

THE EFFECT OF CO-TEACHING ON THE ACADEMIC ACHIEVEMENT
OUTCOMES OF STUDENTS WITH DISABILITIES:

A META-ANALYTIC SYNTHESIS

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Co-teaching has been, and continues to be, a growing trend in American schools since the late 1990s. As the popularity of this service delivery model increases, there is an imperative need for empirical research focusing on how co-teaching affects academic outcomes of students who receive special education services. Evidence regarding the academic outcomes of co-teaching is limited, and reports mixed results. The purpose of this study is to provide a synthesis of research examining academic outcomes of co-teaching on students who receive special education services. Quantitative information from each research report was coded, an overall effect size was computed, and a moderator analysis was conducted. Results suggest a significant effect ($g = .281$, $k = 32$, $p < .05$) of co-teaching on the academic outcomes of students with disabilities when compared to students with disabilities who did not receive instruction in co-taught settings; though a larger effect was found among dissertation reports ($g = .439$, $k = 25$, $p < .001$). Additionally, a significant effect was found when examining the academic outcomes of students in co-teaching compared to the academic outcomes of students in a resource classroom setting ($g = .435$, $k = 27$, $p < .001$). Lastly, effects were stronger the longer these students were in co-teaching environments. Implications of findings and recommendations for further research are discussed.

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INTRODUCTION

The use of teacher collaboration is not a new ideology when serving students with special needs, as it has been used in special education for several decades. However, in recent decades the call for certified general education and special education teachers to work as partners in the provision of instruction in the same classroom setting (i.e., co-teaching) has sharply increased (Friend & Cook, 2010). Co-teaching has been a means of delivering instruction since the 1960s and 1970s; yet, it was not an instructional delivery model for students with disabilities until the late 1980s (Dieker & Murawski, 2003; Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010). What was known as team teaching before the 1980s consisted of two general education teachers teaming together to teach a larger group of general education students. However, in the late 1980s and early 1990s, team teaching with two general education teachers transformed into co-teaching with a general and special education teacher. The Individuals with Disabilities Act of 1997 (IDEA) emphasized students with disabilities who receive instruction in general education settings. Passing the IDEA showed more prevalence of co-teaching with a general and special education teacher as a delivery model for educational service for supporting students who receive special education services in general education settings.

Though including students who have special needs in general education classrooms was already taking place, IDEA of 1997 sparked public schools to create improved models of instruction to ensure students who have disabilities are educated in the least restrictive environment (LRE; Nichols, Dowdy, & Nichols, 2010). Prior to IDEA of 1997, students with disabilities were often educated outside general education

classrooms, and it was common for these students to be removed from accountability ratings, either by not being required to take the state assessments or by having their scores eliminated (McLaughlin & Rhim, 2007). Because accountability for students with disabilities was not required, schools often placed students receiving special education services where they were likely to receive an inferior education and were less likely to be exposed to general education curricula (McLaughlin & Rhim, 2007). Reinforcing the LRE mandate in IDEA of 1997 was emphasized to correct these issues and to help encourage schools to keep students who have disabilities in general education classrooms.

Following the passage of IDEA in 1997, the No Child Left Behind Act (NCLB) of 2001 increased school accountability of students and teachers, in part by requiring student proficiency on high-stake assessments based on state and federal standards (Murawski & Lochner, 2010). Large-scale tests were also a focal point to monitor and measure students' progress and hold schools accountable for students' learning (Volts, Sims, Nelson, & Bivens, 2008). Reauthorization of the Individuals with Disabilities Education Improvement Act (IDEIA) of 2004 reaffirmed that all students (including students in general education and students receiving special education services) must be measured using the same content area assessment, be exposed to the same curricula, and be educated in the LRE (Murawski & Lochner, 2010; Rice, Drame, Owens, & Frattura, 2007; Van Garderen, Scheuermann, Jackson, & Hampton, 2009; Zigmond, Kloo, & Volonino, 2009).

