and special education teachers in the content area of mathematics has been questioned (National Council on Teacher Quality, 2015), as has the preparation of teachers to work together in co-taught settings (Brinkmann & Twiford, 2012; Pancsofar & Petroff, 2013; Ploessl & Rock, 2014). Therefore, for co-teaching to be effective in mathematics, both general and special education teachers need to be provided PD in co-teaching strategies and mathematics.

In this chapter, the researcher provides the foundation for the exploration of coaching co-teaching teams in secondary mathematics classrooms using an online coaching model as PD. The researcher begins this chapter by providing a summary of the current research in co-teaching followed by a review of the literature aligned with co-teaching and student academic achievement. Next, current methods used to provide coaching to co-teaching teams are discussed, including the use of online coaching. The researcher then discusses the components of high quality PD and how this type of coaching as PD aligns with emerging online coaching models. The researcher concludes the chapter with a summary of the emerging evidence-based practices for SWD in secondary mathematics classes along with how these instructional components could provide the foundation for online coaching to ensure SWD succeed in co-taught secondary mathematics classroom.

Co-teaching

The use of co-teaching has emerged as legislative changes have shifted both the placement of SWD and the need for teachers to be highly qualified (Every Student Succeeds Act, 2015, secs. 1177 1177, No Child Left Behind, 2002, sec. 115) in the content they teach. Regulations in the Individuals with Disabilities Improvement Act (Individuals with Disabilities in Education Improvement Act, 2004, sec. 118) require SWD be educated in the least restrictive environment (LRE) and have access to the general education curriculum. The passage of No Child Left Behind (Department of Education, 2002) and the more recent Every Student Succeeds Act (Department of

Education, 2015) emphasizes all students, including those with disabilities, are required to meet grade level standards for all subject areas. These legislative actions make it clear general and special education teachers alike are expected to provide adaptations and modifications across content areas in the general education setting as outlined by the SWD's individualized education program (IEP; Department of Education, 2004).

An emerging model to ensure both access and academic success for SWD in the LRE is the use of co-teaching. Bauwens, Hourcade, and Friend (1989) defined co-teaching as "an educational approach in which general and special educators work in a coactive and coordinated fashion to jointly teach academically and behaviorally heterogeneous groups of students in educationally integrated settings" (p. 18). Collaborative teaching (i.e., co-teaching) has come to have multiple definitions (Thousand et al., 2007), although some agreements exist amongst the definition. The similarities include (a) shared responsibility, (b) engagement of two or more professionals, and (c) shared joint delivery of instruction in a shared space. With the growth of this model, a continuing need in the field is to understand what makes for effective collaboration and determine if teacher collaboration translates into increased learning outcomes for students (Bauwens et al., 1989; Friend, 2016; Pratt, 2014; Walsh, 2012).

The rationale behind co-teaching, as described by Cook and Friend (1995) is to (a) increase instructional options for all students, (b) improve program intensity and continuity, (c) reduce stigma for students with special needs, and (d) increase support for

related service specialists. Friend and colleagues (2010) note the outcome of the push for co-teaching is students now have increased access to the general curriculum.

As researchers reviewed the way general and special education teachers were working together in the general education setting through co-teaching, five different models emerged (see Table 1). Each of these models can be used individually or in combination dependent upon team and student needs (Cook & Friend, 1995; Friend, 2016; Friend, Reising, & Cook, 1993). The five models are (a) one lead, one assist/support; (b) parallel; (c) team; (d) alternative; and (e) station. Researchers have found the one lead, one assist model is most commonly used by teachers in co-taught settings (King-Sears et al., 2014; Mastropieri et al., 2005; Scruggs et al., 2007). However, research has been limited in the use of one model over another aligned to student academic outcomes. Table 1 provides the definitions of each of the models of co-teaching.

After Bauwens and colleagues (1989) defined the models of co-teaching, research on these models began to emerge. Murawski and Swanson completed the first meta-analysis of the co-teaching research (Murawski & Swanson, 2001) These researchers reviewed 89 articles but only six contained enough quantitative information to be included in the analysis. Through their analysis, a range of effect sizes was found from a low of 0.24 to a high of 0.95 and an average effect size of 0.40. A variety of data analyses were included in the study including student grades, achievement scores, and attitudes toward co-teaching. The researchers hypothesized, while some quantitative

research on co-teaching is present, a need exists for further studies directly related to quantitative analysis of co-teaching practices (Murawski & Swanson, 2001).

Following Murawski and Swanson's analysis (2001), Scruggs, Mastropieri, and McDuffie (2007) completed a meta-synthesis of co-teaching evaluating 32 qualitative studies. These researchers identified five areas in need of further evaluation of co-teaching in the field (a) co- implementation, (b) teacher perceptions, (c) problems encountered, (d) perceived benefits, and (e) factors to ensure success. Scruggs and colleagues (2007) discovered several relevant needs of teachers concerning co-teaching including: (a) time for planning; (b) strategies to accommodate for student's ability; and (c) options for ongoing PD. Much like earlier research, Scruggs and colleagues' synthesis showed one lead, one support was the most common model of co-teaching used and special educators often played a subordinate role in the classroom. Their research also identified an issue of special education teachers finding it difficult to employ strategies such as mnemonics, strategy instruction, and self-advocacy skills in the co-taught environment to meet the needs of SWD (Scruggs et al., 2007).

A meta-analysis and meta-synthesis of the literature on co-teaching and a thorough review conducted by this researcher of work preceding 2007 found, co-teaching continues to be a frequently used model of providing access to the general education classroom for SWD (Friend, 2016; Murdock et al., 2016; Pratt, 2014; Sweigart & Landrum, 2015a). However, models that are most effective and how to increase student achievement is still an area in need of further investigation (Friend, 2016; Isenberg & Walsh, 2015; Lindeman & Magiera, 2014; Walsh, 2012). Research is needed to

determine which models of co-teaching are most effective for SWD in terms of achievement and how various types more effectively prepare or support teachers in co-teaching relationships.

Co-teaching and Academic Achievement

Academic achievement and educating students in the LRE are the primary goals cited for the use of a co-teaching model (Friend, 2016; Murawski & Bernhardt, 2016; Sweigart & Landrum, 2015a). Yet, the results have been mixed as to the effectiveness of this intervention in relation to student learning (Murawski, 2006; Murawski & Goodwin, 2014; Strogilos & Stefanidis, 2015; Sweigart & Landrum, 2015a; Thousand et al., 2007; Tremblay, 2013). In a longitudinal study of the benefits and problems associated with co-teaching, Walther-Thomas (1997) found student achievement was one of the benefits of co-teaching. In her study, 143 participants (n = 119 teachers and n = 24 administrators), including 23 school-based teams in eight Virginia school districts, were investigated. These teams spanned 18 elementary schools and 7 middle schools. Teachers reported few students failed to succeed in the new environment, using terms such as "blossoming," "soaring," and "taking off" (p. 399) to describe their performance. Additionally, teachers reported increased independence in the use of co-teaching in academic achievement throughout the school year.

Another example of academic achievement for students in an inclusive environment comes from a study out of Howard County Public Schools (Walsh, 2012). Over a six-year period from 2003 to 2009, an increase in student proficiency in reading

and math occurred based on the Maryland School Assessments (MSA). The school district provided extensive PD on co-teaching to support the teachers. During the same time, the school district saw a 10% increase in the placement of students into co-taught environments. In elementary schools where co-teaching was implemented (n = 8), an 11% increase in MSA reading scores and a 14.5% increase in mathematics occurred. Conversely, the schools where co-teaching was not implemented (n = 31) only a 1% increase in reading and no increase in mathematics occurred from the 2008 to 2009 school years. These findings support that co-teaching, when implemented at a district level, increases SWD access and academic achievement.

In another study focused on co-teaching and academic achievement, Rea, McLaughlin, and Walther-Thomas (2001) compared SWD in a co-taught (n = 36) environment to those in single-teacher (n = 22) classrooms. The researchers evaluated student achievement using end of course grades, achievement on a state standardized test, and the Iowa Test of Basic Skills (ITBS). While students in the co-taught environment did not yield statistically significant differences in state achievement tests, apparent differences in mean scores were found on the ITBS in language arts (p = 0.025) and mathematics (p = 0.029). Additionally, SWD in co-taught classes had significantly higher end-of-course grades in all subject areas (language arts t = 2.67, p = 0.010; mathematics t = 2.50, p = 0.016; science t = 3.60, p = 0.001; and social studies t = 2.62, p = 0.011).

A comparison of academic achievement of students with learning disabilities in co-taught (n = 37) and not co-taught (n = 58) grade 1 and co-taught (n = 21) and not co-

taught (n = 42) grade 2 classes was completed by Tremblay (2013). In this study, student performance was recorded at the beginning and end of first and second grade for students with learning disabilities. Tremblay (2013) noted a significant difference in first graders' language arts performance from the beginning to end of the year in co-taught (t = 3.271, p = 0.002) versus not co-taught classrooms, however, no significant differences were found in mathematics (t = -0.363, p = 0.718). Additionally, at the end of second grade, differences between co-taught and not co-taught settings occurred; however, the results did not produce statistically significant outcomes (t = 1.802, p = 0.091; t = 1.726, p = 0.079).

In contrast to these studies is one completed by Murawski (2006). In this study, Murawski compared the effects of co-teaching, mainstreaming, and separate classrooms for students with learning disabilities. Student achievement was measured using the Test of Written Language-III (TOWL-III), Test of Reading Comprehension-III (TORC-III), Wide Range Achievement Test-Revised (WRAT-R), as well as course grades. General education students (n = 72), identified as students without a designated disability were randomly placed into classes. Special education students (n = 38) were designated as those with learning disabilities and were placed into the specific classes based on their previous year IEP meeting and their level of need. Four teachers (n = 4) were involved in the study. While statistically significant differences (p > .001) were not found comparing pre-tests to post-tests, mean differences were discovered. Students with disabilities in co-taught classes (n = 12) achieved higher scores on the WRAT-R for spelling (m = 31.83) and mathematics (m = 36.08). Additionally, students in the separate setting (n = 14)

consistently performed poorer than students in co-taught and mainstreamed (n = 8) classrooms. End of course grades indicated SWD in the co-taught classroom remained flat from week ten (m = 4.75) through week twenty (m = 4.92). Conversely, students in the separate setting had an improvement in course grades (pre-test m = 5.64; post-test m = 6.36) while those in the mainstreamed class (pre-test m = 4.25; post-test m = 3.38) declined.

As SWD continue to be included in the general education classroom and the model of co-teaching often being the service delivery model used, a need exists to determine not only if co-teaching is a viable option but further, and potentially more importantly if students are making progress. The results remain mixed (Thousand et al., 2007) with a continued need to determine if the PD teachers receive to implement the model is effective (Waitoller & Artiles, 2013). The Howard County Public Schools study (Walsh, 2012) poses the argument that when PD on co-teaching is part of systemic change student achievement is positively affected. Therefore, a continued focus on collecting quantitative and qualitative research on the effects of PD in co-teaching on student access and achievement needs to continue due to the increasing frequency of SWD being served in co-taught settings (U.S. Department of Education, 2015a).

Professional Development and Co-teaching

With the increase of SWD in general education classrooms (U.S. Department of Education, 2015a), and teachers being asked to work collaboratively, a growing need is for teachers to receive instruction on collaborative strategies such as co-teaching (Friend,

2016; Murawski & Bernhardt, 2016; Murdock et al., 2016; Pratt, 2014; Sweigart & Landrum, 2015a). For students to have access to the curriculum and to make academic gains, teachers need to be prepared, with not only co-teaching strategies, but also specifically co-teaching combined with strategies to directly impact student learning.

In a longitudinal study of co-teaching experiences Walther-Thomas (1997) found while professional growth was one of the benefits of co-teaching, PD was a challenge. Both general and special educators reported that working with another educator increased their knowledge of different disciplines and allowed exploration of new ideas. Additionally, the teachers reported co-teaching was one of the "best professional growth opportunities of their careers" (p. 401). When asked about PD opportunities for co-teaching skills, the teachers reported few opportunities existed in the area due to cutbacks in staff development. Many of the participants requested additional PD in co-teaching to fill gaps in their knowledge and skills.

Walsh (2012) described a PD model in Maryland where teachers were introduced to a variety of co-teaching models. This PD was due to Maryland public schools experiencing a culture shift in the way SWD received support (Isenberg & Walsh, 2015; Walsh, 2012). A limited number of teams of teachers were provided intensive support through which examples of tiered instruction, scaffolded supports, and assessments emerged. Through this use of direct PD in co-teaching, student-learning gains were affected positively, leading to the belief that direct co-teaching PD is effective.

Professional development is highly effective if it has direct impact on teacher practice and student outcomes (Archibald et al., 2011). In order to affect student

achievement, the practice to be changed through PD should relate directly to student learning (Archibald et al., 2011). When the characteristics of PD are fragmented, irrelevant, or isolated, PD is not effective (Archibald et al., 2011; Darling-Hammond et al., 2009). Friend and colleagues identified three essential areas in need of PD for co-teaching teams. These areas to directly impact co-teaching practices include discussions on: (a) teachers' roles and relationships, (b) issues related to program logistics, and (c) practices that impact student learning.

The PD received by co-teachers must be high quality for students to make progress (Archibald et al., 2011), and should begin in preservice experiences (Murawski & Goodwin, 2014). By utilizing a gap analysis for teams, PD can be personalized and targeted to district initiatives and focus on student learning (L. M. Desimone & Garet, 2015; Isenberg & Walsh, 2015; Ploessl & Rock, 2014; Walsh, 2012).

Coaching as Professional Development

Effective PD can be executed using many methods and structures. Among these are coaching, single day classes, college courses, and virtual simulations. Hausman and Goldring (2001) reported that when PD is offered at the school level aligned with teacher targeted professional learning goals this type of offering is most effective (Melnick & Witmer, 1999). This alignment in some states, according to reports from the National Council on Teacher Quality (NCTQ, 2015), is moving towards teacher evaluations. Regardless of the modality or reason for PD, teacher growth and development remains a critical component of meeting student-learning needs (NCTQ, 2015).

Joyce and Showers (1980), from a two-year study of PD for teachers, described three major assumptions from the research for effective PD: (a) teachers are wonderful learners who can improve their craft, (b) teachers need specific conditions to make improvements in practice, and (c) PD needs to be grounded in effective practices. The researchers further broke their research into four specific categories for effective PD, namely (1) levels of impact, (2) components of training package, (3) effectiveness of components, and (4) combinations of components. The levels of impact of PD focused on teachers knowing a practice from the awareness level through application and problem solving of the skill (Joyce & Showers, 1980). Each level of impact is equally important but only at the application level of PD, Joyce and Showers (1980) note, is student learning affected.

The three learning components of PD (training package, effectiveness, and combination) described by Joyce and various colleagues are important individually and collectively (Joyce & Calhoun, 2010; Joyce & Showers, 1980, 1982; Showers & Joyce, 1996). The five components of PD are (a) presentation of theory, (b) model or demonstration, (c) practice in classrooms or simulation, (d) feedback, and (e) coaching for application. These researchers further explored the level of impact of each of these components, concluding that research has shown, when PD is created with all five components student learning is positively affected.

Murray, Ma, and Mazur (2009) examined another way to impact teacher practice through an investigation of the effects of peer coaching as a potential model for sustained PD on teacher collaborative interactions and student achievement in mathematics.

Fourteen teachers (N = 14) in six schools were a part of the study with nine teachers in the treatment group (*n = 9*) and five in the control group (*n = 5*). While all participants were provided qualitative responses, only six teachers in the treatment group were provided student data. No apparent effects were found in student achievement, but the participants indicated the coaching as a PD model was of value.

While coaching has started to gain in popularity for providing PD to teachers, a barrier found by Murray et al. (2009) was teachers lacked designated time to meet in person with their coaches. This barrier of a lack of time impacts not only coaching, but also sustained PD in general (Egodawatte, McDougall, & Stoilescu, 2011; Kennedy, Rodgers, Romig, Lloyd, & Brownell, 2017; Ploessl & Rock, 2014). The solution may be a more personalized, direct, job embedded PD with coaching. This type of just in time and personalized PD is an emerging model prime for additional research (Blanchard, LePrevost, Tolin, & Gutierrez, 2016; Dede, Ketelhut, Whitehouse, Breit, & McCloskey, 2009; Hill, Beisiegel, & Jacob, 2013; Stichter et al., 2009; Stichter, Lewis, Richter, Johnson, & Bradley, 2006).

Online Coaching

The current PD trend of online coaching is just like traditional PD, but typically considered to be more convenient for the participant and more targeted to individualized needs (Ploessl & Rock, 2014; Rock, Gregg, Thead, et al., 2009; Rock, Gregg, Gable, & Zigmond, 2009; Scheeler, Ruhl, & McAfee, 2004). Online coaching should include all the components identified by Joyce and Showers (1980, 1982) to build upon the effective

PD research base. This model of PD has been used to help develop the skills of both general and special education teachers alike (Rock, Gregg, Howard, et al., 2009; Rock, Gregg, Gable, et al., 2009, 2009). For example, providing teachers with immediate feedback using technology has proven to be successful (Rock, Gregg, Thead, et al., 2009). In the past, when coaches or supervisors were to work with, or provide support to a classroom teacher, the coach or supervisor would need to be on-site and time would be taken from the school day. Coaches now can provide teachers with feedback on evidence-based practices aligned with direct student learning needs through remote or virtual means increasing the opportunities for coaching while decreasing the travel time of the coach (Rock, Gregg, Howard, et al., 2009).

One example of a way to provide real-time and direct instruction to teachers virtually is through the use of bug in ear (BIE) technology. This tool used in a PD model has been found to assist teachers in the improvement of their skills (Dieker, Stephan, & Smith, 2014; Ploessl & Rock, 2014; Rock, Gregg, Gable, et al., 2009). Bug in ear provides the teachers with immediate feedback during instruction as opposed to deferred feedback, received post observation, and in some cases, long after the lesson is completed (Scheeler, McAfee, Ruhl, & Lee, 2006). In a multiple baseline study evaluating the use of BIE technology with pre-service teachers' learning to use three term contingency trials, researchers found teachers improved their practices in the use of this technique from between 30 to 92 percent. Additionally, the researchers found student correct responses improved from 3 to 17 percentage points (Scheeler et al., 2006).

In co-teaching, Scheeler, Congdon, and Stansbery (2010) evaluated the use of BIE technology. Three sets of teachers ($N = 6$) participated in the multiple baseline study. Teacher teams in co-taught classrooms across different grade levels were included as participants in the study. The researchers used a technique called three term contingency (TTC) trials. Three-term contingency are basic units of instruction where students learn a new technique or behavior and can respond to questions and then receive feedback. The theory behind TTC is if students are allowed more opportunities to respond (OTR) they will make greater learning gains (Alber & Heward, 2000; Albers & Greer, 1991; Scheeler, Congdon, et al., 2010; Scheeler, Macluckie, & Albright, 2010). In this multiple baseline study, the researchers coached the teaching teams using BIE technology and gave the teachers feedback based on their use of TTC in the classroom. The researchers found teacher teams were successful in implementing TTC when receiving the BIE support. Subsequently, the teams maintained their use of TTC through maintenance and generalization phases. Both the general and special educators also made progress in the use of TTC with minimal differences occurring between the two teachers (Scheeler et al., 2010).

No matter the model of coaching, for a PD package to be effective, teachers need to be observed using measureable criteria to determine fidelity of implementation. Kennedy, Rodgers, Romig, Lloyd, and Brownell (2017) created an observational tool to gather measureable outcomes aligned with online PD. Their tool, the Classroom Teaching Scan, Version 1.8.1 (CTS), captures instructional practices, teaching methods, indicators of fidelity-quality in real time, and qualitative notes. All notes are collected in

real time and can be used either in direct observations or in videos of classroom instruction. The tool can collect data on OTR, co-teaching models used, student responses, levels of questioning, and specific instructional practices dependent upon subject matter (i.e. vocabulary in math, science, and language arts). In their multiple baselines across participant's study, Kennedy and colleagues (2017) used the CTS to measure the fidelity of implementation of an online PD package on teacher performance. The researchers found an increase in vocabulary instruction after implementing the PD package. Teachers also implemented unique vocabulary practices with fidelity once they began the PD. In reviewing social validity of the intervention, teachers noted that the intervention not only helped them as teachers, but student learning outcomes as well (Kennedy et al., 2017).

The use of online instruction and PD has continued to gain in popularity in schools and districts across the United States due to its ease of implementation, ability to be personalized to individuals, and effects on student and teacher growth (Archibald et al., 2011; Dede et al., 2009; Gulamhussein, 2009; Hill et al., 2013; Ploessl & Rock, 2014; Rock, Gregg, Thead, et al., 2009). The CTS provides researchers and school administrators a tool to aid in the observation of implementation of PD (Kennedy et al., 2017). This implementation could stretch beyond co-teaching to supporting teacher pedagogical and content knowledge in co-teaching. The need for potential support for content instruction in co-teaching PD (Desimone & Garet, 2015; Naraian, 2010; Waitoller & Artiles, 2013) is another area of limited, yet emerging trend.

Coaching Co-teachers in Content Knowledge

A consensus in the literature is co-teachers need focused, sustained PD related to student learning outcomes (Allen, Perl, Goodson, & Sprouse, 2014; Friend, 2016; Hamilton-Jones & Vail, 2014; Nierengarten, 2013; Shaffer & Thomas-Brown, 2015). Once teachers receive their initial licensure, much of their continued development is offered through PD by the school, district, or state. Teacher PD has traditionally been presented in short, stand-alone workshops to improve teacher pedagogical knowledge (Archibald et al., 2011; Ball & Cohen, 1999; Croft, Coggshall, Dolan, Powers, & Killion, 2010; Desimone & Garet, 2015). Isolated PD opportunities have not always proven to be most effective (Ball & Forzani, 2011; Desimone & Garet, 2015; Pancsofar & Petroff, 2013) as research has shown when teachers are provided ongoing and relevant PD student achievement is effected positively (Desimone, Porter, Garet, Yoon, & Birman, 2002; Garet et al., 2001).

Where to target co-teaching and teacher PD in general is an ongoing question in the field (Friend, 2016; Isenberg & Walsh, 2015; Shaffer & Thomas-Brown, 2015; Sweigart & Landrum, 2015a). A specific targeted area to consider is the overall low achievement of SWD in mathematics (U.S. Department of Education, 2015b). Currently, co-teaching research has had limited focus on this content area as has the field of special education in general (Dietrichson, Bøg, Filges, & Klint Jørgensen, 2016; Ollerton, 2009; Van Garderen, Scheuermann, Jackson, & Hampton, 2009). Between 5% and 8% of school age students have a disability in mathematics (Impecoven-Lind & Foegen, 2010) with SWD in secondary schools earning 63.1% of their mathematics credits in the least

restrictive environment (LRE) of the general education setting. Additionally, 66% of SWD failed at least one course during their high school careers, with the highest failure rates occurring in algebra. One solution to these poor outcomes for SWD in math is to provide teachers coaching as a model of PD embedded in their work as co-taught teams.

The content of PD in the area of mathematics for SWD has been outlined by the National Mathematics Advisory Panel (NMAP, 2008) in their *Foundations for Success* report. The authors of the report found SWD benefit from (a) explicit, systematic instruction; (b) formative assessment; (c) small group instruction, (d) use of real world problems, and (e) calculator use. Additionally, NMAP found that teacher knowledge of mathematics is the only identifiable characteristic of an effective math teacher (Stotsky, 2009), which means teacher PD and support in this content area is critical.

Just as SWD struggle in mathematics, many special education teachers continue to lack a background in mathematics and co-teaching. In order to bridge this gap, PD is needed in both areas (National Council on Teacher Quality, 2015; Pancsofar & Petroff, 2013; Ploessl & Rock, 2014; Shaffer & Thomas-Brown, 2015; Waitoller & Artiles, 2013). Currently, the evaluation of teacher knowledge in mathematics is a single assessment taken prior to receiving a teaching license (Stotsky, 2009). For special education teachers, this measure of math knowledge is markedly different from state to state (Stotsky, 2009). According to the NCTQ, to receive a teaching credential in special education in twenty-one states the candidate can receive a general or generic special education license to teach any subject in grades K-12 (National Council on Teacher Quality, 2015). Fourteen states require elementary special education teachers to pass a

subject matter test similar to other elementary teachers. Additionally, only three states require secondary level special education teachers to pass a test in the subjects they will be teaching (National Council on Teacher Quality, 2015). Five states require secondary special education teachers to take at least one subject matter test to obtain secondary special education licensure. Perhaps more concerning is only five states require general education secondary teachers to demonstrate knowledge of the subject they are teaching (National Council on Teacher Quality, 2015). Therefore, the same poor outcomes for SWD will likely result from putting general and special education teachers together in mathematics without direct, focused, and ongoing PD. .

Teacher PD for co-teaching mathematics should be framed in current student struggles and effective practices literature. Students who struggle early on in mathematics do not possess the content knowledge for higher order mathematics courses, like algebra (Cawley & Miller, 1989; Fuchs et al., 2008, 2011; Miller & Mercer, 1997) and experience difficulty in: (a) cognitive processes, (b) content foundations, and (c) algebra concepts (Impecoven-Lind & Foegen, 2010; Miles & Forcht, 1995). These early and persistent deficits need to be addressed in teacher PD for both teachers in co-taught settings. If not addressed, students will continue to lack basic skills and an inability to comprehend the complex nature of algebra courses (Foegen & Morrison, 2010; Fuchs et al., 2011; Impecoven-Lind & Foegen, 2010). This lack of comprehension leads to both a lack of access and achievement in mathematics for students with disabilities.

Opportunities to Respond

An effective practice to consider as a component for online coaching of co-teachers as PD is in the appropriate use of OTR. The concept of using OTR to elicit responses from students has been found to be beneficial for not only SWD but all students (Haydon et al., 2010; MacSuga-Gage & Simonsen, 2015; Stichter et al., 2009; Zaslofsky, Scholin, Burns, & Varma, 2016) including Scheeler and colleagues work with the three term contingency trials (Scheeler, Congdon, et al., 2010; Scheeler et al., 2006, 2006). Opportunities to respond are used by educators to elicit responses from students (Council for Exceptional Children, 1987; Ferkis et al., 1997; Haydon & Hunter, 2011; Sutherland, Alder, & Gunter, 2003). A teacher can use OTR in one of two ways: (a) teacher directed individual responses, or (b) teacher directed unison responses (Ferkis et al., 1997; MacSuga-Gage & Gage, 2015; MacSuga-Gage & Simonsen, 2015).

An individual response is used when a teacher calls on one student to answer a question (Lambert, Cartlege, Heward, & Lo, 2006) while a unison response is used when a teacher presents a question to the entire class or group of students (Haydon et al., 2010, 2013). Additionally, with the unison response, the teacher can elicit verbal or non-verbal responses such as hand raising, response cards, or thumbs up or down (Haydon et al., 2010, 2013).

One of the first studies of OTR was completed by Carnine (1976). Carnine hypothesized, when instruction was faster paced with questions occurring in a quicker succession, that students would see an increase of on-task behavior and correct responses. A single-case, ABABAB design was implemented with the A condition consisting of

slower instruction and faster instruction in the B condition. In the slower rate presentation (A), a lag occurred between question and response. In contrast, the B condition did not include a lag between question and response. Carnine (1976) found, in the faster paced instruction, students answered more questions correctly and participation increased.

The Council for Exceptional Children (CEC) published guidelines for OTR as a technique to work with SWD (Council for Exceptional Children, 1987). The authors of the guidelines state, teachers should be eliciting four to six OTR per minute for students. Students should respond with 80% accuracy. While students are engaging in independent practice, they should make 8-12 OTR per minute with 90% accuracy

MacSuga-Gage and Gage (2015) extended the work on OTR to determine if increased OTR positively affects student behavioral and academic outcomes. Using a quasi-experimental, within-subjects design, the researchers evaluated first through third grade elementary teachers and students. Teachers began by video recording themselves teaching either phonics or spelling instruction in the classroom using direct instruction. The researchers provided PD to teachers achieving baseline on (a) how to increase OTR, (b) self-monitoring, and (c) entering data into an Excel spreadsheet (MacSuga-Gage & Gage, 2015). Teachers then continued recording their lessons. The researchers found, after the intervention, teachers increased their OTR from 2.24 OTR per minute to 3.90 OTR per minute. Students were measured on two scales, the Direct Behavior Rating-Single Item Scales (DBR-SIS) and academically using the Dynamic Indicator of Basic

Early Literacy-Oral Reading Fluency (DORF). A statistically significant difference was found for both student behavior and academic performance with the increase of OTR.

A systematic literature review on OTR was completed by MacSuga-Gagne and Simonson (2015). Building upon a previous literature review by Sutherland and Wehby in 2001, fifteen empirical studies were reviewed from a pool of 527. The findings from these studies corroborated with previous researchers; teacher directed OTR produce positive behavioral and academic student outcomes. Additionally, the researchers found that, while CEC in 1987 called for 8-12 OTR per minute, MacSuga-Gage and Simonsen (2015) found positive effects when OTR were presented at 3-5 per minute. A positive relationship was found when OTR was above the rate of 3-3.5 per minutes (Haydon & Hunter, 2011; Sutherland et al., 2003). Finally, MacSuga-Gage and Simonsen (2015) reported that while OTR produces positive academic and behavioral outcomes, more research is needed on rates and types of OTR for students with differing abilities.

While the preceding studies reflect the theory that increased OTR led to positive results in the classroom, the opposite was found in a study conducted by McKenna, Muething, Flower, Bryant, and Bryant (2015). The researchers observed high school co-taught classrooms and, through observations, compared the relationship of rates of OTR and specific praise to on-task behavior and student engagement. In person observations were completed to record student behavior and engagement. Audio recordings were taken to evaluate OTR and specific praise. The researchers found that an increase in OTR did not correlate to increased student engagement and better student behavior. Further, while academic data were not included as part of the study, the researchers

questioned the reliability of an increase in OTR for students in secondary settings. Moreover, if indeed OTR is not effective, other methods of engagement must be explored so that students with disabilities, included in the general education setting, make progress.

Sweigart and Landrum (2015) compared co-taught classrooms to solo-taught classrooms and evaluated OTR and positive and negative feedback. The researchers also compared time spent in small groups or one on one with targeted students. While a significant difference was found for elementary school classrooms, the same was not true for middle and high schools. A significant difference ($p < .05$) was found indicating higher rates of OTR in the co-taught classrooms. However, student engagement was higher in the classes with one instructor, leading to the conundrum that students are not more engaged when there is a higher level of OTR.

While all of the aforementioned strategies have led to improvement in mathematics for SWD, these evidence-based practices are not always implemented to fidelity in solo or co-taught mathematics classrooms (Dietrichson et al., 2016; Strickland & Maccini, 2010; Wexler, Reed, Pyle, Mitchell, & Barton, 2015). How the uses of these strategies individually or collectively occur in co-taught settings is not clearly identified in the literature.

Despite PD on these strategies, how this implementation and training in the use of these strategies for co-taught teams is yet to emerge in the literature. An additional issue is raised when general education or special education teachers individually receive PD, but their teammate does not, and how these techniques can be used by teams to impact co-teaching outcomes (Desimone & Garet, 2015; Waitoller & Artiles, 2013).

Conclusion

Ensuring SWD have the same rights and academic success as their typical developing peers (Every Student Succeeds Act, 2015) includes having access to the LRE (Every Student Succeeds Act, 2015, Individuals with Disabilities in Education Improvement Act, 2004; U.S. Department of Education, 2015a), which is provided in many districts through co-teaching (Friend, 2016; Isenberg & Walsh, 2015; Murawski & Bernhardt, 2016; Murdock et al., 2016). Despite the use of this commonly found service delivery model both general and special educators are not always provided with effective PD on co-teaching (Friend, 2016; Murawski & Bernhardt, 2016; Murdock et al., 2016; Sweigart & Landrum, 2015). The target, focus, and intensity of the PD are even more challenging when combined with co-teaching in a high stakes content area like mathematics. Current research on teacher licensure shows that special and general education teachers both lack strong use of effective practices in meeting the needs of SWD in mathematics. The NCTQ (2015) research also shows even in teacher preparation teachers are not always provided with the background needed in mathematics and special education strategies.

One way to fill these gaps is PD emphasizing EBP to meet the needs of all students in co-teaching mathematics. Professional development in co-teaching strategies and targeted mathematics strategies may allow co-teaching teams to work together in a cohesive manner (Joyce & Calhoun, 2010; Naraian, 2010; Shaffer & Thomas-Brown, 2015) to impact student achievement. Unlike traditional single day isolated PD with little follow up (Archibald et al., 2011; Joyce & Calhoun, 2010; Naraian, 2010; Sample McMeeking et al., 2012; Waitoller & Artiles, 2013) best practice in PD requires it be embedded within the daily activities of the teachers (Croft et al., 2010; Shaffer & Thomas-Brown, 2015).

One model of PD that could be embedded into daily co-teaching in mathematics as a sustainable model is online coaching (Joyce & Showers, 1982; Showers, 1985; Showers & Joyce, 1996). Online coaching could provide immediate feedback and focus on effective practices to impact student academic success (Ploessl & Rock, 2014; Rock, Gregg, Howard, et al., 2009; Rock, Gregg, Gable, et al., 2009). The use of online coaching focused on OTR has been shown to be effective for teachers and students as a method of producing increased achievement outcomes in co-taught settings (Ploessl & Rock, 2014; Rock, Gregg, Howard, et al., 2009; Scheeler, Congdon, et al., 2010; Scheeler et al., 2004; Solomon, Klein, & Politylo, 2012). The researcher in this study provides an online model of coaching as PD to secondary co-teaching teams in mathematics (e.g., algebra) to increase the use of OTR in an attempt to impact student achievement.

CHAPTER THREE: METHODS

Introduction

This chapter includes an overview of the procedures followed in this study; rationale, theoretical framework, research questions, variables, and hypothesis. The procedures are aligned with online coaching of secondary co-taught teams in algebra. A summary of the population of teachers and students involved in the study, and the settings where the study was conducted is provided. The researcher concludes with a discussion of the timeline, data collection, reliability, and validity procedures.

Problem and Rationale

A response to supporting students with disabilities (SWD) in the general education setting is the emergence of a commonly used service delivery model, co-teaching (Cook & Cook, 2013; Dieker & Murawski, 2003; Friend, 2016; Magiera & Zigmond, 2005). Despite the increasing use of this model, teachers are not always provided with adequate professional development (PD) to implement co-teaching with fidelity (Sweigart & Landrum, 2015a). Research on co-teaching across states, school districts, and buildings is inconsistent and not conclusive (Friend, 2016; Murawski & Bernhardt, 2016; Shaffer & Thomas-Brown, 2015). Teachers who completed preparation programs before shifts in legislation and practices to educate SWD in more inclusive settings may be less adequately prepared to deliver instruction through co-teaching

models (Brownell, Sindelar, Kiely, & Danielson, 2010; Mastropieri et al., 2011; National Council on Teacher Quality, 2015; Vernon-Dotson, Floyd, Dukes, & Darling, 2013).

A need exists to discover ways to better prepare co-teaching teams for this evolving classroom landscape to positively influence the outcomes for SWD in their classrooms, especially in mathematics (MetLife, 2011). As co-teaching is being used to provide students support in the LRE, teacher teams need PD in co-teaching, specifically in mathematics, to ensure all students, including SWD, are making progress. One way to provide direct and personalized PD to teacher teams is through using a coaching model. A potential model for just in time coaching of teacher teams is through the use of technology. In this study, the researcher explored the effects of participation of secondary co-teaching math teams in an online coaching model as PD to impact student learning outcomes, increase teacher collaboration, and finally to increase OTR. Figure 1 provides an overview of the theory of change used in this study to impact teams using online coaching for co-teaching as a PD model.

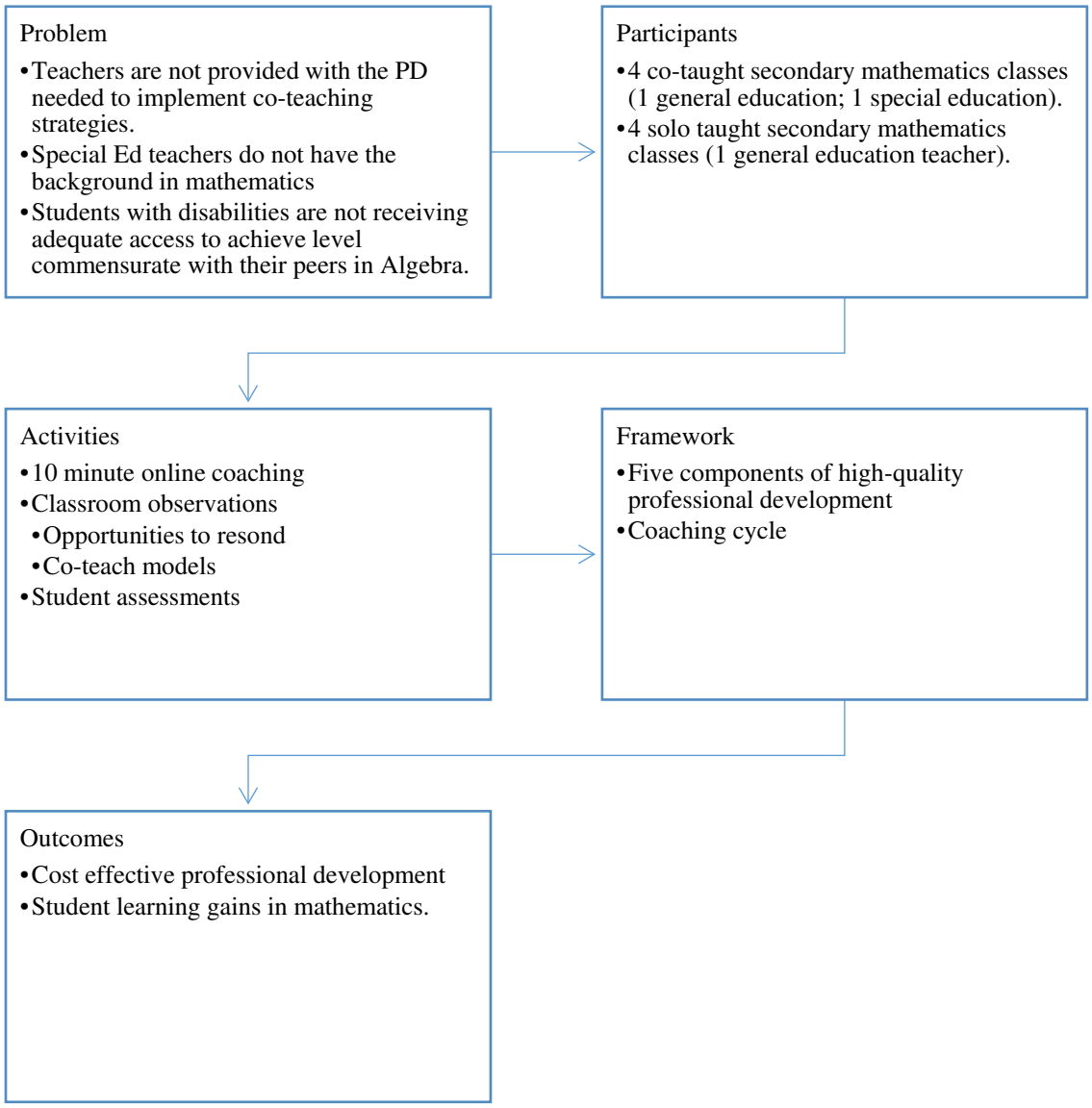

Figure 1. Theory of Change

Theoretical Framework

The framework for implementation of the online coaching model as PD in this study was modeled after the five characteristics identified as critical for high quality outcomes (Archibald et al., 2011; Croft et al., 2010; Joyce & Calhoun, 2010; Leko & Brownell, 2009). The five characteristics of high quality PD (see Figure 2) were

developed through research (Desimone et al., 2002; Garet et al., 2001) and the support of national organizations (e.g., National Staff Development Council, Council of Chief State School Officers). Each of these five characteristics is considered essential in the development and implementation of high quality PD, whether it be face-to-face or in an online model. These characteristics, when put into practice through a coaching model of PD, improve both teacher performance and student learning outcomes (Croft et al., 2010; Guskey, 2003; Sample McMeeking et al., 2012).

Figure 2. High quality professional development

Purpose

In this study, the researcher tested the effectiveness of an online coaching model as PD for secondary math co-teaching teams. The coaching focused on efficacy of the teams in delivering high quality co-teaching using evidence based practices (EBP) in math for SWD and ensuring student progress in algebra. Co-teaching teams received coaching twice a week, for ten minutes, over five weeks, via AdobeConnect. The PD provided targeted, individualized feedback to each team in coaching sessions by the researcher. Each co-teaching team at the beginning of the session reflected upon their prior week's lessons, discussed the upcoming day's lesson plans, and received advice and input on EBP for working with SWD in algebra. This study was built upon two previous pilot studies conducted to develop this online coaching model as effective PD for secondary co-teaching teams.

Pilot Studies

A case study was completed during the 2014-15 school year with one team of teachers to determine if a 10-minutes online coaching model could serve as a tool of PD for teachers who meet weekly online to discuss co-teaching practices. A team of high school co-teachers, both with over five years of experience teaching their individual subjects, was recruited to participate in the study. The team was new to co-teaching and only the special educator had specific training on the subject of co-teaching. Throughout

the school year, the team met with two researchers to discuss co-teaching practices in the classroom.