This new philosophy of higher level accountability has changed the way schools educate students and the roles and responsibilities of teachers (Robinson & Buly,

2007). Overtime, more schools have incorporated co-teaching to educate students who have disabilities in general education classrooms into the goal of delivering rich content aligned with state standards and necessary academic supports (Friend & Cook, 2010; Thousand, Nevin, & Villa, 2007). Students who have disabilities, more than ever, needed to be exposed to general education curricula to have the opportunity to learn concepts in which they would be evaluated with high-stake assessments (Murawski & Lochner, 2010). Therefore, to meet the needs of all students in these mixed general education classrooms, co-teaching strategies have been preferred (Zigmond et al., 2009). As more students with disabilities are being placed in inclusive co-teach settings, more research is needed about how students' placements affect students' academic achievement for students with disabilities. Research thus far has been limited in providing measurable empirical outcomes of co-teaching instructional models.

Co-Teaching

Various definitions of co-teaching exist, but researchers generally accept co-teaching as an inclusive instructional method used by schools in which highly qualified general and special education teachers' team together in general education classrooms. These two teachers work together to deliver content in a general and individualized manner to meet diverse learning needs of all students (Fenty & McDuffie-Landrum, 2011; Friend et al., 2010). The goal of co-teaching is to deliver high-quality instruction to all students, students in general education and students with disabilities, by having a general and special education teacher work to support each other in the same classroom (Pugach & Winn, 2011). Co-teach strategies should provide students'

instructional options while increasing performance and participation of students with disabilities in general curricula (Mastropieri, Scruggs, Graetz, Norland, Gardizi, & McDuffie, 2005).

Co-teaching provides classroom environments in which students with disabilities have access to general education classrooms with the need supports of special education while enhancing a way schools adhere to federal regulations. (i.e., ensuring student access to general education curricula, education in the LRE by highly qualified teachers and preparation for participation in mandated testing) (Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010; Little & Dieker, 2009). In many places, co-teaching has become the adopted approach to help meet these regulations while giving students with disabilities more access to the general education curriculum.

Understanding which co-teaching methods work best for students is key to determining how future content will be delivered (Murawski & Dieker, 2004). Highly qualified co-teachers must understand three co-teaching dynamics for students with disabilities to be successful in co-teaching settings, (a) co-planning, (b) co-instructing, and (c) co-assessing (Murawski & Dieker, 2004). In co-planning, general and special education teachers should leverage their expertise together to determine the most effective co-teaching strategies based on content being delivered. Both teachers should use their strengths to use instructional time effectively. Co-instructing is the joint delivery of course content to the students, and can take on a number of forms. Friend et al., (2010) outlined six co-teaching approaches:

1. *One teach, one observe*, in which one teacher leads large-group instruction while the other gathers academic, behavioral, or social data on specific students or the class group;

2. *Station teaching*, in which instruction is divided into three nonsequential parts and students, likewise divided into three groups, rotate from station to station, being taught by teachers at two of the stations and working independently at the third;
3. *Parallel teaching*, in which the two teachers, each with half the class group, present the same material for the primary purpose of fostering instructional differentiation and increasing student participation;
4. *Alternative teaching*, in which one teacher works with most students while the other works with a small group for remediation, enrichment, assessment, preteaching, or another purpose;
5. *Teaming*, in which both teachers lead large-group instruction by both lecturing, representing opposing views in a debate, illustrating two ways to solve a problem, and so on; and
6. *One teach, one assist*, in which one teacher leads instruction while the other circulates among the students offering individual assistance. (p. 12)

Lastly, co-assessing is when the co-teaching team jointly evaluates the effectiveness of the co-teaching strategies to determine if the instructional methods employed work, when they should be used and when adaptations are needed. When co-teachers are properly co-planning, co-instructing, and co-assessing, students with disabilities are more likely to succeed in co-teaching settings. (Murawski & Dieker, 2004).

Previous Research

Not only has the number of students with disabilities learning in co-teaching settings increased, but the amount of researcher studying the effectiveness of co-teaching has as well. (Friend & Cook, 2010). Several researchers have explored various outcomes and benefits of co-teaching. For instance, Scruggs, Mastropieri, and McDuffie (2007) conducted a meta-synthesis of 32 qualitative research articles from 1995 to 2005 and found several benefits of co-teaching for students with disabilities,

including student report of extra attention and support, as well as increased academic gains and social benefits. Scruggs et al. (2007) noted only a few students in co-taught classrooms were unsuccessful, but as this was a qualitative review, the study did not attempt to quantify the impact of co-teaching on student academic outcomes.

Mageria and Zigmond (2005) found a positive benefit of co-teaching was that students with disabilities received more individualized instruction, but noted when special education teachers were present, less one-on-one instruction was provided by general education teachers. This finding suggested that the perceived equally shared responsibility of co-teaching for students with disabilities in classrooms diminishes when special education teachers are present. Mageria and Zigmond, however, cautioned generalizing these findings to ideal co-teach settings because co-teachers in the study were untrained in co-teaching and did not have a shared planning time. In addition to the findings of increased support provided to students with disabilities, teachers have reported that co-teaching was beneficial to students' academic and social needs when properly implemented. (Rice and Zigmond, 2000).

Nevertheless, Nichols (2010) asserted that co-teaching is not the educational setting of choice because of the assumed quality of instruction but is rather primarily chosen just to meet the mandates of NCLB. The need still exists for more empirical evidence of quantitative academic outcomes of co-teaching. Murawski and Swanson (2001) found a moderate effect, ($d = .40$), of co-teaching on students grades, achievement, social outcomes, attitudes, absences, and referrals. However, these results should be interpreted cautiously given the small sample ($N = 6$) of studies on

which they are based. Of the six articles analyzed, only two contained academic achievement outcomes specific to students with disabilities.

Other researchers have questioned the benefits of co-teaching and lack of evidence-based academic outcomes for students with disabilities (Mastropieri & Scruggs, 2001; Volonino & Zigmond, 2007; Weiss, 2004). Specifically, their questions involve whether students with disabilities are better served in co-taught settings or special education settings in which students receive specially designed instruction generally at a slower pace than they would in the general education setting (i.e., resource classes). Packard, Hazelkorn, Harris, and McLeod (2011) found that ninth grade students with disabilities who were placed in resource classes had larger gains in language area exams than their peers with disabilities placed in co-taught classes. Murawski (2006) compared reading and writing academic outcomes of a group of students with disabilities in a co-taught classroom to three other groups of students (i.e., students without disabilities in general education, students with disabilities in general education, and students with disabilities receiving instruction in a non co-teach setting), and found no statistically significant difference when comparing students with disabilities in co-taught classes to students in the other three situations.

Limitations of Previous Research

Several issues in conducting academic outcomes based research on co-teaching were noted by Friend et al. (2010). One issue was that various types of co-teaching, with inconsistent dependent measures often employed making it difficult to generalize measurements of academic outcomes from co-teaching across settings. Because

teachers are able to vary their delivery of co-teaching content, controlling external factors poses a problem. Additional factors such as planning time, types and severity of special education disabilities in classrooms, ratio of special education students to general education students, teachers' knowledge of content, amount of co-teacher training, and chemistry between teachers, may also impact the effects and be difficult to control or assess.

Another perceived limitation may include the lack of theoretical frameworks for co-teaching. (Thousand, Nevin, & Villa, 2007). Given the lack of theory on collaboration teaching, research in this area tends to be atheoretical, in which the research is driven by practitioner institutional needs rather than scholarly inquiry, and is often difficult to generalize due to the lack of methodological control allowed to researchers.

Purpose of the Study

One common theme permeates the literature on co-teaching is the need to explore its impact on academic outcomes. The purpose of this meta-analytic research study is (a) to review and combine all empirical research studies based on quantitative academic outcomes to determine an overall effect size for co-teaching inclusion strategies and (b) to determine which dependent variables best influence the academic outcomes of students with disabilities in co-teach settings. This research provided data to determine if there is a statistically significant effect for co-teaching students with disabilities and which students, teachers, and instructional characteristics influence this effect. Specifically asking:

- What is the impact of co-teaching on students with disabilities academic achievement?
- What models of co-teaching have the greatest impact on student achievement?
- Do effects vary by subject (i.e., verbal/language arts, math/science)?
- Do effects vary by grade level (primary or secondary)?
- Do effects vary by length of intervention (i.e., shorter than or longer than one year)?
- Do other moderators (i.e., study type, sample size, type of disability, school level, or type of outcome measure) affect co-teaching outcomes?

METHODS

A meta-analysis was deemed the appropriate method to synthesize quantifiable data from previous research. Individual effect sizes were computed from each report meeting the study's inclusionary criteria. These effects were then combined to determine overall estimated effect size for the targeted relationship (Murawski, 2001). In this case, the main effect of co-teaching interventions on the academic achievement of students with disabilities was computed. In addition, descriptive and methodological features of each study were coded. The data were used to conduct moderator analyses to better understand roles specific contextual factors may play in the relation of co-teaching and student academic outcomes.