This case study resulted in several outcomes. The researchers noted that throughout the school year, the teachers sat closer together in the coaching sessions. At the beginning of the year the general educator spoke more often during the coaching session. However, as the year progressed, both teachers spoke an equal amount of time during the sessions. As the result of coaching as a model of PD student outcomes were measured. The researchers were provided with end of semester grade point averages (GPA) of all students in the co-taught class. Additionally, the general education teacher provided the researchers with the GPA of another class of students who were also taking English 10, but no co-teacher was present and no SWD were included in the class. When reviewing growth scores from semester one to semester two, the researchers found that students in the co-taught class did significantly better than the students in the solo-taught class. Leading the researchers to a conclusion, students who are provided instruction in a co-taught setting, while the teachers received coaching as a model of PD on their co-teaching practices, performed significantly better than those in the solo-taught setting.

The model created in this case study was then used with a pilot study in the spring of 2016 to validate the effectiveness of this intervention. A single-case, multiple-baseline across participant design study was conducted on teacher instructional practices using co-teaching. Following an initial meeting with the co-teaching teams to describe the study and provide their AdobeConnect login information, the researcher observed the classrooms remotely using a web camera provided to the team. Technology specialists at

each school site installed the web cameras and ensured proper usage. At the agreed upon time, the teams logged into AdobeConnect with the provided password. After establishing a connection with the researcher, the team would begin classroom instruction with the researcher observing remotely. The researcher disengaged the observation at the end of the class. Teaching teams were rated using a random selection of 10 consecutive minutes of instruction. To determine a start point, the researcher used a random number generator to select a number from 5-15. The teaching team was then evaluated on the following ten minutes and OTR was collected from this point. The individual teachers' total number of OTR was divided by the total OTR of both teachers and a percentage of OTR was calculated (see Figure 3). Baseline was achieved after a minimum of five observations of classroom instruction was completed and it was determined that the OTR showed stability.

$$OTR\ Special\ Ed\ Teacher + OTR\ General\ Ed\ Teacher = TotalOTR$$

$$\frac{OTRTeacher}{OTRTotal} * 100 = \%OTR$$

Figure 3. OTR Percentage Determination

The teaching teams began their coaching intervention after achieving baseline. The teams logged into AdobeConnect at the mutually agreed upon time with the researcher. After introductions, the team reflected for three minutes on the prior week. For the next five minutes, the team discussed the "big idea" for the coming week. The teams discussed how to use questioning and increase OTR in the classroom.

Additionally, the co-teaching models to be used in the class for the coming week were discussed. Finally, the last two minutes was spent concluding the session and providing the teachers with one key suggestion to be implemented into the classroom.

Observations continued for the teaching teams after the intervention was implemented for two or three times per week, dependent upon the teachers' schedules. To ensure fidelity of implementation of the intervention (U.S. Department of Education, 2016), an outside observer scored 33% of the sessions (n = 3) and specifically looked for (a) introduction of teachers, (b) review of prior week, (c) big idea for the coming week, (d) take-a-way provided, and (e) timing of the session (10-12 minutes). Intervention was completed with an acceptable fidelity of 86%.

Several findings emerged from this pilot study. First, when the teams were provided with online coaching as a model of PD, teacher teams moved from using only the one-lead/one-support model to other models of co-teaching except for one team. Teams gradually began using teaming, alternative teaching, and station teaching. Parallel teaching was not implemented by any of the teams. Additionally, the researcher found in the baseline condition, general education teachers provided more OTR than the special educators. After implementation, the difference between general and special educators diminished in two of three teams. Further, the researcher found while general educators led the majority of instruction in baseline, special educators began leading more instruction and were found at the front of the classroom more frequently once the online coaching began.

While this was an initial pilot study, and no student data were collected, the teachers were prompted during coaching sessions to discuss student performance. The teachers indicated the students were more engaged, attentive, and participatory in class after coaching began. Upon reflection of the intervention, teachers indicated they could implement the skills discussed in coaching in their classrooms, and they felt greater camaraderie with their teacher after the intervention. Additionally, after the study was completed, two of the three teams voluntarily continued online coaching sessions as they indicated it was a worthwhile activity for their continued PD.

Research Design

Building upon the work pilot work from the case study and single subject research, the current study used the lessons learned on creating effective online coaching as an effective model of PD with secondary algebra co-taught teams. The study was conducted using a quasi-experimental nonequivalent group design with pretest and posttest measures (Gall et al., 2007). Through use of this design, participants were not randomly assigned to experiment groups and both groups participated in a pre-test and post-test (Gall et al., 2007). This design is common in educational research as students are assigned into groups of classes and often have similar characteristics.

Research Questions

The researcher developed this study to address the following research questions (RQs):

RQ.1 Is there a statistically significant difference on how students in co-taught secondary math classes perform on progress monitoring assessments when teachers are provided with coaching related to co-teaching practices as compared to solo-taught high school algebra classes?

- Independent Variable – Ten-minute online co-teaching coaching sessions.
- Dependent Variable – STAR 360® math assessment
- Hypothesis – When teachers are provided the online coaching, students will have greater gains in co-taught high school algebra assessments than those students in solo taught algebra classrooms.

RQ.2 To what extent does an online coaching program impact co-teachers' use of multiple co-teaching models (e.g. one lead/one support, parallel teaching) as measured by 30 minutes of observation of content material using the CTS (see Figure 6) in co-taught high school algebra classes.

- Independent Variable – Ten-minute online co-teaching coaching sessions
- Dependent Variable – Partial interval recording of method of co-teaching (see Table 1) implemented by the team.

- Hypothesis – When teachers are provided with online coaching sessions, there will be more variance in the models of co-teaching utilized in the classroom.

RQ.3 To what extent does online coaching influence teachers' use of OTR in co-taught high school algebra classrooms in a 30-minute lesson using the Classroom Teaching Scan, Version 1.8.1 (CTS).

- Independent Variable – Ten-minute online co-teaching coaching sessions
- Dependent Variable – Change of OTR
- Hypothesis – When teachers in co-taught settings are provided the online coaching program, they will have more OTR than teachers who are in a solo-taught setting.

Power Analysis

Research on student progress in co-taught settings, specifically secondary mathematics, is lacking in the field. A search of academic databases for co-teaching, secondary mathematics or algebra, and student growth yielded less than 50 results. Hattie (2009) synthesized meta-analyses related to student learning and found 136 studies on co-teaching. Hattie discovered 47 studies in which researchers reported effect sizes. Within those studies only a small effect size ($d = .19$) was found in relation to student progress when in a co-taught classroom (Hattie, 2009).

For the purpose of this study, a power analysis was conducted to ensure the study would have an adequate sample size to allow for the detection of differences based on co-

taught and solo-taught classes and control for attrition. The researcher conducted an a priori power analysis for an analysis of variance (ANOVA) using G* Power 3.1 software (Faul, Erdfelder, Buchner, & Lang, 2009). A small effect size of 0.4 was applied in addition to an alpha level of 0.05, and a power level of 0.8. The effect size was intentionally higher than that of Hattie's research. The result indicated that 50 students were required for effective power.

Inclusionary Criteria

Co-teaching teams were recruited for this study through school district administrators. A district level administrator identified teams of teachers who would potentially participate in the study. Teams to participate were required to be: (a) a co-teaching team consisting of a general and a special educator, (b) teaching together a minimum of three days per week or per six-day cycle, (c) teaching students with and without disabilities at a preferred ratio of 1:3 special to general education students in the classroom, and (d) available a minimum of 10 minutes, two times per week, for planning purposes, to log into AdobeConnect together. Potential teams were excluded if they: (a) previously participated in online coaching with the researcher, (b) taught the same class less than 3 times per week or six-day cycle together, (c) did not have any common planning time, (d) had a team of a paraprofessional and general educator, or (e) identified that either teacher was uncertified.

For student participants, inclusionary criteria were designated as any child who is in a co-taught or solo-taught algebra classroom of the teaching teams or solo-taught class.

If a student missed either of the administrations of the pre or post assessment, the student's scores were not included in the analysis.

Participants

For this study, co-teaching teams consisted of two certified teachers; one general education and one special education. A convenience sample was utilized due to the need to select participant teams currently co-teaching. Participating teachers were expected to be teaching a 9th and 10th grade algebra or pre-algebra class with two or more SWD enrolled in the class. Additionally, the general education teacher selected also instructed a separate class of algebra or pre-algebra without a co-teacher (solo-taught). The teachers did not have to be dually certified in another subject area to participate in the study (e.g., special educator did not need to have a mathematics certification in addition to special education). Teams were selected only if the two teachers in the classroom were certified in their discipline and employed as teachers as opposed to a general educator and a paraprofessional working together in a secondary mathematics classroom.

Recruitment

Recruitment for this study was conducted through initial emails to a special education director in a moderate sized school district in southwestern Florida after IRB approval was given by the University of Central Florida Institutional Review Board (see Appendix C). The special education director identified which schools were currently

using a co-teach model where both teachers are responsible for classroom instruction. Four schools were identified as having both co-taught classes and solo-taught classes in algebra. Demographic information for each school is found in Table 2. Teaching teams were then approached by district and building administration to participate. Finally, initial emails from the researcher and dates to meet were scheduled. The researcher visited each school site to meet with the teams individually and building administrators to explain the study and to collect completed consent documents.

Table 2

School Demographics

		S1	S2	S3	S4
Grade		C	D	A	C
Total Students		1631	2022	1948	1552
Gender	Male	49.4%	51.1%	48.8%	53.2%
	Female	50.6%	48.9%	51.2%	46.8%
Ethnicity	White	48.7%	16.6%	59.8%	55.4%
	Hispanic	29.2%	57.5%	16.4%	35.8%
	Black	17.8%	23.1%	16.7%	5.2%
	Two or more	2.1%	1.9%	2.1%	2.3%
	Asian	1.9%	0.6%	5.0%	1.1%
	American Indian	**	**	**	**
	Pacific Islander	**	**	**	**
Disability	SWD	12.4%	13.5%	9.1%	13.7%
	Students without disabilities	87.6%	86.5%	90.9%	86.3%
Language Proficiency	ELL	9.4%	12.5%	1.5%	3.9%
	Non-ELL	90.6%	87.5%	98.5%	96.1%
Economically Diverse	Economically Disadvantaged	40.3%	60.7%	38.5%	41.2%
	Non-Economically Disadvantaged	59.7%	39.3%	61.5%	58.8%

Participant Assignment

Participants in the study were assigned to their respective groups based on the teaching structure (co-taught or solo taught) class. The common factor in both groups was the general education teacher.

Demographic Information

The following demographic information was gathered from teaching teams. This information included role, co-teacher, grade taught, number of years teaching, number of years co-teaching, gender, ethnicity, number of college credits earned in math, number of college credits earned in special education, type of bachelor's degree, master's degree, if applicable, type of licensure, and any previous PD in co-teaching (see Tables 3-8). Student data were reported to the researcher in the form of a spreadsheet provided to the teaching teams to maintain anonymity of students (see Table 9). Finally district demographics were compared to state demographics (see Table 10).

Table 3

Teacher Demographics

	School 1		School 2		School 3		School 4	
Role	SET	GET	SET	GET	SET	GET	SET	GET
Gender	F	M	F	F	M	F	F	F
Years Teaching	4-6	8-10	8-10	4-7	11+	11+	11+	0-3
Years Co-teaching	0-3	0-3	4-7	0-3	0-3	0-3	0-3	0-3
Credits in Math	3-9	16+	10-15	Less than 3	Less than 3	16+	3-9	Less than 3
Credits in SE	3-9	3-9	16+	Less than 3	16+	16+	16+	Less than 3
Adv Degree	No	Yes	Yes	No	No	Yes	No	No
Co-teaching PD	4-6	4-6	1-3	1-3	4-6	4-6	1-3	1-3

Table 4

Student Demographic Information

	School 1		School 2		School 3		School 4	
	S1 CT	S1 ST	S2 CT	S2 ST	S3 CT	S3 ST	S4 CT	S4 ST
Course	PA	PA	PA	PA	A1	A1	PA	PA
Total Students	29	29	24	16	22	24	28	26
Male	16	22	16	7	16	18	18	13
Female	13	7	8	9	6	6	10	13
SWD	2	4	6	2	6	3	9	11
ELL	20	25	3	5	1	2	4	2
White	3	5	1	3	5	3	23	17
Black	6	9	9	1	9	15	2	2
Hispanic	17	13	14	12	6	6	10	7
Asian	1	0	0	0	0	0	0	0
Other	1	0	0	1	0	0	0	0
9th grade	21	28	19	3	18	22	27	24
10th grade	6	1	4	13	3	2	1	2
11th grade	2	0	1	0	0	0	0	0
Level 1	10	14	15	5	10	10	8	15
Level 2	7	5	6	1	5	7	11	5
Level 3	2	0	3	0	6	6	5	4
Level 4	0	0	0	0	0	1	0	2
No Level	10	10	0	10	0	0	4	0

Note. Pre-Algebra (PA); Algebra (A1); Co-taught (CT); Solo-taught (ST)

Table 5

State to District Comparison

	State	District
Total Students	2816824	92,686
Male	51.3%	51.6%
Female	48.7%	48.4%
White	38.7%	41.0%
Hispanic	32.4%	39.7%
Black	22.3%	14.6%
Two or more races	3.4%	2.7%
Asian	2.7%	1.7%
Total Students	2816824	92,686
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Hispanic	32.4%	39.7%
Black	22.3%	14.6%
Two or more races	3.4%	2.7%
Asian	2.7%	1.7%

Consent Process

All teacher participants in the study were over the age of 18, therefore, each participant was provided a consent form (see Appendix D) approved by the University of Central Florida (UCF) Institutional Review Board (IRB). All demographic information and assessment scores were provided by the teaching teams; therefore, a consent form was not required for student participation per the UCF IRB; however, the school district required consent from parents or guardians to release student data (see Appendix E). Student data were cleansed of all identifying information before being provided to the researcher.

Setting

Two different settings were utilized for this study. The first setting, used for the coaching intervention sessions, was the AdobeConnect environment (see Figure 4). To access AdobeConnect, teams utilized a computer equipped with an internal camera and microphone. During an initial meeting, teams received a specific hyperlink for their coaching along with systematic instructions for accessing AdobeConnect (see Appendix F). Teaching teams specified two 15-minute blocks of time during which they would participate in coaching with the researcher. An additional 5 minutes were included in the coaching blocks to address any technical issues in audio or video. All sessions were recorded as a means to determine the level of fidelity with which the coaching was administered.

The second setting was the classrooms of all teaching teams involved in the study. Four different high schools were utilized for the study. All classroom observations were completed in the classroom of the general education teacher. To complete the observations the researcher utilized a SWIVL™ and an iPhone™ or Microsoft Surface™ device. The SWIVL™ (see Figure 5) device included a base, or robot, an infrared audio recording device, and a separate video recording device (e.g. Microsoft Surface™, iPhone, iPad). The infrared device was hung around the neck of the person being observed. When the recording began, the robot base, with the video recording device attached, moves (swivels) to follow the sound of the observed teacher. The infrared

device picked up the teacher's voice to allow the observer a clear audio recording. Thirty minutes of instruction were recorded and subsequently analyzed.

Figure 4. AdobeConnect Session

Instruments

STAR360® Assessment

The STAR360® assessment was used in the study to determine student growth pre and post coaching sessions. Renaissance Learning™ developed this progress monitoring assessment and linked it directly to the Florida State Achievement (FSA) test (Renaissance Learning, 2016). Correlation studies between the STAR360® assessment and the FSA in mathematics indicated an average 0.79 to 0.81 correlation. The

assessment, given four times during the school year, monitors a student's progress on components of the FSA administered in the late spring of each school year. The STAR360® assessment has been recognized by the National Center on Intensive Intervention as highly rated for progress monitoring. Further, the STAR360® assessment received the highest possible ratings for screening and progress monitoring from the National Center on Response to Intervention (Renaissance Learning, 2016). The participating school district provided the researcher with student assessment results for the third and fourth quarter administrations of the school year. As the research began shortly after the administration of the third assessment, the researcher analyzed student growth from the third to fourth administrations to determine if students in co-taught classes made more progress than students in solo-taught classes.

Observation components

Teachers were observed at the beginning and the end of the study in their respective classrooms by the researcher with a SWIVL™ and a Microsoft Surface or iPhone recording device. Two components of instruction were observed; student OTR and type of co-teaching models used. Opportunities to respond (OTR) was operationally defined as incidences where a question is asked to an individual student or a group of students to elicit a response (Council for Exceptional Children, 1987; Ferkis et al., 1997). The Council for Exceptional Children (1987) indicated that OTR should be given at a rate of 9-12 per minute. For the purposes of this study, the researcher recorded the number of

OTR given by each teacher in the co-teaching team. The number of OTR for both the general and special education teacher was recorded using the CT Scan (see Figure 6).

Descriptive data were collected on the type of co-teaching models (see Table 1) used in the classroom. Teacher teams were provided with information and implementation techniques for each of the co-teaching models during coaching sessions.

Figure 5. SWIVL™ Robot

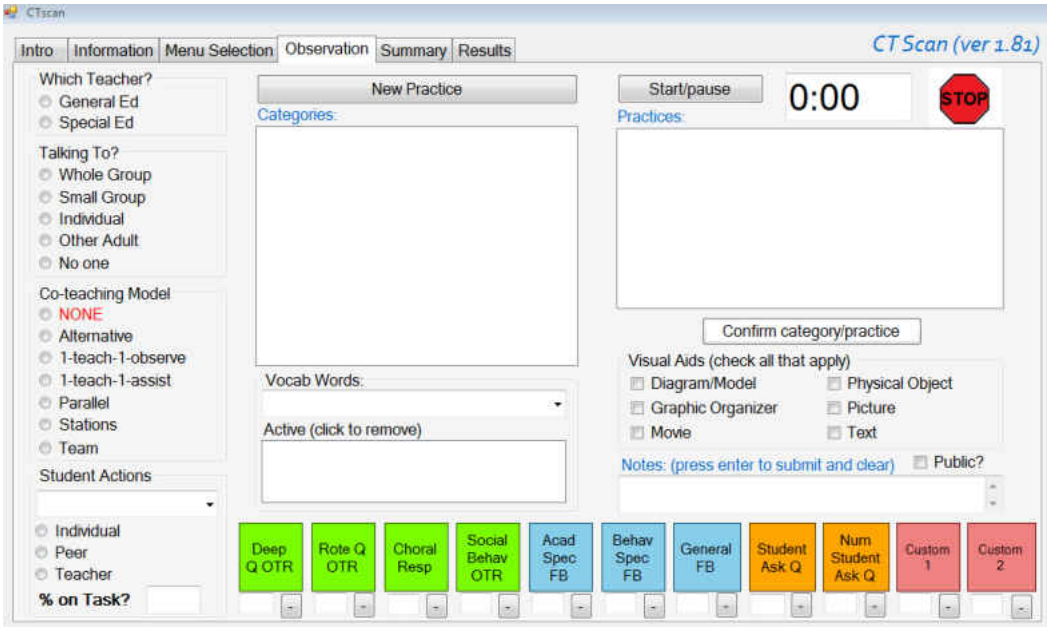


Figure 6. CTS Dashboard

Social Validity Questionnaire

The researcher used the Colorado Assessment of Co-teaching (Co-ACT) to determine social validity. The Co-ACT (Adams, Cessna, & Friend, 1993) is a 42-question inventory comprised of 5-point Likert scale items. This assessment is used to measure critical components of effective general and special education co-teaching and the respondent's preparedness to implement the strategies. The reliability and validity of the Co-ACT was established in a research project with the Colorado State Department of Education (Adams et al., 1993). The instrument is used to assess preparedness and perceptions of co-teaching (Pearl, Dieker, & Kirkpatrick, 2012). For purposes of this study, the Co-ACT was administered to each participant to determine levels of comfort with different aspects of co-teaching and subsequently to determine if this level changed

after the intervention. Team members completed the Co-ACT through a Qualtrics survey independent of their co-teacher (see Appendix G and H). Permission to use the Co-ACT was provided by Dr. Marilyn Friend (see Appendix I).

Procedures

The researcher conducted this study over five weeks during the last quarter of the school year. An initial meeting was held individually with each set of teachers and an administrator of the school. During this initial meeting, the teachers and administrator was provided specifics of the study. The researcher described the initial pilot studies that were completed that led to the current study. A further description of information collected during the observations was included. Finally, the researcher created a coaching schedule and observation dates were determined. Questions were gathered from both the teachers and administrators and consent forms were provided.

Two observations, pre- and post- coaching were conducted by the researcher in person and the observations were recorded for Interobserver agreement. Due to time and resources, a midpoint observation was not completed. The observations were thirty-minutes long. This selection of time was determined based on the prior pilot study and additionally to collect data during a part of the class where both teachers were present and instruction on core content was taking place to ensure the ability to observe both the types of co-teaching and the rate of OTR during core instruction. The researcher did not collect observation data during the beginning or end of the class due to teachers generally taking attendance or wrapping up the class. The researcher additionally observed the

same thirty-minutes of time when the general education teacher was teaching individually to a solo-taught class. Data collected included OTR and type of co-teaching models used. An interim observation between pre and post observations was not included in the study due to the length of time of the study and resources available.

The intervention of coaching occurred for the teams after the initial observation but prior to the last observations (see Figure 7). Teams received ten coaching sessions, two per week, for five weeks. The coaching consisted of a cycle of coaching, reflection, and feedback (Joyce & Showers, 1980, 1982; Knight et al., 2015; Ploessl & Rock, 2014). This cycle of coaching is well documented in the literature as an effective way of coaching teachers using immediate feedback to improve practice in the classroom (Ploessl & Rock, 2014; Rock, Gregg, Thead, et al., 2009, 2009; Scheeler, Macluckie, et al., 2010; Scheeler et al., 2006, 2004).

At the beginning of each coaching session, the team reflected on the previous lessons. The researcher coached the team through a discussion on instruction, type of co-teaching models used, differentiation, and student learning gains. Next, the teaching team received coaching on the next lesson. The researcher led the team through a conversation on the objectives and ways to differentiate instruction and co-teaching models to use. Finally, the team received feedback on the previous lesson and suggestions for future use. The cycle continued in the next coaching session starting with reflection on the previous lesson. Due to the limited time of the coaching session, the amount of time devoted to feedback was limited to only 2-3 minutes. The researcher followed a checklist to ensure fidelity of implementation (see Appendix B). However,

teaching teams received individualized coaching; therefore, some variance from the script took place to address immediate needs in the classroom (e.g. final exams, student behavior, and classroom management).

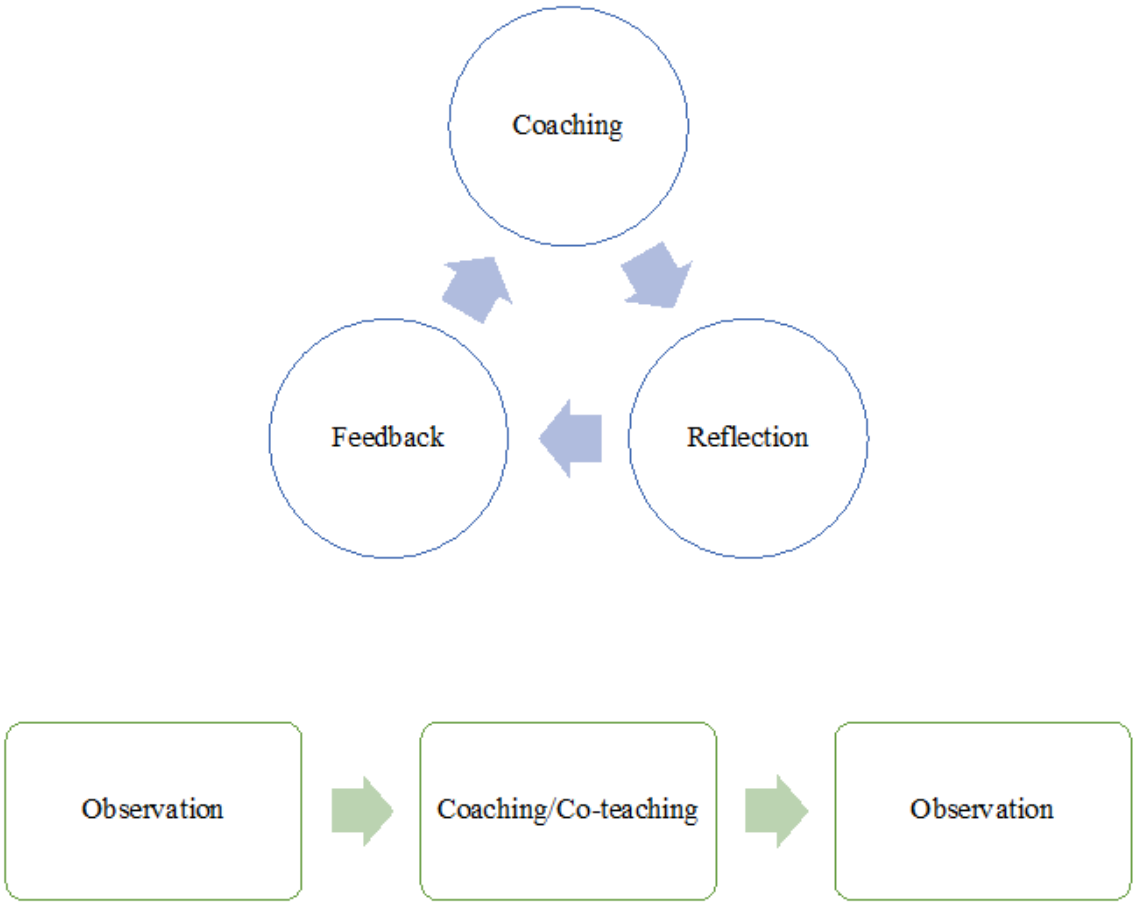


Figure 7. Ten-minute online coaching

Finally, general education teacher provided student data to the researcher at the beginning and end of the study. Data collected included student level STAR360®

percentile rankings and demographic student data (e.g. gender, race, disability status). All data were cleansed of any identifying information to maintain anonymity of students. The researcher subsequently calculated a gain score from the pre to post test. Any student who missed one or both assessments was removed from the composite data set. However, absentee rates of students were not collected.

Research Timeline

A research timeline can be found in Appendix J. This timeline was developed based on several variables including: (a) prior research conducted in this area including pilot study, (b) ability to gather student data as close to the beginning of the quarter as possible to mitigate the threat of maturity (Gall et al., 2007), and (c) ability to accommodate schedules of teachers and students. This research was implemented over 5 weeks beginning at the start of the final quarter of the school year.

Research Fidelity

Implementation protocols were developed for all components of the study for the researcher and data collectors to implement the intervention with fidelity. The researcher followed a schedule for each of the coaching sessions (see Appendix K). Additionally, a fidelity checklist (see Appendix A) was followed for each coaching session. An outside observer reviewed 33% of coaching sessions to ensure fidelity of implementation. The checklist included a line for each item. The rater indicated a one for implementation of

the item or a zero if not implemented. A total score was calculated for each selected intervention by adding up the total number of "1's" divided by the total number of ratings (combination of 1's and 0's). A percentage of 85% was considered implementation of intervention to fidelity (Gall et al., 2007). Potential threats to validity and safeguards were put into place to address any threats and this list can be found in Table 11.

Table 6

Threats to Validity and Safeguards

Potential Threat	Safeguard
Use of convenience sample	The use of a convenience sample could potentially cause lack of generalizability to teachers in other areas (Gall et al., 2007).
Previous coaching or PD on co-teaching	Teaching teams may have prior experience with PD on co-teaching which can act as a mediator or moderated during the coaching program. Demographic information indicating the amount of prior coaching or PD was collected. If a team was part of the pilot study, the team was unable to participate.
Student test scores	This study took place in multiple schools in a school district of over 200,000 students. Students embedded within the classroom may have more experience with algebra than other students. A gain score was calculated instead of using the actual pre-and posttest scores, allowing for student growth to be measured.
Hawthorne effect	Due to the novelty of the coaching, there is the possibility of teams having inflated observation scores (Gall et al., 2007). To control for this, the researcher compared scores between a treatment and a control group.
Observer bias	There is the possibility the observer showed bias towards teaching teams (Gall et al., 2007). To control for this potential bias, interobservers were trained and a fidelity checklist was implemented. Additionally, all data were collected during the same timeframe.

Data Collection

Data were collected at multiple points during the study. An overview of data collected to address each research question is found in Table 7. Student level data were collected for all students in the co-taught and solo-taught classes. Data included demographic information (e.g. race, gender, disability status) and STAR360® scores from the third and fourth quarter administrations. A growth score was calculated for each student, and these scores were used in data analyses. Students not present for one or both administrations were removed from the sample.

Observational data were collected and focused on two areas. These areas included the number of OTR per teacher and the co-teaching models used. To aid in the collection of these targeted areas, the CTS (Kennedy et al., 2017) was used (see Figure 6). The tool provides the ability for the researcher to gather numerous data points. For the purposes of this study, the researcher only collected OTR and type of co-teaching models used. All observations were recorded using a Microsoft Surface or iPhone and a SWIVL™ robot for reliability and to allow for interobserver agreement.

The researcher collected teacher Co-ACT (Adams et al., 1993) scores at the beginning and end of the study. The Co-ACT scores were used to determine teachers' preparedness for co-teaching and social validity along with additional questions (see Appendix J). Finally demographic data were collected on each teacher participant in the study.

Table 7

Data Collection Objectives, Timelines, and Tools

	Research Question 1	Research Question 2	Research Question 3	Social Validity
Information	• OTR count for each teacher • Total OTR calculated	• Co-teaching models used	• STAR360® Score	• Demographic Information (teacher and student level) • Co-Act
Timeline	• Prior to week 1 • After week 5	• Prior to week 1 • After week 5	• Third and Fourth quarter	• Prior to week 1 • After week 5
Means of collection	• Classroom Observation • CTS	• Classroom observation • CTS	• Provided to researcher from teachers	• Qualtrics survey

Data Management

All data were stored according to UCF IRB requirements. Video recordings of intervention sessions and observation sessions were stored on a password protected AdobeConnect account. Survey data were stored in a password protected Qualtrics account. Student data were stored in a locked cabinet with access by only the researcher and research assistant.

Interobserver Agreement

Interobserver agreement was calculated for all aspects of the study. After training a research assistant, observations were evaluated by the researcher and an assistant. Thirty-three percent of the observations were evaluated independently by the research assistant (U.S. Department of Education, 2016). Opportunities to respond and type of co-teaching method used were collected using the CTS. The observation data were compared to the researcher data and a percentage of agreement was calculated using total agreement (number of responses-number of disagreements)/total number of items (Gast, 2010). Student assessments were scored by the software provided by Renaissance Learning.

Data Analyses

Each research question was analyzed using SPSS (IBM Corp., 2016). Data were analyzed at the end of the intervention. Data were inputted into SPSS by the researcher and was checked for accuracy by a research assistant to ensure research fidelity.

Research question one was analyzed using ANOVA to determine student growth from pre to post intervention. An ANOVA was used because one dependent variable of the type of class (co-taught or solo-taught) that students received their instruction was gathered. The researcher was interested in analyzing the differences in change scores between solo and co-taught class settings.

Research question two was analyzed using descriptive data procedures. This question was framed by reporting what method of co-teaching was being used by teams as well as how often it was used. A frequency count of types of co-teaching models was recorded over the observation periods is provided.

Finally, the researcher used a descriptive t-test to analyze research question three. This analysis is appropriate, as the small sample size limited a priori power to calculate an ANOVA (Faul et al., 2009). The t-test allowed the researcher to determine if there was a change between two different means. For the purposes of this study the change score from pre-observation to post-observation and a comparison between co-taught and solo-taught classes per school were the variables used.

CHAPTER FOUR: RESULTS

Overview of Data Analysis

The purpose of this study was to determine if an online coaching intervention effected co-teaching teams in terms of student performance in algebra classrooms, co-teaching models used, and opportunities to respond. The results of each research question and analysis are included in this chapter. The researcher developed this study to address the following research questions (RQs):

RQ.1 Is there a statistically significant difference on how students in co-taught algebra classes perform on progress monitoring assessments when teachers are provided with PD related to co-teaching practices as compared to solo taught high school algebra classes?

- Independent Variable – Ten-minute online co-teaching coaching sessions.
- Dependent Variable – STAR 360® math assessment
- Hypothesis – When teachers are provided the online coaching, students will have greater gains in co-taught high school algebra assessments than those students in solo taught algebra classrooms.

RQ.2 To what extent does an online coaching program impact co-teachers' use of multiple co-teaching models (e.g. one lead/one support, parallel teaching) as measured by 30 minutes of observation of content material using the CTS (see Figure 6) in co-taught high school algebra classes.

- Independent Variable – Ten-minute online co-teaching coaching sessions

- Dependent Variable – Partial interval recording of method of co-teaching (see Table 1) implemented by the team.
- Hypothesis – When teachers are provided with online coaching sessions, there will be more variance in the models of co-teaching utilized in the classroom.

RQ.3 To what extent does online coaching influence teachers' use of OTR in co-taught high school algebra classrooms in a 30-minute lesson using the Classroom Teaching Scan, Version 1.8.1 (CTS).

- Independent Variable – Ten-minute online co-teaching coaching sessions
- Dependent Variable – Change in OTR
- Hypothesis – When teachers in co-taught settings are provided the online coaching program they will have more OTR than teachers who are in a solo taught setting.

Data Analysis

Research question one was evaluated to determine if a statistically significant difference existed in student assessment scores between co-taught and solo-taught classrooms. The researcher calculated a change score of student STAR360® percentile scores and then calculated an ANOVA to compare the solo and co-taught classes.

To answer research question two, the researcher evaluated only the co-taught classrooms. During the initial 30-minute observations, the researcher noted the co-teaching models used in each classroom (see table 1). A second observation occurred

after coaching was completed. With the exception of one team, co-teaching teams used different models of co-teaching in their final observations.

Research question three was posed to determine if, when teachers are afforded the opportunity to have online coaching in relation to co-teaching models and OTR, does the co-teaching team provides more OTR in the classroom. The underlying theory fueling this question is when students are afforded more OTR they do better academically (MacSuga-Gage & Simonsen, 2015; McKenna et al., 2015; Sweigart & Landrum, 2015a; Zaslofsky et al., 2016). The researcher recorded a frequency count of the number of OTR offered in solo-taught and co-taught classes during an initial observation of 30 minutes of instruction prior to the beginning of the intervention. Observational data were compared to an observation completed after the intervention. An independent t-test was used to compare the difference in OTR from pre to post observations in both solo and co-taught classes by school.

Demographic Information

Demographic information was collected for each of the schools and each individual co-taught classroom. Additionally, information was collected on the school district and the comparison to the state. Based on the data collected, the district was similar to the state results. Considering the demographic information of the student sample, the schools were different in a few ways. In particular, there was only one A level school with the remainder of schools scoring a C or D. The state rates a school based on several factors including student assessment data, graduation rates, and teacher

evaluations. A school is designated a "title 1" school based on student demographics and family income level. Title 1 schools receive more funding than those not designated Title 1 because the population of students from a low socioeconomic status is higher. All schools, with the exception of one, had fewer- than 10% of students designated as English Learners (EL). School 2 had a percentage of EL students over 10%. Students with disabilities accounted for approximately 10% to 15% of the population in the schools in this study.

Instrumentation

The research questions were evaluated using one of two instruments. Research question one was measured using the STAR 360®. Teachers in the study administered the assessment during class periods. The assessment, which takes approximately 15 minutes to complete, is administered by computer or iPad. Students take the assessment at four points during the school year. For purposes of this study, student growth measures were calculated from the third to fourth administration as the teachers received the study intervention during that period of time.

The Classroom Teaching Scan (Kennedy et al., 2017) was used to determine the OTR and co-teaching models and to answer research questions two and three. The CTS allowed the researcher to complete a frequency count of OTR by the general and the special educators in the classroom. Additionally, the CTS was used to record the co-teaching models used by the teams during the classroom observations.

Overall Data Analyses

Research Question 1

Research question one explored student progress in co-taught and solo-taught classes. To measure student progress, the researcher used the STAR360® assessment. The STAR360® is a progress monitoring assessment and aligns with the end of year assessments taken by students in the state where the research was completed. The participant teams provided student standard scores for each administration. If student participants did not participate in either pre or post assessment, the students' scores were removed from the data set (n = 10).

The researcher conducted a one-way ANOVA to examine differences in gain scores between co-taught and solo-taught classrooms. Participants were placed into two groups based on their classroom setting: co-taught (n = 80) and solo-taught (n = 70). Data were normally distributed for each group (see Table 8), as assessed by Shapiro-Wilk test ($p > .05$); and homogeneity of variances was established (see Table 9), as assessed by Levene's test of homogeneity of variances ($p = .058$). Data are presented as mean ± standard deviation. Student gain scores (see Table 10) in co-taught classes (M = 8.262, SD = 16.12) were higher than those found in solo-taught classes (M = -6.0286, SD = 19.25). Co-taught classes had a statistically significantly (see Table 11) higher gain score than solo-taught classes, F (1, 148) = 24.469, $p < .005$. The results of the analysis indicate a moderate effect size, $\eta^2 = .142$, with significant power, $\beta = .998$ (Cohen, 1988). Two outliers were found as assessed by boxplot.

These outliers were included in the data as they did not change the output result when compared to removing them from the data set.

Table 8

Test of Normality

	Type of Instruction	Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
CHG_SCR	CT	.107	80	.024	.973	80	.092
	ST	.111	70	.031	.973	70	.141

a. Lilliefors Significance Correction

Table 9

Levene's test of equality of error variances

F	df1	df2	Sig.
3.652	1	148	.058

a. Design: Intercept + INST

Table 10

Descriptive Statistics

Type of Instruction	Mean	Std. Deviation	N
CT	8.2625	16.12667	80
ST	-6.0286	19.25118	70
Total	1.5933	18.99173	150

Table 11

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	7624.763[a]	1	7624.763	24.469	.000	.142	24.469	.998
Intercept	186.310	1	186.310	.598	.441	.004	.598	.120
INST	7624.763	1	7624.763	24.469	.000	.142	24.469	.998
Error	46117.430	148	311.604					
Total	54123.000	150						
Corrected Total	53742.193	149						

a. R Squared = .142 (Adjusted R Squared = .136)

b. Computed using alpha =

Research Question 2

For research question two, the researcher evaluated the co-teaching models that were used in the co-taught settings. Data were collected during the first observation prior to the teachers beginning the intervention and at the end of the study after teachers received their 10 coaching sessions. Results of the data are found in Table 12.

Table 12

Co-teach Models Used

Team	Observation 1	Observation 2
T1	One Lead/One Support	Team
T2	One Lead/One Support	Stations One Lead/One Support
T3	One Lead/One Support	Team
T4	One Lead/One Support	One Lead/One Support

During the initial observations, all teams utilized the one lead/one support model exclusively. In every class observed, the general education teacher was leading the instruction, at the front of the classroom, with the special education teacher roaming around the classroom and checking in with students, providing behavioral interventions, and providing academic interventions. One exception was in T2 the special educator brought two students to the back of the room to complete missed work during the pre-observation. In T1's class, an additional adult was present who served as the paraprofessional (classroom assistant) to one student. The special educator did need to provide additional assistance to this student as well, but the paraprofessional was not involved in a co-teaching role.

During the second observation, after the teams completed their coaching, two additional co-teaching models were observed. Team one engaged in team teaching during the post observation. Each of the teachers in T1 rotated throughout the classroom, checking in with students with and without disabilities as the students completed an

activity. Teachers discussed student progress at multiple times during the observation to ensure that all students understood the activity.

Team two engaged in two models of co-teaching during their post observation, namely one lead/one support and station teaching. The class began with one lead/one support with the general educator reviewing bell work and instructions and expectations for the stations. Due to behavioral concerns in the class, the students remained in their seats as the teachers rotated themselves through the stations. Students were in heterogeneous groups selected by the teachers and lasted fifteen minutes.

Team three employed two different models of co-teaching during their two observations. During the first observation, the teachers engaged in a one lead/one support model. Each teacher provided students with strategies that could be utilized during the lesson. The second observation of T4 included the students working in small groups around the class assigned by the general and special educator. As students worked on their projects, the general and special educators rotated throughout the classroom. Students were in heterogeneous groups and the teachers met five times during the observed lesson to discuss student progress.

Team four did not change their model of co-teaching between their first and second observations. The teachers engaged in the one lead/one support model of co-teaching with the general educator at the front of the room lecturing to students while the special educator rotated through the classroom providing primarily behavioral support. The special educator interjected questions to the general education teacher during the observation.

Research Question 3

To answer research question three, the researcher observed 8 classes and did a frequency count of the number of OTR elicited by both the general and special education teachers and calculated a total score. The researcher's frequency counts were obtained from video recordings made using both the SWIVL™ and iPhone™ technology to record all 8 solo and co-taught classes. While observing the videos, the researcher used the CTS to record the OTR and to calculate the total OTR occurring in a 30-minute segment of a lesson pre and post the online coaching. The 30-minute segment observed began after the initial beginning of the class activities were completed and direct instruction by the teacher(s) began.

An independent samples t-test was calculated to determine if differences existed in OTR change score from pre to post observation between solo (n = 4) and co-taught (n = 4) classes. Differences in OTR for each group were normally distributed (see Table 14) as assessed by Shaprio-Wilk's test ($p > .05$) and no outliers were found in the data set as assessed by inspection of a boxplot. In both the co-taught and solo-taught algebra classrooms, the mean OTR decreased during the post-observation, which occurred near the end of the school year. The co-taught classes (see Table 15), had fewer OTR (M = -27.00, S = 67.176) than solo-taught classes (M = -23.00, SD = -23.00). There was homogeneity of variances as assessed by Levene's test for equality of variances (p = .488). Solo-taught class OTR was 4.00, 95% CI [-96.6907 to 104.690] higher than co-taught OTR. There was not a statistically significant difference in mean OTR change scores between co-taught and solo-taught classes, t (6) = .545, p = .926 (see Table 16).