The following moderator variables were examined: school level (i.e., primary or secondary), length of co-teaching intervention (measured in years [continuous]), study type (i.e., dissertation or peer-reviewed article), comparison group type (i.e., resource or mainstream), academic subject area of outcome measure (i.e., math/science or verbal/language arts), and length of study. Additionally, the potential interaction of subject area was examined for aforementioned moderators. Other potentially moderators this study planned to examine (e.g., gender, type of disability, co-teaching experience, etc.) were omitted given their insufficient reporting in the sample of studies identified.

Inclusion and Exclusion Criteria

This research was designed to specifically address academic outcomes of student with disabilities in co-teaching settings. To that end, the studies included in this

meta-analysis had to meet the following criteria:

1. Specifically focused on use of co-teaching (one special education teacher and one general education teacher instructing together in the same class) as the instructional model for students in grades Pre-K through 12.
2. Contained quantitative data measuring academic outcomes of students with disabilities in co-teaching settings.
3. Included data that permits calculation of a numeric effect size for at least one eligible outcome variable.
4. Used a true- or quasi-experimental research design.
5. Contained a comparison group (i.e., control, alternative to co-teaching)
6. Was not a master thesis.

Articles that met search criteria dated from the early 1970s to present. However, articles prior to 1992 were excluded from this analysis because the co-teaching model employed in these studies (referred to as team teaching) consisted of two general education teachers, and focused on general education students outcomes (Meehan, 1973). Articles were also excluded from this analysis if the results did not provide quantitative academic outcomes, there was not sufficient information to determine an effect size, only outcomes for students in general education were reported, or the instruction involved one certified teacher and one non-certified teacher.

Search Strategy

Electronic searches of ERIC, Education Research Complete, and PsycInfo were conducted using the EBSCO Host database. Combinations of descriptor terms used in searches included *co-teach*, *team teach**, *collaborative teaching*, and *cooperative teach** with *achievement*, *outcomes*, *efficacy*, and *effect**. No publication date limits

were set in databases for this article search. However, publication and document type limiters were set, including books, full text digests, and journal articles.

These electronic searches resulted in 1,738 total reports. An abstract review of these articles narrowed the selection to 108 articles containing co-teaching research for further review to determine if they yielded enough information to compute an effect size. Of the 108 articles chosen, 23 articles met this study's criteria of having quantitative data measuring academic outcomes of students with disabilities and reported sufficient data for the computation of an effect size. These 23 articles were then further reviewed to ensure all other qualifying criteria were met (i.e., used a true- or quasi- experimental research design; contained a comparison group).

A second search containing the same descriptor terms was conducted using the ProQuest Dissertation and Thesis database. Of the 649 reports initially identified, 66 reports were selected for further review based on their abstracts. A more detailed review of these reports resulted in the number of potentially qualifying studies (i.e., measured students with disabilities in co-teaching; those containing sufficient data to compute an effect size), being narrowed to 32. These 32 studies were also further analyzed to ensure all other qualifying criteria were met.

A total of 55 quantitative reports were identified for further examination via the aforementioned searches. A reference search of these 55 articles was also conducted to identify other potential reports relevant to this study that might have been missed by electronic searches (e.g., unpublished reports). This reference search identified an additional 10 potential reports for further review.

The complete literature review process resulted in locating 65 potential articles to be coded (i.e., 23 journal articles and 32 dissertations from electronic searches, and 10 articles from reference searches). Of these 65 potential reports, 45 reports were excluded from the final meta-analysis for not meeting all of the inclusion criteria (e.g., insufficient data reported, missing information, etc.). As such, the final meta-analysis included 20 studies (i.e., 4 journal articles, 13 dissertations from electronic searches, and 3 journal articles from reference searches) that meet this study's inclusionary criteria and were coded.