This difference in OTR could be due to a variety of influences including time of year, lack of time to plan outside of the coaching, type of instruction occurring (e.g. Direct instruction, group work, guided practice), or students participating in group work where, instead of teacher OTR, student-to-student OTR was occurring.

Table 13

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Setting	Statistic	df	Sig.	Statistic	df	Sig.
OTR_Dif	Solo-taught	.216	4	.	.977	4	.882
	Co-taught	.350	4	.	.832	4	.173

a. Lilliefors Significance Correction

Table 14

Group Statistics

	Setting	N	Mean	Std. Deviation	Std. Error Mean
OTR_Dif	Solo-taught	4	-23.0000	47.54647	23.77323
	Co-taught	4	-27.0000	67.17638	33.58819

Table 15

Independent Samples T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					
								95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
OTR_Dif	Equal variances assumed	.545	.488	.097	6	.926	4.00000	41.15013	-96.69074	104.69074
	Equal variances not assumed			.097	5.40	.926	4.00000	41.15013	-99.45140	107.45140

As the researcher compiled the data for analysis, it became evident that further analyses were needed to depict a true description of the changes that occurred from the coaching intervention. Therefore, the researcher conducted an observation summary for each school. Observations were divided into six equal segments of five minutes each. Next, a further review of the observation videos was completed to determine what type of instruction was occurring during the segment (e.g. direct instruction, guided practice, independent practice, and group work). The researcher conducted independent t-tests for each school to determine if variance existed in OTR. The researcher also noted the student change scores for the solo and co-taught classes by school (see tables 16-19).

Observation Summary

Table 16

School 1(S1)

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Total	St Growth
Change CT	-6	-10	-3	-2	2	8	-11	3.42
Change ST	-5	1	-7	-2	-4	-3	-20	2.2667
Significance							**0.603**	
Pre Inst CT	GP	IP	GP	GP	GP	GP		
Pre Inst ST	DI	GP	IP	GP	GP	GP		
Post Inst CT	GW	GW	GW	GW	GW	GW		
Post Inst ST	DI	GW	GW	GW	GW	GW		
Pre co-teach	OLOS	OLOS	OLOS	OLOS	OLOS	OLOS		
Post co-teach	Team	Team	Team	Team	Team	Team		

In S1, the teachers moved from a model that was primarily guided practice and direct instruction in the pre-observation to more group work following guided practice. The co-teaching model used was one lead/one support. However, in post-observation, the team moved to a team teaching model. While the OTR did not yield a statistically significant change, students in the co-taught class had a higher average change score than those in the solo taught class. Additionally, the researcher notes that students were more engaged across both classes in the post-observation and the students, while completing group work (see Appendix J) had multiple opportunities for OTR with peers, but not directly with the co-teachers at a higher rate.

Table 17

School 2 (S2)

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Total	St Growth
Change CT	3	1	-2	12	12	2	28	12.026
Change ST	-17	-30	-17	-7	0	-8	-79	-.3000
Significance							**0.005**	
Pre Inst CT	GP	GP	GP	GP	IP	GP		
Pre Inst ST	GP	GP	GP	GP	GP	GP		
Post Inst CT	DI	GP	GQ	GW	GW	GW		
Post Inst ST	DI	GP	GP	GP	GP	GW		
Pre co-teach	OLOS	OLOS	OLOS	OLOS	OLOS	OLOS		
Post co-teach	OLOS	OLOS	ST	ST	ST	ST		

School two presented several changes in their performance including a statistically significant change in OTR for the co-taught class. The co-teaching team changed their practice from the pre to post observations by implementing the station teaching (ST) model of co-teaching and moving to more group work within the stations. The teachers noted there were challenges with having students move during stations. Thus, they modified their teaching to have teachers move to different stations as opposed to students moving. Additionally, the teachers provided additional OTR by allowing students to work in teams and therefore allowing for OTR from peer to peer, but only teacher OTR was included in the count in this study.

Table 18

School 3(S3)

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Total	St Growth
Change CT	19	1	-3	5	-9	-6	7	13.080
Change ST	17	0	5	-2	14	0	34	-14.720
Significance							**0.411**	
Pre Inst CT	GP	GP	GP	GP	IP	IP		
Pre Inst ST	IP	IP	GP	GW	DI	DI		
Post Inst CT	GW	GW	GW	GW	GW	GW		
Post Inst ST	GP	GP	IP	IP	GP	GP		
Pre co-teach	OLOS	OLOS	OLOS	OLOS	OLOS	OLOS		
Post co-teach	Team	Team	Team	Team	Team	Team		

School three (S3), much like S2, had multiple changes that occurred from the pre to post observations. The teacher team moved from a model of one lead/one support (OLOS) exclusively to team teaching. The students in the co-taught class were engaged and it was difficult for the researcher to gather every OTR due to the inquisitive talk that was occurring in the post observation. One difference that was noted in this observation that was not evident in other schools was the special education teacher taking more of a lead in instruction during pre-observations. However, even with this additional support of the special education teacher, the solo-taught class had more OTR than the co-taught class. Student growth was notably different between the solo and co-taught classes with students in co-taught classes outperforming those in solo-taught classes.

Table 19

School 4

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Total	St Growth
Change CT	-16	-26	-12	-36	-31	-3	-124	.8421
Change ST	0	-7	-13	1	-1	-9	-29	-4.250
Significance							**0.018**	
Pre Inst CT	IP	IP	IP	GP	GP	GP		
Pre Inst ST	GP	IP	GP	GP	IP	GP		
Post Inst CT	DI	DI	DI	DI	DI	DI		
Post Inst ST	DI	DI	DI	GP	GP	IP		
Pre co-teach	OLOS	OLOS	OLOS	OLOS	OLOS	OLOS		
Post co-teach	OLOS	OLOS	OLOS	OLOS	OLOS	OLOS		

The team in S4 had more challenges than the other co-teaching teams. The team never moved from a one lead/one support model of co-teaching and additionally, much of the instruction was direct instruction (DI). The result of the t-test indicated a statistically significant difference in change score that showed variance in the reverse direction of the research question with the change score of OTR decreasing by 124 in the co-taught class and by only 29 in the solo-taught class. There were slight changes noted in student growth with the mean change score in the co-taught class being higher than the solo-taught class.

This further breakdown of observations allowed the researcher to gather more information of what was happening in each classroom as well as which models of both co-teaching and type of instruction lend themselves to greater OTR. Additionally, the

factor of peer to peer OTR was lost in the analysis. However, by breaking the observations down by segments, it became plausible that when teachers and students were engaging in more group work (i.e. teaming and station teaching) student OTR was positively affected, but these gains were not possible to analyze in this study as student groups were not audio recorded.

Interobserver Agreement for Data Collection

Interobserver agreement of data collection was completed by a research assistant. The researcher and assistant watched one observation together to compare counts of OTR and co-teach models. After 90% agreement, using point-by-point total agreement (House, House, & Campbell, 1981), was obtained, the research assistant coded four additional observations (33% of observations) independently and compared results with the researcher. Observations were consistent with 85% accuracy, which is considered by House et al. (1981) as an adequate measure of agreement.

Fidelity of Procedures

A checklist was used to ensure for fidelity of implementation of the online coaching (see Appendix A). The research assistant reviewed 33% of randomly chosen coaching sessions. After completing the fidelity checklist, it was determined 87 % of sessions were implemented to fidelity.

Social Validity

At the end of the final observation, teachers individually completed the Co-ACT (Adams et al., 1993) and answered questions regarding the goals, procedures, and effects of the coaching (Wolf, 1978). Teachers reported the intervention met goals, procedures, and effects during the course of the intervention. Additional time to implement strategies was noted as an area lacking in the study.

Teacher participants were asked a variety of questions to determine if the intervention was valuable on an individual level. Teachers reported favorably to the use of the intervention. Teachers (n = 6) agreed they had adequate time to incorporate strategies (see Table 20).

Table 20

Time to Incorporate Strategies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	1	12.5	12.5	12.5
	Somewhat agree	5	62.5	62.5	75.0
	Neither agree nor disagree	1	12.5	12.5	87.5
	Somewhat disagree	1	12.5	12.5	100.0
	Total	8	100.0	100.0	

Teachers were also asked to reflect on the coaching as a valuable use of time. Most teachers agreed (n = 6) that the coaching was a valuable use of time (see Table 21).

Table 21

Use of Time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	4	50.0	50.0	50.0
	Somewhat agree	2	25.0	25.0	75.0
	Neither agree nor disagree	1	12.5	12.5	87.5
	Somewhat disagree	1	12.5	12.5	100.0
	Total	8	100.0	100.0	

Finally, teachers were asked to reflect on the goals set at the beginning of the study. Teachers agreed (n = 7) they met the goals set forth at the beginning of the study (see Table 22).

Table 22

Goal Setting

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	4	50.0	50.0	50.0
	Somewhat agree	3	37.5	37.5	87.5
	Neither agree nor disagree	1	12.5	12.5	100.0
	Total	8	100.0	100.0	

The researcher also evaluated Co-Act scores from pre to post intervention. Mean scores were higher after the intervention was completed (M = 192, SD = 18.53) as compared to pre-intervention (M = 180, SD = 14.877). This result indicates teachers were more prepared for co-teaching and had an increase in positive perceptions of co-teaching after the intervention was completed.

Summary of Data Analyses

The online 10-minute coaching program was administered to four teams of co-teachers in high school secondary algebra classrooms. Each team received ten coaching sessions completed online in the AdobeConnect environment. Student data were analyzed using the STAR360® assessment. Student gain scores were calculated from the beginning of the intervention to the end of the intervention. An ANOVA was used to determine if a difference occurred between co-taught and solo-taught class gain scores. Results of this analysis indicated that students in the co-taught classes had significantly higher gain scores than the solo-taught classes. This result was met with significant power and a moderate effect size.

Teacher teams were observed prior to the intervention beginning in addition to at the conclusion of the coaching intervention. Teacher teams were recorded using SWIVL™ and iPhone™ technology and observations were tcoded to determine OTR rate and co-teaching models present. The type of co-teaching models used by each team was noted. Three of four teams moved from using only one lead/one support, to including different co-teaching models such as teaming and station teaching.

To gather information on rate of OTR, teachers were observed in both co-taught and solo-taught classes (N = 8). An independent t-test was analyzed to determine if there was a significant difference in number of OTR between solo and co-taught classes after teachers completed the coaching intervention. While the result was not statistically significant, there was a positive significant variance in one of the four schools and a negative variance in another school.

These analyses lead the researcher to come to several conclusions. First, much like the initial pilot case study conducted to determine if an online coaching program was beneficial to student improvement, the researcher found statistical significance between solo and co-taught classes. This analysis confirms the hypothesis that if students are provided instruction in a co-taught classes that growth is higher than in solo-taught classrooms. It additionally adds to the body of research available on co-teaching and confirms that co-teaching may indeed be an appropriate service delivery model.

Next, teams were able to gain enough information through the coaching to make different choices in which model of co-teaching to use. A question heard from each of the co-teaching teams is which model works best in their class setting. While the teams had received prior PD on co-teaching models, the use of these models was not evident in observations. After the teachers participated in the coaching different models were observed.

The use of OTR did not significantly change over the course of the intervention. Several factors could be involved which led to the decline in OTR including time of school year, difficulty in observing OTR in a co-teaching team, and finally student OTR

not included in the study. To gather a true measure of OTR the researcher would have needed to gather more information which would be challenging in a classroom setting when many people are talking.

In conclusion, it is unclear if the coaching intervention was the sole influence on teaching practices. Had the intervention started at the beginning of the year, been long term, or if additional observations could be collected, there would be a better opportunity to determine if the coaching was valid.

CHAPTER FIVE: DISCUSSION

Chapter Overview

In this chapter, the researcher reviews the outcomes of this study and discusses the relationship of the current findings with the foundational research in co-teaching. The author discusses future implications of this research in teacher education and co-teaching as well as the limitations of the current findings. The researcher concludes the chapter with the potential impact of these findings on the field of special education, secondary mathematics, and co-teaching.

Purpose, Procedures and Outcomes of the Research Study

Co-teaching remains one model for providing support to students with disabilities (SWD) who are included in general education classrooms (Bryant Davis, Dieker, Pearl, & Kirkpatrick, 2012; Dieker et al., 2014; Friend, 2016; Friend et al., 2010; Murawski & Bernhardt, 2016; Murawski & Goodwin, 2014; Murdock et al., 2016; Sweigart & Landrum, 2015a). Currently, over 90% of SWD are instructed for at least part of their school day in a general education setting (U.S. Department of Education, 2015a). However, teachers are not always provided the professional development (PD) to instruct students in these environments (Desimone & Garet, 2015, 2015; Desimone et al., 2002; Garet et al., 2001; Kennedy et al., 2017). Archibald and colleagues (2011) and the National Comprehensive Center on Teacher Quality (2011) provide a framework for

what constitutes effective PD that includes these five components; (a) alignment with school goals; (b) focus on core content; (c) active learning; (d) opportunities for collaboration; and (e) embedded follow up and continuous feedback. These components are considered essential for high quality outcomes of PD (Archibald et al., 2011).

The purpose of this study was to develop a personalized PD model of coaching for co-teaching through an online 10-minute coaching program using these five components. Data were collected and analyzed to determine if this model of coaching for co-teachers had a positive effect on student growth in mathematics, impacted the type of co-teaching models used, and increased the use of OTR. The researcher coached four teams of co-teachers for ten sessions online for ten minutes per session. During the coaching time, the researcher facilitated a meeting that included a review of previous instruction, an update on student progress, and a plan for the next co-taught lesson to include increased OTR and a discussion of the types of co-teaching models to be used (see Table 1). Following the coaching session, each co-teaching team was provided a written summary of the session.

Data were collected on student performance pre and post the coaching sessions. The primary data collected on student learning came from the STAR360®, a progress monitoring assessment aligned to state standards in mathematics to measure student growth (Renaissance Learning, 2016). Student growth scores were used to assess student progress and analyzed from the third administration to fourth administration for this study. The researcher analyzed if students in co-taught algebra classes made higher gains than those in solo-taught classes, both taught by the same general education teacher. An

analysis of student growth scores indicated that students in the co-taught setting had significantly higher growth than their peers in the solo-taught settings.

To collect data on OTR and the types of co-teaching models used, the researcher recorded observations of the teams for thirty (30) minutes prior to the coaching intervention and after the intervention was completed using a SWIVL™ and iPhone™ technology. The researcher then calculated the number of OTR by using a frequency count of each OTR offered by the general and special educators. Co-teaching models and types of instruction (direct instruction, guided practice, independent practice, and group work) also were noted.

The outcome of these sessions showed changes in three of four teams' co-teaching models, changes in how students were grouped, as well as how both teachers participated in the co-teaching setting. The individual observations of OTR did not yield a statistically significant difference across teams. At the conclusion of the study, teacher participants were asked a variety of questions to determine if the intervention was valuable on an individual level and completed the Co-ACT to show any changes in their thinking about co-teaching. Teachers reported favorably about the coaching sessions and one team stated, "This has been the best PD I have ever received. I really felt like you cared and wanted to see us be successful."

Co-teaching and Student Progress

Researchers have continued to call for research on co-teaching that the service delivery model indeed results in better student growth than other delivery models such as

separate classes and schools (Almon & Feng, 2012; Friend, 2016; Solis, Vaughn, Swanson, & McCulley, 2012; Strogilos & Stefanidis, 2015; Sweigart & Landrum, 2015b; Tremblay, 2013). Research on secondary co-teaching has been limited in relation to student achievement (Cramer, Liston, & Nevin, 2010; King-Sears et al., 2014; Shaffer & Thomas-Brown, 2015). As schools continue to search for the most effective model of intervention for students with and without disabilities, this research study provides the answer, students with disabilities in co-taught classrooms can and do make progress.

Research on co-teaching has been mixed in relation to student progress (Friend, 2016; Isenberg & Walsh, 2015; Lindeman & Magiera, 2014; Sweigart & Landrum, 2015b) and much research has been qualitative in nature as opposed to quantitative (Nierengarten, 2013; Pratt, 2014; Tremblay, 2013). Further, many scholarly articles on co-teaching include ways to co-teach as opposed to data on co-teaching in practice (Friend, 2016; Murawski & Bernhardt, 2016; Murdock et al., 2016). For schools and districts to make the decision to implement co-teaching in the school requires data showing that co-teaching is effective. This current study, along with the prior pilot case study, starts the conversation and indicates that if students are in co-taught classes that student progress is indeed possible and attainable.

Implications of Observations

Due to the findings of OTR not being significant within research question three, the researcher chose to take a further look at the observations that were completed. The complexity of observing two teachers, even with technology, is one for future discussion

and research, but several researchers note a single observation does not always serve as an indicator of what is going on in the classroom on a regular basis (Joyce & Showers, 1982; McKenna et al., 2015). This reflection is one shared by the researcher as an outcome of this study.

The researcher chose to use a validated and quantitative tool to look at coaching practices developed by Kennedy and colleagues (2017) through a funded Institute of Education Sciences grant. The CTS allowed the researcher to complete separate observations of co-teachers by looking at their teaching in sections of time through time stamping events. This time stamp allowed the researcher to go back and review the teams' performances to think further about the lack of significance in statistical changes through a lens of what did occur beyond the research questions posed. The researcher separated each thirty-minute observation into six, five minute segments to determine if any patterns emerged across segments aligned with OTR, types of co-teaching, and what types of activities were occurring in the classroom. Table 28 provides an overview per segment of this information for discussion purposes of the overall findings and potential future research on the topics analyzed in this study. Although this integration and expansion of data by segments was not the original intent, this table represents a way to think further about the patterns of data gathered for further discussion and research on this complex topic of embedded human interactions between two adults and an array of students.

The data provided in Table 23 are descriptive statistics from pre to post observations. Data including types of co-teaching models used, types of instruction (i.e.

direct instruction, guided practice), and OTR by both the general and special educator were reviewed. Teacher teams, in post observations, utilized different models of instruction, which may have allowed for an increase in OTR between peers via activities, but only teacher directed OTR were counted in this study. Therefore, while these OTR were not captured in observations, a change in how teachers were instructing students did occur due to the coaching, which may have decreased their ability to provide teacher to student OTR, but did increase peer-to-peer OTR. This pattern may be something to consider for the further investigations in co-teaching research.

Table 23

Descriptive Analyses of Observations – All Observations

Type	Segment 1		Segment 2		Segment 3		Segment 4		Segment 5		Segment 6	
CT Model	Obs 1	Obs 2	Obs 1	Obs 2	Obs 1	Obs 2	Obs 1	Obs 2	Obs 1	Obs 2	Obs 1	Obs 2
	OLOS 100%	OLOS 50% Team 50%	OLOS 100%	OLOS 50% Team 50%	OLOS 100%	OLOS 25% ST 25% Team 50%	OLOS 100%	OLOS 25% ST 25% Team 50%	OLOS 100%	OLOS 25% ST 25% Team 50%	OLOS 100%	OLOS 25% ST 25% Team 50%
CT Action	GP 75% IP 25%	DI 50% GW 50%	GP 50% IP 50%	DI 25% GP 25% GW 50%	GP 75% IP 25%	DI 25% GW 75%	GP 100%	DI 25% GW 75%	GP 50% IP 50%	DI 25% GW 75%	GP 75% IP 25%	DI 25% GW 75%
ST Action	DI 25% GP 50% IP 25%	DI 75% GP 25%	DI 25% GP 50% IP 25%	DI 25% GP 50% GW 25%	GP 75% IP 25%	DI 25% GP 25% IP 25% GW 25%	GP 75% GW 25%	GP 50% IP 25% GW 25%	DI 25% GP 50% IP 25%	GP 75% GW 25%	DI 25% GP 75%	GP 25% IP 25% GW 50%

Note. One Lead/One Support (OLOS); Station teaching (ST); Direct instruction (DI); Guided Practice (GP); Independent Practice (IP); Group Work (GW)

For co-teaching teams, a difference from the initial observation to the post observations in how teams interacted with their students did occur. The significance of this change is unknown at this time but is an interesting pattern for consideration in future investigations on co-teaching teams. The teams in initial observations relied mostly upon guided practice and independent practice in initial observations. A large percentage of time was spent guiding students through instruction with one lead/one support being the only model of co-teaching used. In all cases, the general educator was the lead teacher with the special education teacher supporting the instruction. Conversely, in post observations, three of the four teams moved to a model of team teaching with group work being the primary mode of instruction. Students were in teams of two–five dependent upon the teacher and the assignment given. This change is one that cannot be seen in the statistical analysis of the data, but the pattern is interesting to consider in relation to how it may have related to the number of OTR observed with this being defined teacher to student.

Interesting to note in the solo taught classes, changes in instruction were observed, much the same as the co-taught classrooms. Teachers in initial observations relied upon direct instruction, guided practice, and independent practice as the primary mode of instruction. Teachers moved to group work with less reliance upon direct instruction during post intervention observations. The indirect impact of the co-teaching on the behavior of the solo taught teachers again could not be measured in the statistical data but is another theme for further consideration and investigation.

Due to these variances in instruction and co-teaching models used, as well as the changes that also occurred in the solo taught classroom, it is difficult to compare OTR from pre to post observations as a singular indicator of change in instruction. Teachers in all cases changed their instruction and implemented new strategies that could have been acquired from coaching into their post coaching observations. The researcher, therefore, is cautious in considering OTR as an indicator of change and recommends the use of more sensitive and isolated behaviors in future co-teaching research.

Good Professional Development on Inclusive Practices and Teachers' Needs

Professional development leaders in education, according to Guskey (2003), continue to debate the requirements for high quality PD. Guskey (2003) came to three conclusions from his analyses. First, the definition and evaluation of effectiveness is not clear. While some studies consider teacher reports, still others rely only on opinions of others who have completed the same PD. However, Guskey (2003) proposes that student learning outcomes are the metric by which PD should be measured.

Research based practices were used to develop the 10-minute online coaching model. The researcher embedded in the coaching the framework put forth by Archibald and colleagues (2011) of the five components of high quality PD. These five components are (a) alignment with school goals; (b) focus on core content and modeling of teaching strategies; (c) active learning; (d) opportunity for collaboration; and (e) embedded follow up and continuous feedback. Using the components of high quality PD, a schedule was

designed for each of the coaching sessions (see Appendix K). Each session included a co-teaching model to be discussed, time for reflection, and one area (planning, instruction, or assessment) to be discussed. Furthermore, a fidelity checklist (see Appendix B) was created to ensure fidelity of implementation. The checklist included three areas; namely review, planning, and closing with additional components of start time and adherence to the ten-minute coaching time. Use of the coaching schedule and the fidelity checklist made the 10-minute coaching replicable to other potential coaches and leaders.

Students with a variety of abilities and disabilities are continuing to be put into heterogeneous classrooms instructed by one or more teachers due to continuing changes in legislation (U.S. Department of Education, 2015a). With the exception of 1% of students with the most significant disabilities, all students are required to take state administered assessments at the current grade level after third grade in reading and mathematics (Every Student Succeeds Act, 2015). States and school districts are required, by law through ESSA and IDEA, to provide an education for students in the least restrictive environment. Teachers, therefore, need to receive the PD necessary to develop effective teaching practices for this population of students, including in the area of mathematics (Bray, 2005; Fruth & Woods, 2007; Harris et al., 2014; Jitendra & Star, 2011; Jordan, Glenn, & McGhie-Richmond, 2010; Jordan, Schwartz, & McGhie-Richmond, 2009).

Professional development (PD) often is completed in a single day, stand-alone session with strategies that may not be implemented upon return to the school without coaching along with administrative and financial support (Dede et al., 2009; L. M. Desimone & Garet, 2015; Desimone et al., 2002; Garet et al., 2001; Leko & Brownell, 2009; Ploessl & Rock, 2014). Additionally, without a direct impact on student progress, schools, districts, and states are reluctant to allocate funding and resources to PD (Archibald et al., 2011; Gulamhussein, 2009; Guskey, 2002; Odden, Archibald, Fermanich, & Gallagher, 2002; Waitoller & Artiles, 2013).

Jordan, Schwartz, and McGhie-Richmond (2009), in their study on preparation of teachers for inclusive classrooms, found several factors were essential for PD to be effective. If general education teachers believe SWD are their responsibility, they are overall more effective (Jordan et al., 2009). Teachers need to be explicitly taught strategies that work for SWD when they are in the general education setting which, it has been found, can work for students without disabilities as well (Jordan et al., 2009, 2010). In this study, the solo-taught teachers were learning strategies for SWD from both the coaching sessions and their work with the special education teachers. The fact that significant differences occurred in student learning gains in co-taught classes is exciting but should be assessed with caution. The learning gains could be related to multiple variables, and it is unclear if the change occurred due to just the intervention. Further analysis to determine if there was the same rate of change between quarters where

coaching was not implemented could be one way to determine if the student growth was due to the coaching intervention or other factors.

What this researcher found through the course of this study was, while the coaching model was based in research, the schedule and checklist were not the areas the individual teams needed or desired improvement. In fact, the teacher teams many times desired different information and this differentiated coaching is potentially a factor in why rates of OTR decreased. Coaching sessions quickly turned to a more authentic, in the moment coaching. Teachers had questions about specific students who were struggling and interventions that might be helpful. Still others had questions regarding course content and different ways to teach the content.

One such instance presented itself when teachers were reviewing slope and the differences behind slope-intercept and y-intercept notation. Due to the coach's background in both co-teaching and Algebra, the coach was able to delve deeper into the target area of increasing student progress. The coach and the team brainstormed ideas for instruction, and the teachers were able to take the knowledge and apply it in their classroom. At the next coaching session, the team was able to return and have a conversation of what went well and what did not align to student based outcomes.

Still another instance arose when teachers were discussing the end of the school year and ways to review for final exams and projects. Due to the fact that the coach was working with different schools and teams, sharing what each different school was doing in order to determine student learning gains was found helpful. The coach then had the

opportunity to observe some of the strategies recommended during the post-coaching observation.

It was during this post-coaching observation that the researcher took a closer look at what was discussed during each coaching session and how the teachers carried out these conversations into the classroom. During the initial observations, the teachers as a whole had very "teacher led" lessons. This included teachers talking directly to students and leading the instruction and discourse in the classroom. However, during the second observations that took place after coaching, three out of four classrooms were engaging in more facilitative instruction where the teachers moved freely through the room while students were talking to each other. Both teachers also were engaged in the instruction with distinct roles in three out of four classrooms. However, this change in instruction led to the decrease in actual teacher to student OTR. What increased though was the amount of student participation, peer-to-peer questioning, and student engagement. A question remains then, was OTR truly decreased or was it just moved from teacher to student.

The question to answer for online coaching as a PD model for co-teaching is who decides what teachers need or do not need in terms of PD? Is the model of the eight-hour scripted PD, which leaves little time for follow up and follow through, better for teachers or is something more personalized needed? This researcher would venture to say that both have their place but without follow-up and grounded components of effective PD positive changes may not occur. For example, the school district that participated in this

study did implement a district wide co-teaching program three years ago. Teachers' district wide received PD from a researcher in the field on co-teaching. Administrators in the district received the same PD in order to better observe and reflect with teachers on co-teaching practices. This PD gave all teams in this study the basics of what co-teaching is (i.e. models, co-planning, co-assessment). While this PD provided consistent information across the district, it was not personalized to what was happening in the classroom for co-teaching teams. Meanwhile, co-teaching was implemented district wide whether the teachers understood, bought into, or practiced the components of co-teaching with feedback. Further, new employees to the district may not have had the benefit of the initial co-teaching PD.

A districtwide overview of practices is quite different from the model implemented in this study. In this online coaching that served as a 5 week PD model, the teachers were able to work directly with the researcher on what was currently happening in their classrooms or other current challenges. The researcher could speak specifically about concerns with direct student and teacher needs. Each of the classes had areas that were unique. For example, S1 had a large number of EL students in the class. Strategies for EL students needed to be implemented into the class structure. Conversely, in S3, the teachers in the team each had different educational backgrounds. The general education teacher had an advanced degree and came with multiple years of experience. However, her partner, the special education teacher had many years of experience but did not hold an advanced degree. In addition, the special education teacher missed three coaching

sessions due to other responsibilities, which impacted the potential overall effectiveness of this online model. This lack of presence of one teacher may have impacted their overall outcomes; another area for further investigation.

Due to these situations as well as others, the coaching of OTR and co-teaching models became challenging with this team. The general education teacher in S3, when presented with strategies to try in the classroom replied that she "couldn't count on" the special education teacher being in class. This made coaching difficult for the researcher initially to find common ground and to discuss strategies with this teacher and team when they both were present. Furthermore, with the coaching occurring at the end of the school year, when state testing was happening, the special education teachers were pulled from class to proctor assessments making it challenging for teachers to implement strategies. As such, when reaching the part of the coaching protocol where review of the prior lesson was to be discussed, this team could not always discuss the lesson with the researcher.

These unique issues called for a unique and personalized model. This 10-minute online coaching model provided just that; targeted and personalized PD.

Summary of Findings

The researcher in the study observed changes in co-teachers' practices, increased grouping of students, and interactive practices. As one of the important aspects of effective PD is student growth, the growth in student achievement from this coaching

model is both exciting and important. Further, the significant results of this study in secondary algebra classes are even more important. Algebra is considered one of the most important courses that leads to both higher graduation rates as well as post-secondary outcomes (Foegen & Morrison, 2010; Hughes, Witzel, Riccomini, Fries, & Kanyongo, 2014; Impecoven-Lind & Foegen, 2010; Kena et al., 2015; Lynch & Star, 2014). The fact that students in the co-taught class performed significantly better than the solo-taught classes is an important and promising finding for co-teaching.

The outcomes of this study indicated the use of an online coaching program for co-teaching teams did not make an impact on OTRs except for two teams, and why these two teams made growth is something to be answered beyond the scope of this study. Despite a lack of significance in change in OTRs, changes were observed in the types of co-teaching models used by the teams. Additionally, an overall significant change occurred in student scores with student growth being higher in co-taught classes than solo-taught classes. The reason why this occurred can be attributed to many factors, one of which could be the presence of a second teacher in the classroom or the implementation of the coaching intervention.

As schools and districts are searching for efficient ways to provide PD to teachers that is relevant, timely, and focused on what is currently happening in the classroom, further research and development in this online 10-minute coaching program is a model to consider. Teachers, in coaching sessions, were observed collaborating with each other through asking questions and discussing current progress in the classroom. Additionally,

teachers were able to get "just in time" suggestions of strategies to use in the classroom. Teachers, after implementing strategies, came back to the coach to discuss strengths and weaknesses. As more teachers are asked to collaborate and funding streams are weakening, typical day long PD could be replaced or enhanced with additional innovative strategies, like online coaching. This study provides the foundation for further shaping, innovating, or creating a new array of tools for online coaching as a PD model for co-teaching.

A further outcome of this study is the need to create observational tools to gather data on co-teaching teams. While observational tools are available (Kennedy et al., 2017; King-Sears et al., 2014; Murawski & Lochner, 2010), it is important to determine if a true measure of what each teacher is doing in the class can be captured. Administrators and others who evaluate teachers may need to go beyond the one formal observation a year or use an array of tools to clearly observe the nuances and development of co-teaching teams. Using online tools to observe and gather data could help increase team outcomes while decreasing interruptions of walking into environments. These observations also could have direct goals in mind like those set by the teams in this study.

Limitations of the Study

In an attempt to minimize limitations to this study, the researcher indicated potential threats to validity before starting the study as noted in Table 11. The threats were considered as the researcher planned the study and an attempt to control each was

made to the extent possible. During the study, additional limitations were determined and should be considered along for future researchers.

The researcher created and carried out an online 10-minute coaching. A reliability checklist was created by the researcher after reviewing previous iterations of this study in the spring of 2016. The researcher and a research assistant reached 85% agreement of observed coaching sessions. However, due to the nature of the personalized PD component of the coaching, a limitation of fidelity of implementation is present. As the coaching is meant to be personalized to the co-teaching team, current challenges of student progress, behavior, or the absence of one of the team members can occur.

The limited duration of this study and the time the study occurred in the school year is another limitation. The initial intent of the study was to have a 10-week intervention where teachers meet the coach one time per week for 10 minutes. However, due to challenges in obtaining participants through the school district, the intervention happened over five weeks with coaching occurring two times per week. While teachers reported they had time to implement strategies discussed in coaching; teachers often stated they were unable to implement a strategy immediately due to a myriad of reasons including ongoing state and district wide testing, IEP meetings, parent conferences, and teacher absences. Furthermore, the study was completed near the end of the school year. This caused teachers to be engaging in more review work instead of new content material. Many teachers were planning for end of year assessments or activities, which left little time for direct instruction of new material.

The classroom observations were an additional limitation to the study. The complexity of one person observing two teachers at the same time posed a challenge and a limitation. While one teacher could wear the SWIVL™microphone, this teacher was the only one whose voice was tracked. In addition, the iPhone™ video only followed the teacher with the microphone. When reviewing videos to gather OTR data, it was challenging to hear what both teachers were saying. A potential resolution to this limitation is recent technology released by the SWIVL™ company where two microphones and cameras can be used in the classroom.

A fourth limitation to this study is the use of only OTR to determine progress made from the weekly coaching sessions. Using only one marker of teacher growth does not paint a clear picture of co-teaching. Throughout the study, the researcher realized this limitation, which led to gathering further information such as the activities happening during the class (e.g. direct instruction, independent practice, guided practice, group work). By further breaking the observations down to six five-minute segments the researcher gained a better understanding of co-teaching practices.

Another limitation is collecting student data from a single moment in time. While the STAR360® is a validated assessment that correlates with state testing, it only represents how a student performed at a single point in time. Many extenuating factors coming into play during assessments such as a poor night sleep, hunger, thirst, or other outside influences. It is impossible to control for these factors and this poses the limitation of using this data analysis. Using a composite view of student growth could be

advantageous. Further, the researcher did not collect absentee data from the study. This variable could lead to students not performing as well as others due to missing instruction, but the influence of absenteeism on the student learning data is not known, as it was not provided by the district as part of the study agreed upon components.

Additionally, while a statistically significant difference was found on student gain scores in co-taught classes as compared to solo-taught classes, this increase only reflected the time that the coaching intervention occurred. To gain a true measure of student growth, it would be essential to analyze segments of time when coaching was not implemented. Further, an analysis of student growth comparing teams receiving the coaching to teams that do not receive coaching could yield a more effective measure of student growth.

As this study was completed towards the end of the school year, the teachers have already been co-teaching for over six months. This limitation is only controlled for if the coaching begins at the start of the year. By the end of the year, the teachers could have fallen into rituals and routines that may be difficult to change. For example, one of the teams was made up of two teachers who had differing points of view. One teacher was present at all coaching sessions; however, the co-teacher missed several sessions due to other responsibilities. As such, in observations of this team, the one lead/one support model was the only co-teaching model observed with the general education teacher taking the lead in instruction.

Co-teaching, in its purest form of two teachers teaching a heterogeneous group of students, remains a debated topic as to the essential components and precisely what are the salient virtues of an effective team (Friend, 2016; Isenberg & Walsh, 2015; Lindeman & Magiera, 2014; Murawski & Bernhardt, 2016; Murawski & Goodwin, 2014; Pratt, 2014; Strogilos & Stefanidis, 2015; Sweigart & Landrum, 2015a). Teachers and researchers have debated whether co-teaching is the most effective way to teach students, and there is concern some students are in co-taught classes for the "social" aspect as opposed to the academic benefits. Teachers continue to need PD around differentiated instruction and assessment (McKenna et al., 2015; Patterson et al., 2014; Santamaria & Thousand, 2004) to ensure all students are able to access the curriculum. Any research involving human subjects is compromised to some degree by external factors. Through all phases of the research, the researcher noted that some teams were more "participatory" than others.

Certain teams attended coaching sessions on time without fail with both teachers being present. Other teams rescheduled coaching sessions multiple times, posed challenges with obtaining student data information, and in one case, one of the team members did not attend all coaching sessions. These instances may have affected the outcomes of observations and of student progress.

Recommendations for Future Research

Several outcomes emerged from this study to be further considered in future research around PD for co-teaching teams specifically around effective PD, co-teaching, and mathematics. In terms of the coaching in general, replicating the model for coaches other than the researcher to carry out the coaching sessions should be explored. Further evaluating the coaching checklist to determine if all areas are essential to each coaching session could be beneficial.

Co-teaching specifically is an area in need of continued research. Large studies looking specifically at student outcomes in co-teaching are not the norm in co-teaching research. Many qualitative studies and single case design studies have occurred, however, more research is needed to determine if co-teaching is the best service delivery option for students with disabilities within and across content and grade levels. Co-teaching is a difficult area to research as it is carried out differently across states, districts, and schools and involves multiple levels of human interactions. The different levels of teacher knowledge, background, class makeup, relationships, and past experiences cause a conundrum of issues for researchers to consider related to these multiple layers in co-teaching practice.

Content knowledge and knowledge of strategies to work with SWD is another area of concern. Whether this knowledge comes at the higher education level before teachers are put into classrooms or gained through PD, it is important to consider levels of each teacher's content knowledge when co-teaching. Special education teachers do

not always have the content knowledge to teach higher level mathematics. General education teachers often are provided a course on working with students with disabilities. While both teachers may not be dually certified in the corresponding subject matter (math or special education), a general level of knowledge is essential for the teachers to be seen as equals in the class. Additionally, unique knowledge in practices is needed for co-teaching. It was noticed from observations of the teaching teams in this study, when the special educator was comfortable with the content, the teacher was more participatory in the class. Moreover, one special education teacher reported, when questioned about what the teacher did when she was uncomfortable with a specific question, she said she would ask her co-teacher for a further explanation. While this was an interesting insight, it was the exception as opposed to the norm and troublesome that the teacher did not have the skill set prior to co-teaching in the content she was supporting. This issue leads to a question for the field of special education, how can learning gains occur with teachers who may not know how to teach the content they are supporting? Additionally, research on what is taught in introductory level courses in higher education may be necessary to determine exact needs of PD once teachers are in the classroom, both general and special education teachers.

A replication of this study is a final recommendation. When considering the replication three key areas need to be considered. The first is to make the coaching routine followed immediately by observation of the skills discussed during the coaching

sessions. The use of virtual observations is a potential way to support this challenge of time and resources for ongoing observations.

The second component for future researchers to consider is to have greater buy-in by the participants. Researchers have noted that when teams buy into both the model of co-teaching as well as PD, greater growth is noted (Dieker & Murawski, 2003; Dieker et al., 2014; Friend, 2007, 2016; Mastropieri et al., 2005; Murawski & Bernhardt, 2016; Scruggs et al., 2007). It was noted that of the four teams in the study, one team did not have the level of buy in and parity as the others. Future research could expand the number of teams that want this level of coaching and observations for co-teaching.

Finally, building off of the framework provided in Appendix K for a standardized coaching model is a potential next step for future research. This framework was used as a guideline to coaching and did provide outcomes that showed positive student learning gains. While the guidelines for coaching are important, equally essential is the personal nature of the intervention. When teachers were able to implement strategies immediately in the classroom and to talk about what was currently happening, greater buy-in was notable. Future researchers should look for this structured, yet personalized model for coaching co-teaching teams.

Conclusions

In this ever changing climate of education, SWD continue to be included into the general education classroom with increasing frequency. Teachers need to be prepared to

meet the needs of the changing makeup of students in their classrooms. Yet, teachers frequently share the type of PD they are provided is not effective to elicit changes in practices (Garet et al., 2001; Martin, Kragler, Quatroche, Bauserman, & Hargreaves, 2014; Waitoller & Artiles, 2013). For PD to be effective, it needs to increase student growth (Archibald et al., 2011; Guskey, 2014; Waitoller & Artiles, 2013).

With the increased emphasis on student outcome measures and potential federal and state dollars attached to student growth models, PD needs to be embedded in directly instructing students with and without disabilities in the general education classroom. Co-teaching has frequently been used to provide this instruction in the general education setting, but with insufficient preparation of either teacher. As districts and schools continue to search for effective ways to provide PD to teachers, an online 10-minute coaching program presents one option to consider. The 10-minute coaching program could be a cost effective model for PD while demonstrating both student growth and professional growth for teachers.

APPENDIX A

PERMISSION FOR CLASSROOM TEACHING (CT) SCAN

UNIVERSITY of VIRGINIA
CURRY SCHOOL OF EDUCATION

Department of Curriculum, Instruction, & Special Education
417 Emmet Street South
Bavaro Hall Room 327
P.O. Box 400273
Charlottesville, VA 22904
MKennedy@Virginia.edu

June 7, 2016

To Whom It May Concern:

Jennifer Holbrook has permission to use the Classroom Teaching (CT) Scan during her dissertation study. As the creator and owner of the CT Scan I have the necessary authority to grant this permission. Please contact me as the need arises: MKennedy@Virginia.edu.

Sincerely,

M. K.

Michael J. Kennedy, Ph.D.
Assistant Professor

APPENDIX B

COACHING FIDELITY CHECKLIST

Coaching Fidelity Checklist

For each observation, note a 1 if the item was observed during the 10-minute coaching and a 0 if it was not included.