Coding Procedures

After all studies pertinent to this meta-analysis were chosen, each report was coded for demographic and co-teaching variables. Demographic variables consisted of student age, gender, grade, ethnicity, and type of disability, as well as control group information (i.e., educational setting; number of students; disability types). Co-teaching variables selected for coding included: the co-teaching model implemented, grade or grades being co-taught, number of co-taught students with disabilities, type of measures used for analysis, type of statistical analysis in study, and teacher information (i.e., number of special education and general education teachers participating, amount of co-teach training prior to implementation, amount of co-teach planning time, number of years of teaching experience, number of years as a co-teacher, level of teacher education, and types of teacher attitudes towards co-teaching). Interobserver agreement (IOA) was conducted by the author and a trained coder on five (25.0%) studies to determine the level of agreement in determining study characteristics. The

percent agreement between the two raters was 100.0%, indicating perfect agreement across raters. An overview of IOA coding is outlined in Appendix A.

Moderator Analysis and Coding

As mentioned, this study was used to investigate the following moderators: school level (i.e., primary or secondary), length of co-teaching intervention, study type (i.e., dissertation or peer-reviewed article), comparison group type (i.e., resource or mainstream), academic subject area of outcome measure (i.e., math/science or verbal/language arts), and length of study. These moderators were chosen due to systematic and individual differences in each study and students' variables that were reported. The aim of examining these moderators was to further investigate the efficacy of co-teaching on student learning outcomes among students who have disabilities, regardless of influences from methodological and participant characteristics. Length of intervention (expressed in years) was coded as a continuous moderator, and the remaining four moderators were categorical and were coded based on aforementioned breakdowns. Due to the lack of studies with the co-teaching model specified, this variable was not able to be analyzed and therefore, excluded as a moderator.

Statistical Methods

Effect Size Metric and Calculation

Effect sizes were calculated based on the pretest adjusted standardized mean difference (SMD) between pre- and post-intervention scores for co-teaching exposure

and non-co-teaching exposure; effect sizes were expressed as Hedge's g . Effect sizes were calculated utilizing the Comprehensive Meta-Analysis software (CMA, v2). Based on Hedges' (1982) recommendation, there were differences in sample sizes (notably among small samples), so effect sizes of studies were adjusted using the small sample correction defined as $1 - (3/4n - 9)$. Due to various sample sizes across studies, Hedge's g was used as the measure of effect size for all studies. For this study, effect sizes will be interpreted as small ($\sim.15$), medium ($\sim.45$), and large ($\sim.90$), based on Lipsey and Wilson's (2001) recommendation.

Statistical Procedures

Before the primary meta-analysis was conducted, exploratory analyses were completed to examine the potential impact of outliers on primary analyses. Specifically, extreme outliers of computed effect sizes and sample sizes were examined utilizing SPSS version 19 based on criteria of set by Tukey (1977). None of the obtained and/or calculated effect sizes met criteria of an extreme outlier, so effect sizes were not modified. Additionally, before primary meta-analyses were conducted, weights were assigned to each study based on an average weighted index in order to counter balance the potential impact of sample size on effect sizes and were computed utilizing the CMA software, (see Appendix B for weighted values; Cooper, 2009).

Next, the homogeneity of studies utilized in this meta-analysis was examined by computing the Q statistic, as follows:

$$Q = \sum w_i * (g_i - \bar{g})^2$$

Where w_i refers to the weight assigned, g_i refers to the effect size (expressed as Hedge's g), for each study, and \bar{g} refers to the sum of effect sizes. The Q statistic is based on the chi-square distribution, and df is defined as $k - 1$ (Lipsey & Wilson, 2001). A significant Q statistic indicates that differences in effect sizes may not be fully accounted for by sampling error.

The primary meta-analyses used a random effects model, as recommended by Field and Gillett (2010). Multiple effect sizes within a single study were retained in analyses; however, these effect sizes were parceled out to investigate potential impact of moderators. Categorical moderators were tested by conducting random effects model of data split by categorical moderator. Further interactions of multiple categorical moderators were tested by taking multiple splits of moderators by key moderators of interest: in this case, outcome measure type (e.g., verbal/language arts and math/science). Continuous moderators were tested using meta-regressions and predicting outcome effect size from length of intervention. To further examine impacts of outcome measure types, meta-regressions were also conducted on split files to detect potential differences in relationships between intervention length and effect size as a function of outcome measure type. In addition to these analyses, forest plots, funnel plots (to examine publication bias), and scatter plots were used as visual representations of this study's findings. These analyses used CMA software and the metafor package for R (Vietchbauer, 2010).