Item	**Implemented**	**Not Implemented**
Review		
Introductions of co-teachers		
Differentiated instruction used		
Co-teaching models used		
Student gains based on formal/informal data collection		
Planning		
Big idea for the week		
Co-teaching models to use		
Differentiation of instruction		
Closing – 2 minutes		
Take-a-way or strategy		
Questions		
Closure		
Other		
Did the session start on time		
Was the session 10 – 12 minutes		
Total		

APPENDIX C

IRB APPROVAL FROM UNIVERSITY OF CENTRAL FLORIDA

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Jennifer Holbrook** and Co-PI: **Lisa A. Dieker**

Date: **October 17, 2016**

Dear Researcher:

On 10/17/2016 the IRB approved the following human participant research until 10/16/2017 inclusive:

Type of Review:	IRB Continuing Review Application Form Expedited Review
Project Title:	Effects of a Weekly Online Coaching Model on Co-teaching for Novice Co-Teachers on Teacher Effectiveness and Student Achievement.
Investigator:	Jennifer Holbrook
IRB Number:	SBE-15-11663
Funding Agency:	
Grant Title:	
Research ID:	N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 10/16/2017, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Kamille Chaparro on 10/17/2016 10:04:22 AM EDT

IRB Coordinator

APPENDIX D

PARTICIPANT CONSENT FORM

Supporting a New Co-Teaching Team through Online Coaching and Weekly Planning

Informed Consent

Principal Investigator: **Jennifer Holbrook and Lisa Dieker, PhD**
Investigational Site(s): [redacted]

Introduction:

Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being invited to take part in a research study which will include teachers at [redacted]. You have been asked to take part in this research study because you are co-teaching and would like weekly online coaching. You must be 18 years of age or older to be included in the research study.

The people doing this research are Jennifer Holbrook, Doctoral Candidate in Exceptional Education and Lisa Dieker, Professor in the UCF College of Education and Human Performance at UCF.

What you should know about a research study:

- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should take part in this study only because you want to.
- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you.
- Feel free to ask all the questions you want before you decide.

Purpose of the research study:

This research projects seeks to answer the following questions:

1. To what extent does an online virtual coaching program impact co-teachers' use of OTR as measured by 30 minutes of observation of content material using the CTS in co-taught algebra classrooms.
2. To what extent does an online weekly coaching program impact co-teachers' use of multiple co-teaching models as measured by 30 minutes of observation of content material using the CTS in co-taught algebra classes.
3. Is there a statistically significant difference on how students in co-taught algebra classes perform on district monitoring assessments when teachers are provided with PD related to co-teaching practices and opportunities to respond?

What you will be asked to do in the study:

=

- You will be asked to meet via Adobe Connect each week (up to a maximum of 10 minutes per session, 2 times per week) with your co-teacher to discuss your co-teaching processes for co-planning, co-instructing and co-assessing and opportunities to respond.
- Each session will be recorded with your knowledge and permission using the Adobe Connect platform.
- The expected duration of the intervention will be 5 weeks.
- Any video that the team would like to share with other teachers or teams will only be used with the permission of both teachers and no student names or information will be a part of any video that is shared.
- You will also be asked to come to each online session with potential needs related to co-planning, co-instructing or co-assesing.
- You will be asked to be observed for 3 class sessions for up to 30 minutes in each session. You as the teacher will decide when the observation will be completed and the observation will be of content material.
- You will be asked to provide student data, dependent upon parent consent, on quarterly math assessments.

Location:

The study will take place in your classroom via Adobe Connect.

Time required: We expect that you will be in this research study for the 2016-2017 Academic School year.

Videotaping:

Video recording will occur via Adobe Connect for each session. No students will be video recorded and all sessions will reside on the password protected site on Adobe Connect. Video that is considered for use in sharing processes in the form of blogs, articles or other venues of publication will be vetted and signed off by for use by both teachers prior to use. If you do not want to be video recorded during any session, the researcher will turn off the recording system in Adobe Connect. All video recordings not signed for use in publications or future teacher professional development will be destroyed one year after the conclusion of the study.

Risks: There are no reasonably foreseeable risks or discomforts involved in taking part in this study.

Benefits:

We cannot promise any benefits to you or others from your taking part in this research. However, possible benefits include learning evidence-based practices for teaching students with disabilities, improved rapport with your co-teacher and your students, and opportunities to teach others evidence-based practices about co-teaching.

Confidentiality:

We will limit your personal data collected in this study to people who have a need to review this information. We cannot promise complete secrecy as your images and voices will be included in work with your written permission. If a research paper is published without you serving as a co-author, your name will not be used in study reports.

Study contact for questions about the study or to report a problem:

If you have questions, concerns, or complaints, please contact [redacted] Department of Child, Family, and Community Sciences at [redacted] or Jennifer Holbrook, Doctoral Candidate at [redacted] or by email at jholbrook@knights.ucf.edu.

IRB contact about your rights in the study or to report a complaint:

Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

Withdrawing from the study:

You may withdraw from the study at any time for any reason. If you decide to leave the study, contact the investigator so that the investigator may terminate observations. The person in charge of the research study or the sponsor can remove you from the research study without your approval. Possible reasons for removal include failure to follow instructions of the research staff including discussion of the study or intervention with other parties prior to the completion of the study. The sponsor can also end the research study early.

APPENDIX E

STUDENT CONSENT FORM

The Effects of an Online Weekly Coaching Model for Co-teaching Teams

Informed Consent ***[from a Parent for a Child in a Non-Exempt Research Study]***

Principal Investigator: Jennifer A. Holbrook, M.Ed.

Faculty Advisor: *Lisa Dieker, Ph.D.*

Investigational Site(s): [redacted]

How to Return this Consent Form: You are provided with two copies of this consent form. If you do give consent for your child to participate in the research, please sign one copy and return it to the classroom teacher.

Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being asked to allow your child to take part in a research study which will include about 200 students in Lee County. Your child is being invited to take part in this research study because he or she is currently taking Algebra I in Lee County and the class is taught by a general and special education teacher using a model called co-teaching. All information about your child wil be kept confidential and only demographic information and student test scores will be collected.

The person doing this research is Jennifer Holbrook, a doctoral candidate in exceptional education at the University of Central Florida. Because the researcher is a doctoral candidate, she is being guided by Lisa Dieker, a faculty advisor in the College of Education and Human Performance at UCF. UCF students learning about research are helping to do this study as part of the research team. Their names are Jillian Schreffler and Angelica Fulchini.

What you should know about a research study:

- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should allow your child to take part in this study only because you want to.
- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you or your child.
- Feel free to ask all the questions you want before you decide.

Permission to Take Part in a Human Research Study

Purpose of the research study: The purpose of this research study is to determine if, when teachers are provided with ongoing weekly professional development on co-teaching practices, students make greater gains than those who are not provided with the weekly professional development.

What your child will be asked to do in the study: Students who participate in this study will **not** be asked to do anything additional to what is currently required for the math course. The researcher will collect data that is presented by the classroom teacher. Data to be collected will be:

- Student test scores from quarterly assessments will be given to the researcher with no identifying information.
- Student demographic information will be given to the researcher with names and any identifying information removed

Compensation or payment:
There is no compensation or other payment to you or your child for your child's part in this study.

Anonymous research: This study is anonymous. That means that no one, not even members of the research team, will know that the information your child gave came from him or her.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt your child talk to Jennifer Holbrook, Doctoral Candidate, University of Central Flori[redacted] or Dr. Lisa Dieker, Faculty Supervisor, College of Education and Human Performance ([redacted]

IRB contact about you and your child's rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

Withdrawing from the study:
If you decide to have your child leave the study, contact the investigator so that the investigator can notify the classroom teacher or the researcher.

Your signature below indicates your permission for the child named below to take part in this research.

Name of participant	
Signature of parent or guardian	Date
Printed name of parent or guardian	❑ Parent ❑ Guardian (See note below)

Note on permission by guardians: An individual may provide permission for a child only if that individual can provide a written document indicating that he or she is legally authorized to consent to the child's general medical care. Attach the documentation to the signed document.

APPENDIX F

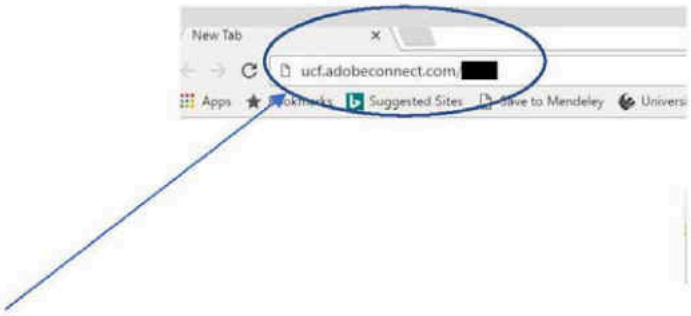
ADOBE CONNECT INSTRUCTIONS

Adobe Connect Instructions

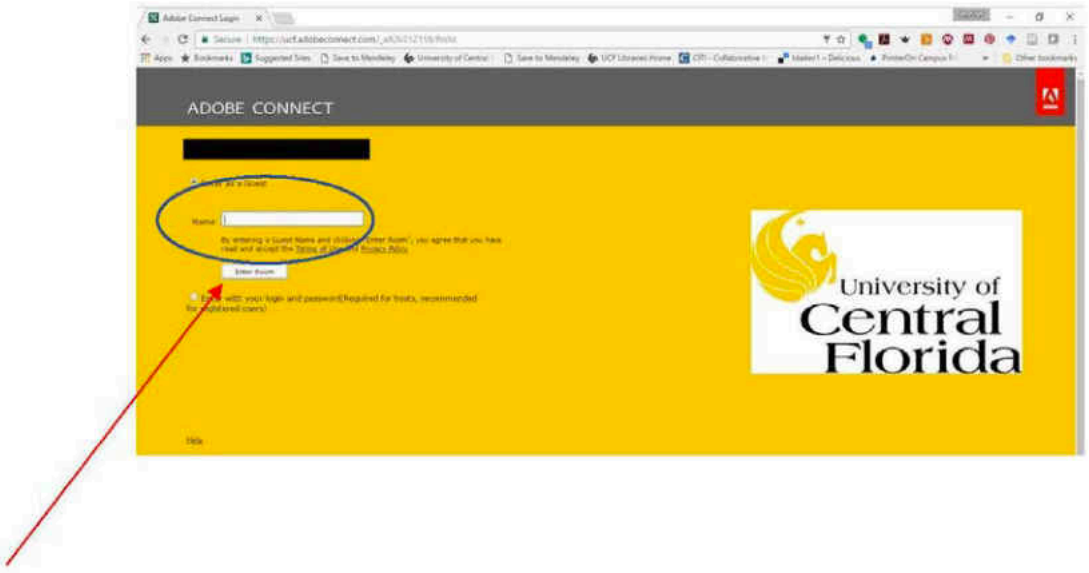
Your Personal Website –

Your Login Time –

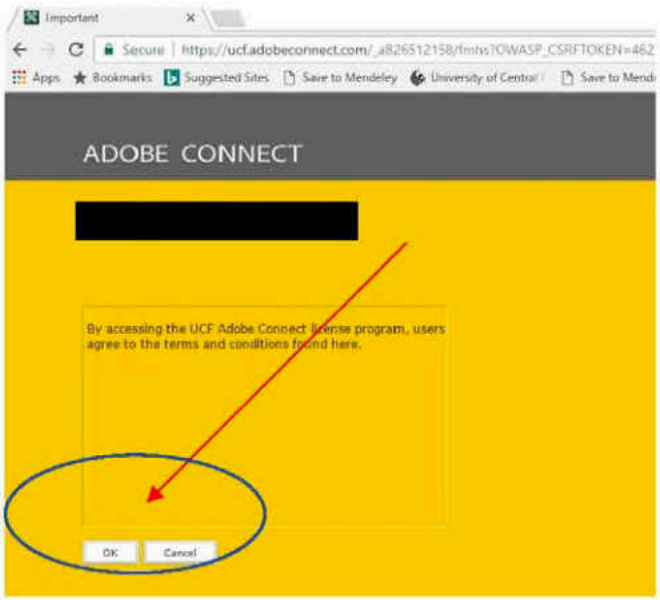
1. Go to your designated website



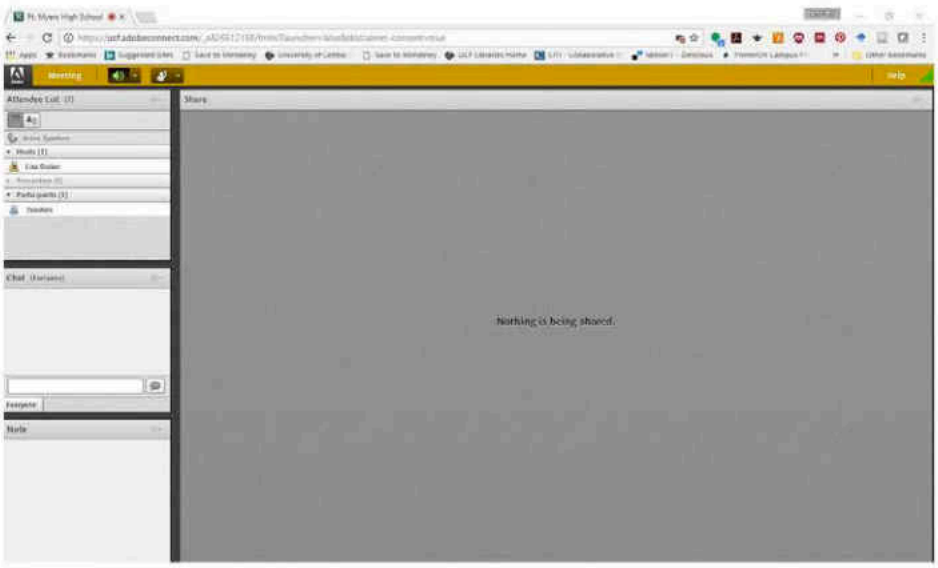
2. Enter as a guest



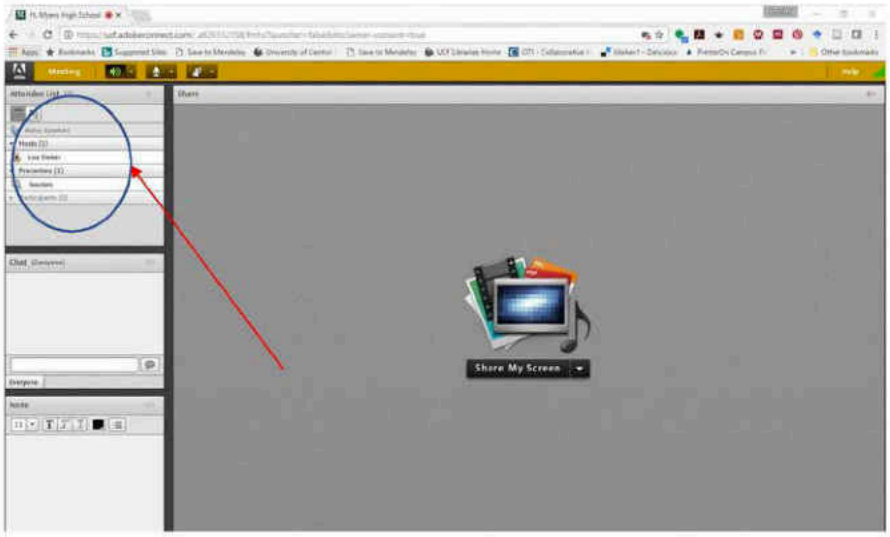
3. Click Ok



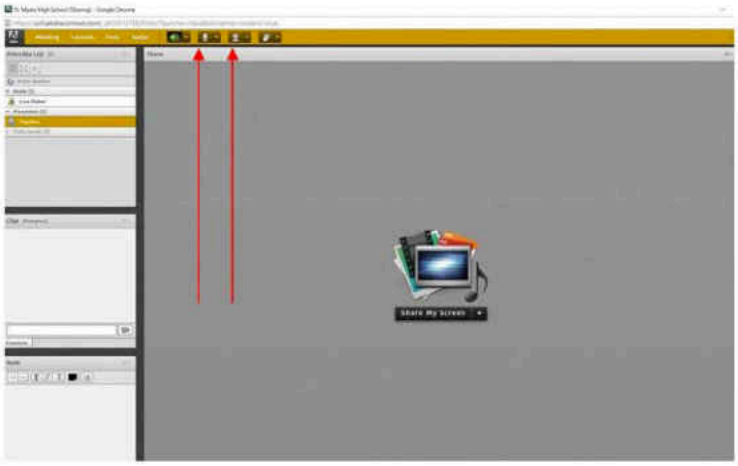
4. Your Screen will look like this after you click ok



5. I will raise you to the level of presenter

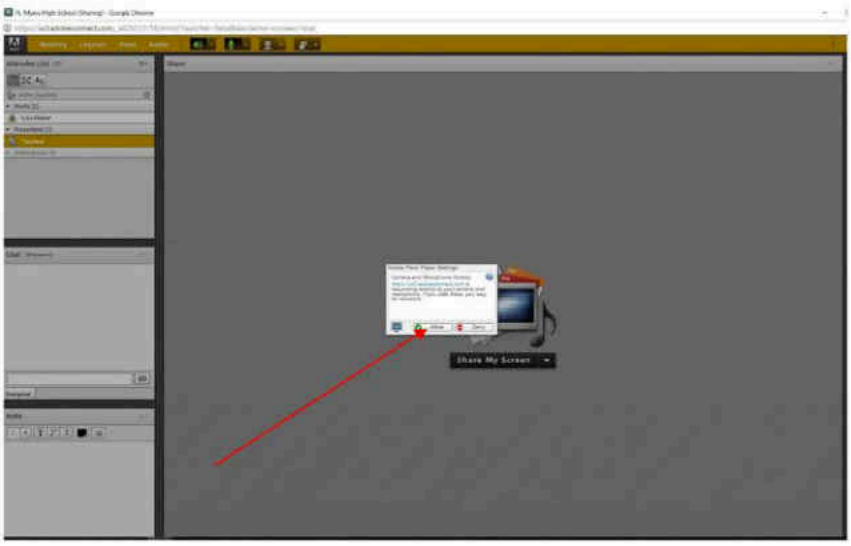


6. Click the microphone and the camera icon at the top of the screen

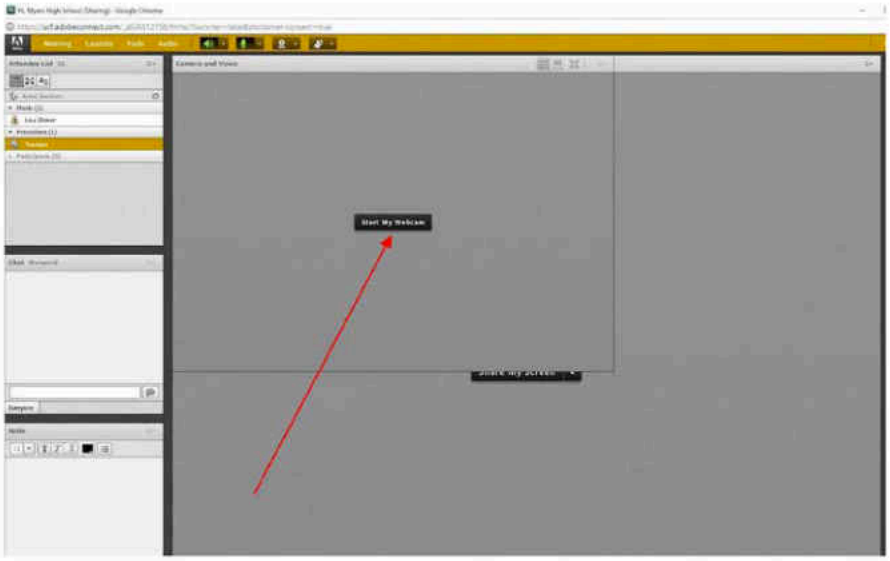


When you do this the icons will turn green

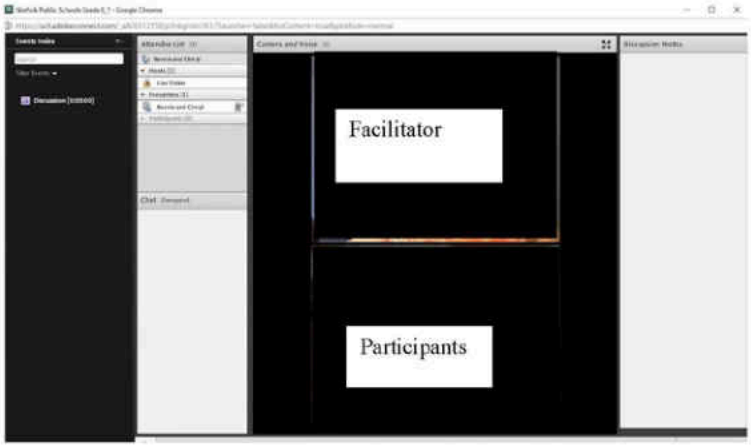
7. Click allow



8. Click "Start my webcam"



9. The screen will look like this and we will start our session



A few extra "tips"

1. When you click the microphone, camera, or speaker icons you can choose your device you'd like to use if there is more than one installed on your computer.
2. For audio concerns, if you go to "Preferences" you will see a drop down to "Audio Setup Wizard". It might be a good idea to go through this before your first coaching session.
3. Your computer may ask you to "install plugin" when you first use the program. This is perfectly normal. This is not installing a virus on your computer.