RESULTS

Article Descriptives

Descriptives of studies included in the meta-analysis are presented in Table 1. The majority of studies included were conducted in secondary schools ($n = 11$, $k = 10$, 64.7%). A greater number of studies included were dissertations ($n = 13$, $k = 25$, 61.9%), compared to peer-reviewed publications ($n = 8$, $k = 7$, 38.1%). Over half of the studies also included verbal/language arts outcome measures. Eighteen ($k = 30$) of the studies located included a length of the co-teaching intervention and the average duration was .92 years ($SD = .55$). Further study descriptives are outlined in Appendix B and C.

While this study planned on investigating teacher-level characteristics in the primary analyses, coding revealed that an inadequate number of studies provided sufficient information about co-teachers for further analysis to be conducted. Among the characteristics inadequately reported were the co-teaching method used, the type of student disability and co-teacher characteristics (i.e., education level, number of teaching years, co-teaching training, planning time). The reported measures for each article coded are displayed in Appendix D.

Table 1

Study Characteristics for Comparative Analysis

	<i>n</i>	%	<i>M</i>	<i>k</i>	<i>SD</i>
School Level Identified					
Primary	8	44.4		12	
Secondary	10	55.5		10	
Comparison Group					
Resource	15	75.0		27	
Mainstream	5	25.0		5	
Study Type					
Peer Reviewed Publication	7	35.0		7	
Dissertation	13	65.0		25	
Subject Identified					
Math/Science	14	45.2		14	
Verbal/Language Arts	17	54.8		17	
Length of Study	18		.92	30	.55

Note. Percentages reported are percentages within subheading; frequencies not summing to 20 reflect studies that did not provide enough information to determine subgrouping domain.

Summary of Effect Sizes

A summary of the overall estimated effect size is outlined in Table 2. As shown, the Q-test was significant, indicating that all studies included in analyses were heterogeneous and that differences in variance were likely due to factors other than sampling bias. Observed effect sizes ranged from -1.734 to 1.812 ($k = 32$). Overall estimated effect size across studies was significant, $g = .281$, $p < .05$, indicating that students with a disability who were exposed to co-teaching had superior learning outcomes compared to students with disabilities who were not exposed to co-teaching.

Figure 1 displays a summary of the obtained effect sizes, confidence intervals, and random effects model of all studies included in the meta-analysis. These findings suggest that among students with disabilities, co-teaching does significantly affect students' learning objective outcome measures, compared to non-co-teaching interventions.

Table 2

Mean Effect Sizes (g), 95% Confidence Intervals (CI), Number of Effect Sizes (k), and Random Effects Homogeneity Statistics (Q) for Weighted Analyses

Target Sample		<i>g</i>	95% <i>CI</i>		<i>k</i>	<i>Q</i>
All Studies		.281*	.041	.521	32	126.43***
School Level	Primary	.285	-.068	.637	12	44.01***
	Secondary	.188	-.431	.807	10	52.55***
Study Type	Publication	-.343	-.903	.216	7	24.60***
	Dissertation	.439***	.202	.676	25	82.53***
Subject	Math/Science	.278	-.029	.585	14	42.87***
	Verbal/Language Arts	.275	-.097	.646	17	82.70***
Comparison Group	Resource	.435***	.256	.615	27	56.52***
	Mainstream	-.660	-1.537	.218	5	22.53***

Note. * $p < .05$; ** $p < .01$; *** $p < .001$; negative *g* indicates decreased score across comparison group.