If at any time you have questions or concerns please don't hesitate to email me at [redacted] or you can call me at [redacted]

APPENDIX G

CO-ACT QUALTRICS ASSESSMENT

Colorado Assessment of Co-Teaching (CO-ACT)

How much do you agree that each factor describes your co-teaching situation?

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Co-teachers are willing to share their knowledge and skills with each other	○	○	○	○	○
Co-teachers monitor student progress on a regular basis	○	○	○	○	○
Co-teachers monitor student progress in all areas of the curriculum.	○	○	○	○	○
The classroom teacher has skills to teach the curriculum effectively	○	○	○	○	○
Co-teachers regularly assess what's working and what isn't.	○	○	○	○	○
Co-teachers are confident of their skills as individual teachers.	○	○	○	○	○
Co-teachers are competent problem solvers.	○	○	○	○	○
One of the classroom teacher's strengths is knowledge of the curriculum.	○	○	○	○	○
Co-teachers make a commitment to deliberately build and maintain their professional relationship.	○	○	○	○	○
Co-teachers each have a distinct but essential purpose in the co-taught class.	○	○	○	○	○

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Co-teachers make a unique contribution based on-but not limited to-their professional expertise.	○	○	○	○	○
Co-teachers vary student grouping arrangements to foster student learning.	○	○	○	○	○
Students in a co-taught class receive help and structure to complete assignments.	○	○	○	○	○
Co-teachers model effective communication.	○	○	○	○	○
Co-teachers model cooperation.	○	○	○	○	○
Co-teachers are able to release some control to their co-teacher.	○	○	○	○	○
Co-teachers are equally responsible for what happens in the classroom.	○	○	○	○	○
Co-teachers make important decisions together.	○	○	○	○	○
Co-teachers carry their part of the workload.	○	○	○	○	○
During a lesson co-teachers can sense the others' thoughts and direction.	○	○	○	○	○
Co-teachers share the gentle and the tough roles.	○	○	○	○	○
One co-teacher can pick up where the other left off	○	○	○	○	○
Co-teachers monitor on-task behavior during instruction.	○	○	○	○	○
Co-teachers are organized.	○	○	○	○	○

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Co-teachers switch instructional strategies when necessary.	○	○	○	○	○
Co-teachers make continual adjustments to ensure student success.	○	○	○	○	○
Co-teachers adapt assessment tools and procedures as needed.	○	○	○	○	○
Co-teachers use a variety of techniques to motivate students.	○	○	○	○	○
In a co-taught class students may be working on the same goal, but they may demonstrate their accomplishment in different ways	○	○	○	○	○
The curriculum in a co-taught class includes social-emotional skills.	○	○	○	○	○
The special educator has skills to develop and adapt curricula to meet the unique student needs.	○	○	○	○	○
Co-teachers know a variety of ways to respond to student diversity.	○	○	○	○	○
Co-teachers believe students' needs determine classroom practice.	○	○	○	○	○
Co-teachers believe it's important to balance academic needs of students.	○	○	○	○	○
Co-teachers believe co-teaching is worth the effort.	○	○	○	○	○
Co-teachers share a philosopy about learning and teaching.	○	○	○	○	○

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Co-teachers believe their purpose is to facilitate learning as well as to impart knowledge.	○	○	○	○	○
The special educator has skills to suggest instructional strategies to meet unique student needs.	○	○	○	○	○
Co-teachers regularly set aside a time to communicate.	○	○	○	○	○
Co-teachers have schedules that permit them to plan together.	○	○	○	○	○
Co-teachers trust each other.	○	○	○	○	○
Co-teachers respect each other's professionalism.	○	○	○	○	○

What is your current role?

General Education Teacher

Special Education Teacher

Other

Who is your co-teacher?

In what grade are you currently co-teaching

8th

9th

Other

How many years have you been teaching?

How many years have you been co-teaching?

What is your gender

Male
Female

What is your ethnicity

White
Black or African American
American Indian or Alaska Native
Asian
Native Hawaiian or Pacific Islander
Other

How many credits have you taken in math instruction (undergraduate and graduate)?

less than 3
3-9
10-15
16+

How many credits have you taken in special education (undergraduate and graduate)?

less than 3
3-9
10-15
16+

What is your Bachelor's degree in?

Math Education
Special Education
Other

What is your Master's Degree in?

Math Education
Special Education
Administration
Other
Do not have Master's degree yet

Approximately how many hours of professional development have you had in co-teaching practices?

Less than 3 hours
3-6 hours
6-12 hours
More than 12 hours

The amount of time we had to incorporate strategies learned in coaching was adequate

Strongly agree
Somewhat agree
Neither agree nor disagree
Somewhat disagree
Strongly disagree

The coaching was a valuable use of time

Strongly agree
Somewhat agree
Neither agree nor disagree
Somewhat disagree
Strongly disagree

My co-teacher and I met our goals we set at the beginning of the coaching

Strongly agree
Somewhat agree
Neither agree nor disagree
Somewhat disagree
Strongly disagree

Any additional comments you may have regarding the study

APPENDIX H

SOCIAL VALIDITY QUESTIONNAIRE

Post-Coaching Survey

1. Did your coaching meet the goals set at the beginning of your intervention sessions?
2. Did you find the online coaching effective in improving your co-teaching practices?
3. Were you satisfied by the results of the coaching for you and your co-teacher as a team?
4. Were you satisfied by the results of the coaching regarding your students?

APPENDIX I

PERMISSION FROM MARILYN FRIEND FOR CO-ACT

University of Central Florida

Department of Child, Family and Community Sciences

Dr. Marilyn Friend, Ph.D.
Professor Emerita
University of North Carolina, Greensboro

Dear. Dr. Friend,

I am currently a second year doctoral candidate at the University of Central Florida (UCF) studying under Dr. Lisa Dieker. My research interest for the past two years, and prior to my admittance to UCF, has been on co-teaching, specifically on effective strategies for teachers that in turn produce positive academic results for children with disabilities.

My dissertation will be on the effect of a weekly online coaching protocol on co-teachers behaviors in the classroom and on student progress in algebra classrooms. As part of my dissertation, I would like to use the Co-ACT as one part of the matching process for the co-teaching teams. Additionally, we hope to analyze how teacher perceptions and preparedness for co-teaching changes as a result of this weekly coaching.

I respectfully ask your permission to utilize the Co-ACT survey to administer to my participants. I will use a password protected account on Qualtrics to distribute the survey to my participants. Only participants in my research will have access to the assessment. As my past research has been in this same realm, I will only have to add an amendment to my IRB as per the IRB office at UCF.

Thank you for your time and consideration.

Sincerely,

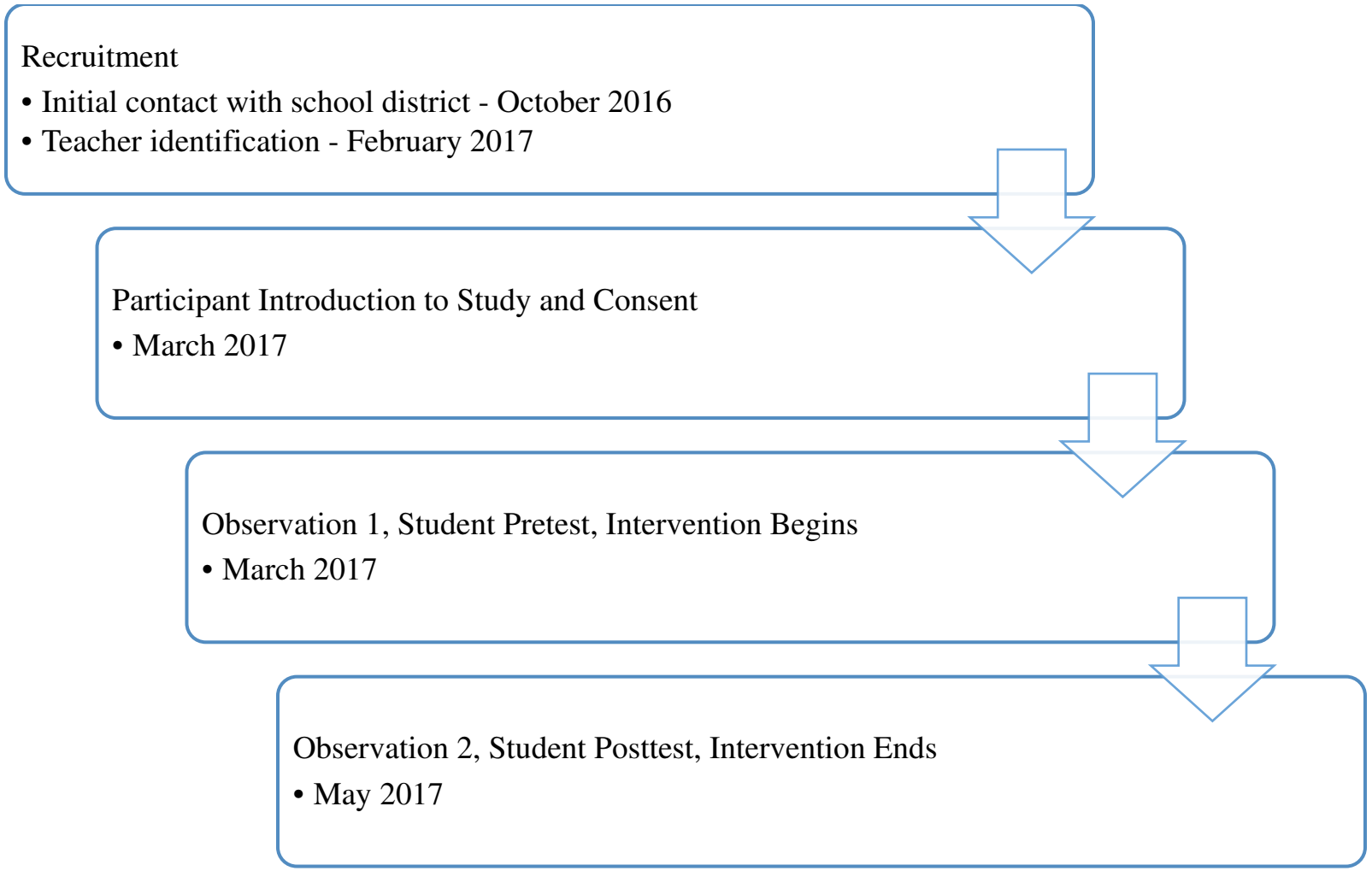
Jennifer A. Holbrook
Doctoral Student
University of Central Florida

Permission granted for dissertation use.
Marilyn Friend
6.12.16

COLLEGE OF EDUCATION
P.O. Box 161250 • Orlando, FL 32816-1250 • (407) 823-2401 • FAX (407) 823-3859

APPENDIX J

RESEARCH TIMELINE


Recruitment
• Initial contact with school district - October 2016
• Teacher identification - February 2017
Participant Introduction to Study and Consent
• March 2017
Observation 1, Student Pretest, Intervention Begins
• March 2017
Observation 2, Student Posttest, Intervention Ends
• May 2017

APPENDIX K

COACHING SCHEDULE

Session	Topic	Materials	Participant Follow Up	Coach Follow Up
Observation				
1	• Introduction to study • Data collection of background information • Answer questions of participants • Introduction of "big idea"	• Co-teaching menu • Models of Co-teaching	• Fill out survey • Discuss ways to implement follow up.	• Provide participants with survey • Send participants follow up notes
2	• Co-Planning • Follow up from previous session. • Implementing a new co-teach model.	• Co-teach menu • Models of Co-teach	• Fill out survey • Plan for next session – how will you implement a new strategy.	• Provide participants with survey • Send participants follow up notes
3	• Lesson reflection • Teaming model	• Co-teach menu • Co-instruction model sheet	• Choose one model to implement • Fill out survey	• Provide participants with survey • Send participants follow up notes
4	• Co-instruction models (Station Teaching) • Reflection on co-instruction – what model worked well? Which one might work better? • Plan for new model of instruction	• Co-teaching lesson plan • Co-instruction model sheet	• Co-teach lesson plan – utilize station teaching • Fill out survey	• Provide participants with article • Provide participants with survey • Send participants follow up notes

Session	Topic	Materials	Participant Follow Up	Coach Follow Up
5	• Co-instruction models (Parallel teaching) • Reflection on co-instruction – what worked well? What changes? •	• Co-teaching lesson plan • Co-instruction model sheet	• Co-teach lesson plan – utilize parallel teaching • Fill out survey	• Provide participants with survey • Send participants follow up notes
6	• Co-instruction models (Team teaching) • Reflection on co-instruction – what worked well? What changes? • Plan for new model of instruction	• Co-teaching lesson plan • Co-instruction model sheet	• Co-teach lesson plan – utilize Team teaching • Fill out survey	• Provide participants with survey • Send participants follow up notes
7	• Co-instruction – where are we? • What model has worked best so far? Why? • Introduce co-teaching menu • Plan for next week – team choice of model	• Co-teaching lesson plan • Co-instruction model sheet • Co-teaching menu	• Use the co-teaching menu to choose co-instruction model • Fill out survey	• Provide participants with menu • Provide participants with survey • Send participants follow up notes

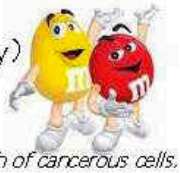
Session	Topic	Materials	Participant Follow Up	Coach Follow Up
8	• Co-instruction – check in week • What model is working? • Co-teaching menu – what model did you choose? How did the lesson go? • Plan for next week – use menu	• Co-teaching lesson plan • Co-instruction model sheet • Co-teaching menu	• Use the co-teaching menu to choose co-instruction model • Fill out survey	• Provide participants with survey • Send participants follow up notes
9	• Co-assessment – what is the next area being assessed? • Discuss current assessment strategies • Formative assessment in the classroom (clipboard, IEP goals)	• Co-teaching lesson plan • Co-instruction model sheet	• Choose formative assessment area • Fill out survey • Lesson using menu	• Provide participants with survey • Send participants follow up notes
Final Observation				

APPENDIX L

CLASS ACTIVITY

Name_____ Partners _____ _____

M&M Lab (Exponential Growth and Decay)



Part I: Modeling Exponential Growth M&M Activity

The purpose of this lab is to provide a simple model to illustrate exponential growth of cancerous cells.

In our experiment, an M&M represents a cancerous cell. If the M&M lands "M" up, the cell divides into the "parent" cell and "daughter" cell. The cancerous cells divide like this uncontrollably-without end.

*We will conduct **15 trials** and record the number of "cancerous cells" on the plate.*

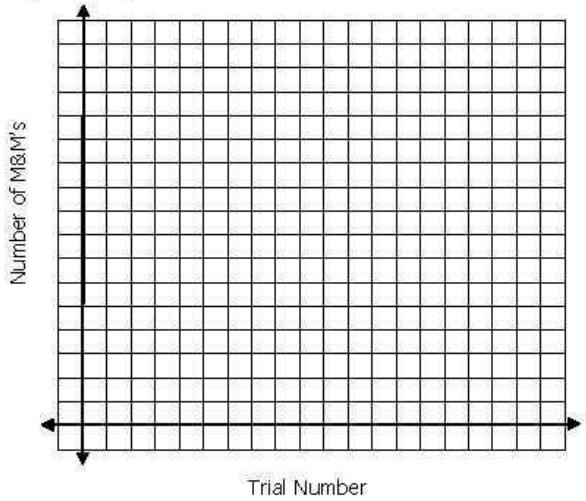
DO NOT EAT THE M&M's UNTIL YOU ARE DONE COLLECTING ALL DATA

Exponential Growth Procedure

1) Place 2 M&M's in a cup/plate. This is trial number 0.
2) Shake the cup and dump out the M&Ms. For every M&M with the "M" showing, add another M&M and then record the new population. (Ex. If 5 M&Ms land face up, then you add 5 more M&Ms)
3) Repeat step number 2 until you are done with 15 trials OR you run out of M&Ms.

Trial #	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
# of M&M's *(# of cells)*	2															

4) Graph your data (scatterplot) with the trial number on the x-axis and the number of M&M's on the y-axis.



5) Should your graph touch the x-axis? Why or why not?

6) After each time you shook the cup, *approximate* the percentage of M&M's that landed with the imprint of "M" face up by looking at your table. _____

To *calculate* the percentage, we will calculate the percent change for *each* trial using the formula below.

$$\frac{\#M\&M's\text{ in Phase1} - \#M\&M's\text{ in Phase0}}{\#M\&M's\text{ in Phase 0}} = \frac{\text{new amount} - \text{old amount}}{\text{old amount}}$$

Complete the table below.

Trial #	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Percent *(write as decimal)*	X															

Calculate the average of *ALL* the percents: _____

7) We can write an exponential growth function that models the data above using the formula $\mathbf{y = C(1+r)^t}$

Initial amount of M&M's (# of M&Ms you started with) C = _____

Rate of growth (calculated average from #6) r = _____ (written as a decimal)

Time (this represents a specific phase number) t = # of repetitions

Fill in the variables to write your own exponential growth equation:

8) We can also use a graphing calculator to write the exponential growth equation.

You will need to enter your data table from page 1 into your graphing calculator.

Click STAT, and under EDIT choose Edit. A blank table should appear. Under L_1 you are going to list the trial number and under L_2 list the Number of M&Ms.

(ONLY IF YOUR ALREADY HAVE DATA IN THE LISTS: To clear the lists before you begin, highlight the list name all the way at the top and press CLEAR—not delete—and ENTER.)

Now you need to find the "curve of best fit". This will make an equation that *best models* your data. Go to your home screen (2^{nd} QUIT), click STAT, scroll right to CALC, select ExpReg, press ENTER.

Write the exponential regression equation to three decimal places.

$y = \underset{a}{\_\_\_\_\_} * (\underset{b}{\_\_\_\_\_})^x$

9) Use your exponential growth model that you created in #7 to predict the number of "cancerous cells" there would be in:

Trial 25 _____ Trial 50 _____

Now, use your exponential growth model that you created in #8 to predict the number of "cancerous cells" there would be in:

Trial 25 _____ Trial 50 _____

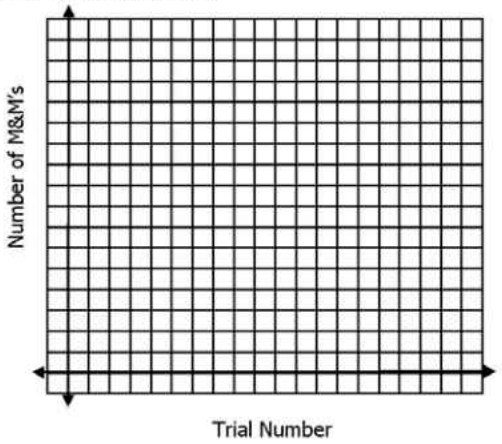
Explain any differences.

Part II: Modeling Exponential Decay

10) Count the total number of M&Ms that you have. Record this number in trial # 0.
11) This time when you shake the cup and dump out the M&Ms, remove the M&Ms with the "M" showing. Record the M&M population.
12) Continue this process and fill in the table. You are done when you have completed 10 phases –OR- when your M&M population gets below 4. **Do NOT record 0 as the population!!!**

Trial #	0	1	2	3	4	5	6	7	8	9	10
M&M Population											

13) Sketch the graph representing your data.



Exponential Decay Discussion

14) In the instructions for #14 (in Part II), why do you think you are NOT supposed to reduce the number of M&Ms all the way to zero? Explain.

15) Using your calculator again, write the exponential regression equation to three decimal places (see step #8 in part I)

$y = \underset{a}{\_\_\_\_\_} * (\underset{b}{\_\_\_\_\_})^{x}$

16) Use the exponential decay model you found in #16 to determine your M&M population on the 4th Phase? How does this "theoretical" number compare to your actual data for the 4th phase. Are they the same? Are they similar? What are some reasons why your results are different? Explain.

Part III: Lab Discussion

Look at the exponential regression equations from your calculator … These questions will help you to determine how well your exponential equation fits your actual data

1. In Part I, what was the "a" value? _____ In Part II, what was the "a" value? _____

   Why were the "a" values different in Parts I and II? _____

   _____

   What does the "a" value represent in the equation $y = a * b^{x}$? BE SPECIFIC. _____

   _____

2. In Part I, what was the "b" value? _____ In Part II, what was the "b" value? _____

   Why were the "b" values different in Parts I and II? _____

   _____

   What does the "b" value represent in the equation $y = a * b^{x}$? BE SPECIFIC. _____

   _____

3. In the instructions for Part II (decay) why do you think you are NOT supposed to reduce the number of M&Ms all the way to zero? Explain.

   _____

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