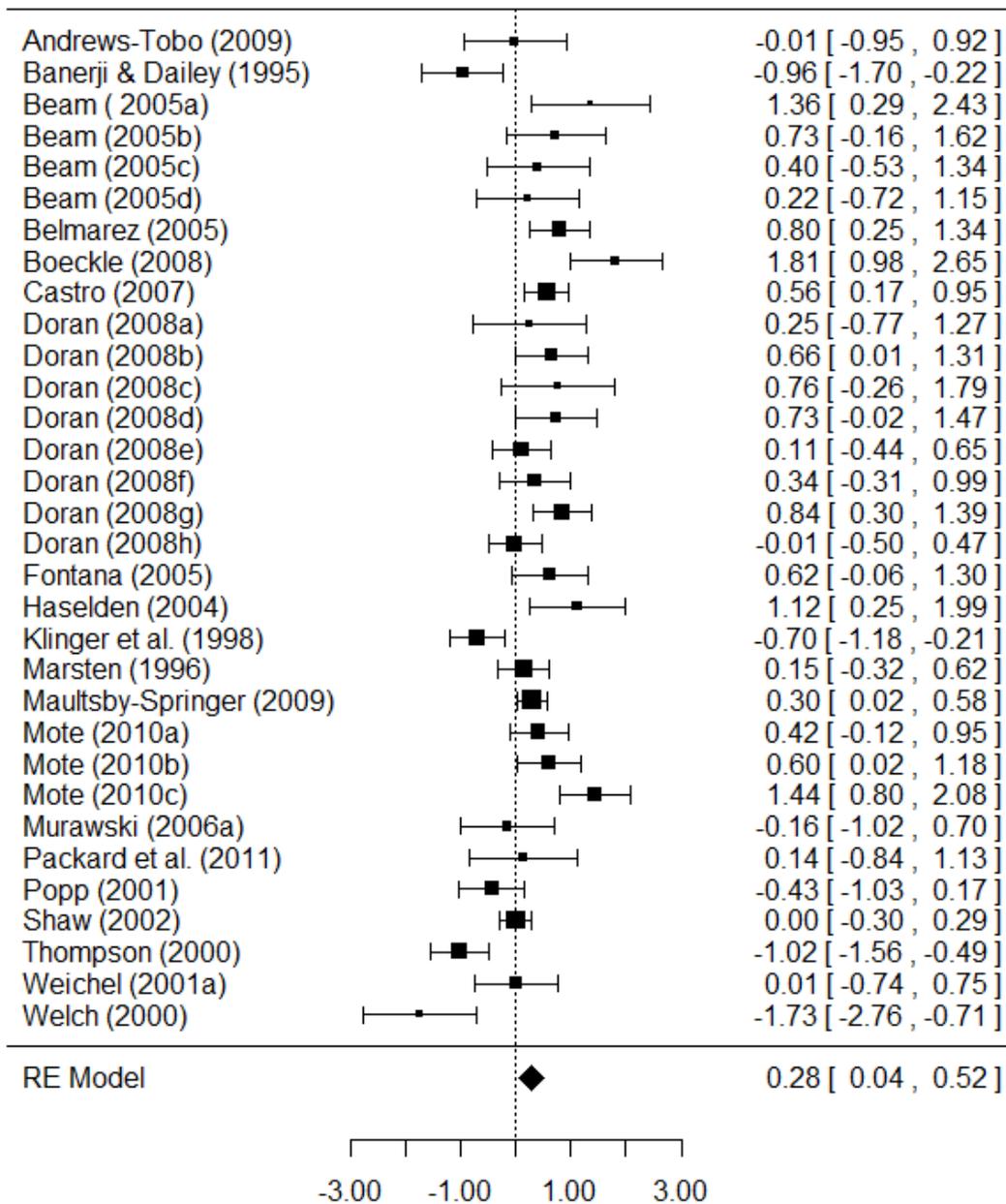


Figure 1. Forest plot of effects of co-teaching (all studies).

Examination of Moderators

Simple Moderators

An overview of the analysis of dichotomous moderators is outlined in Table 2. As shown, the Q-test was significant across all moderators tested (i.e., school level, study

type, subject, and comparison group), indicating that factors other than sampling biases likely contributed to differences in variance across studies. A significant estimated effect size among reviewed dissertations showed that students who were exposed to co-teaching had significantly greater outcomes than did students who were not exposed to co-teaching ($g = .439$, $k = 25$, $p < .05$). Across studies included in this meta-analysis, a significant estimated effect size depended on the comparison group to which the co-teaching was being compared. Compared to students who were put in a resource room, students who were exposed to co-teaching tended to perform better, ($g = .439$, $k = 27$, $p < .001$). The remaining dichotomous moderators (e.g., school level, subject, mainstream comparison group) failed to yield a significant effect of co-teaching on academic outcomes across school level or subject matter (all $p > .05$).

Interaction of Dichotomous Moderators

To investigate potential differences in estimated effect sizes by outcome measure, additional analyses were conducted, stratified by outcome measure type (see Table 3). An overview of the estimated effect sizes obtained is outlined in Figures 2 and 3. There was a significant estimated effect size for school level on math outcomes, with those in primary school exposed to co-teaching having significantly higher learning outcomes ($g = .440$, $k = 10$, $p < .05$). Additionally, further analyses were conducted to test for significant effects of co-teaching by subject and other dichotomous moderators to investigate any potential interaction effects of dichotomous moderators by subject type of outcome measures (see Table 3). Analyses split by outcome measure types yielded similar findings, indicating that relationships among co-teaching exposure and

students' learning outcomes tended to have the same degree of efficacy, regardless of outcome measure type.

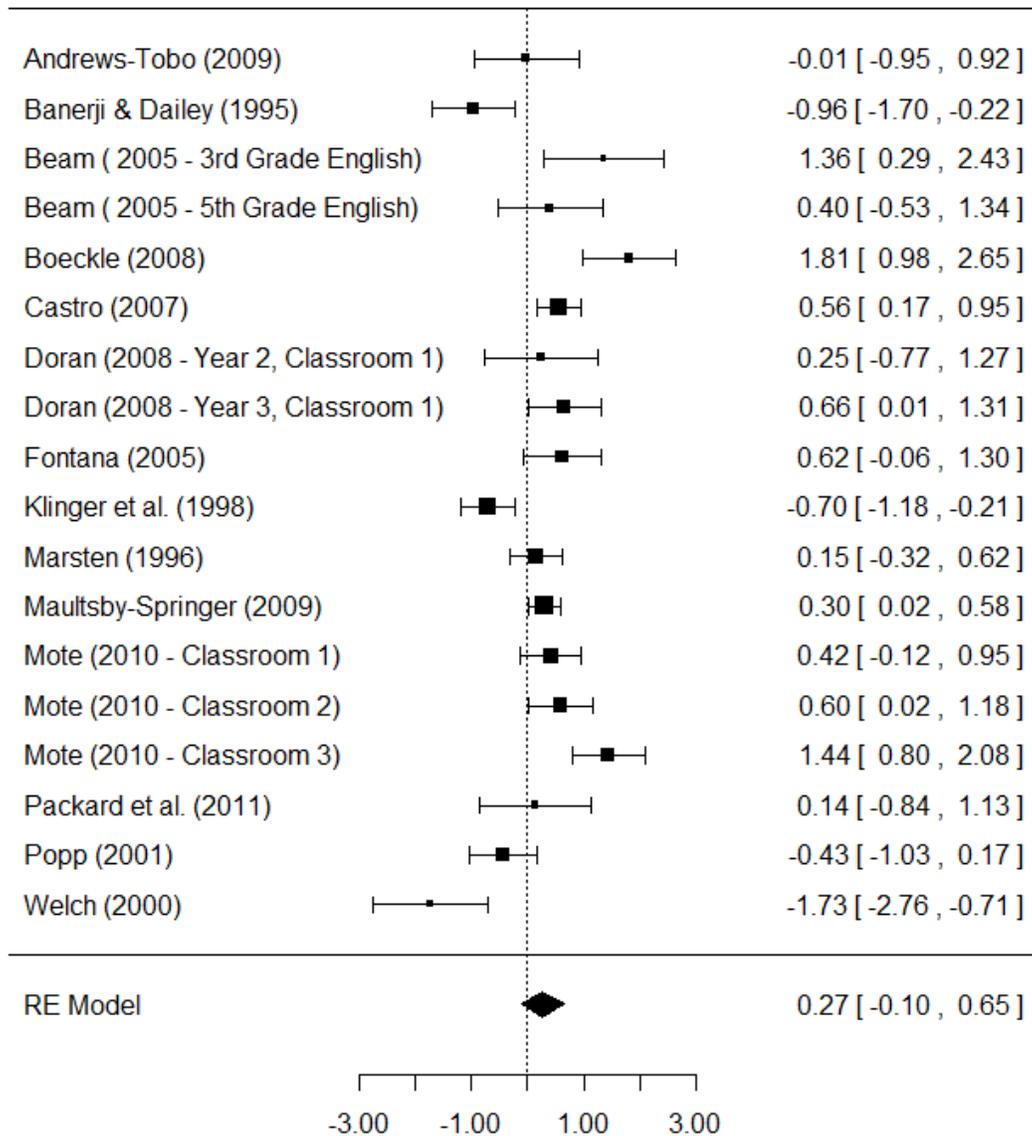


Figure 2. Forest plot of effects of co-teaching (verbal/language arts).

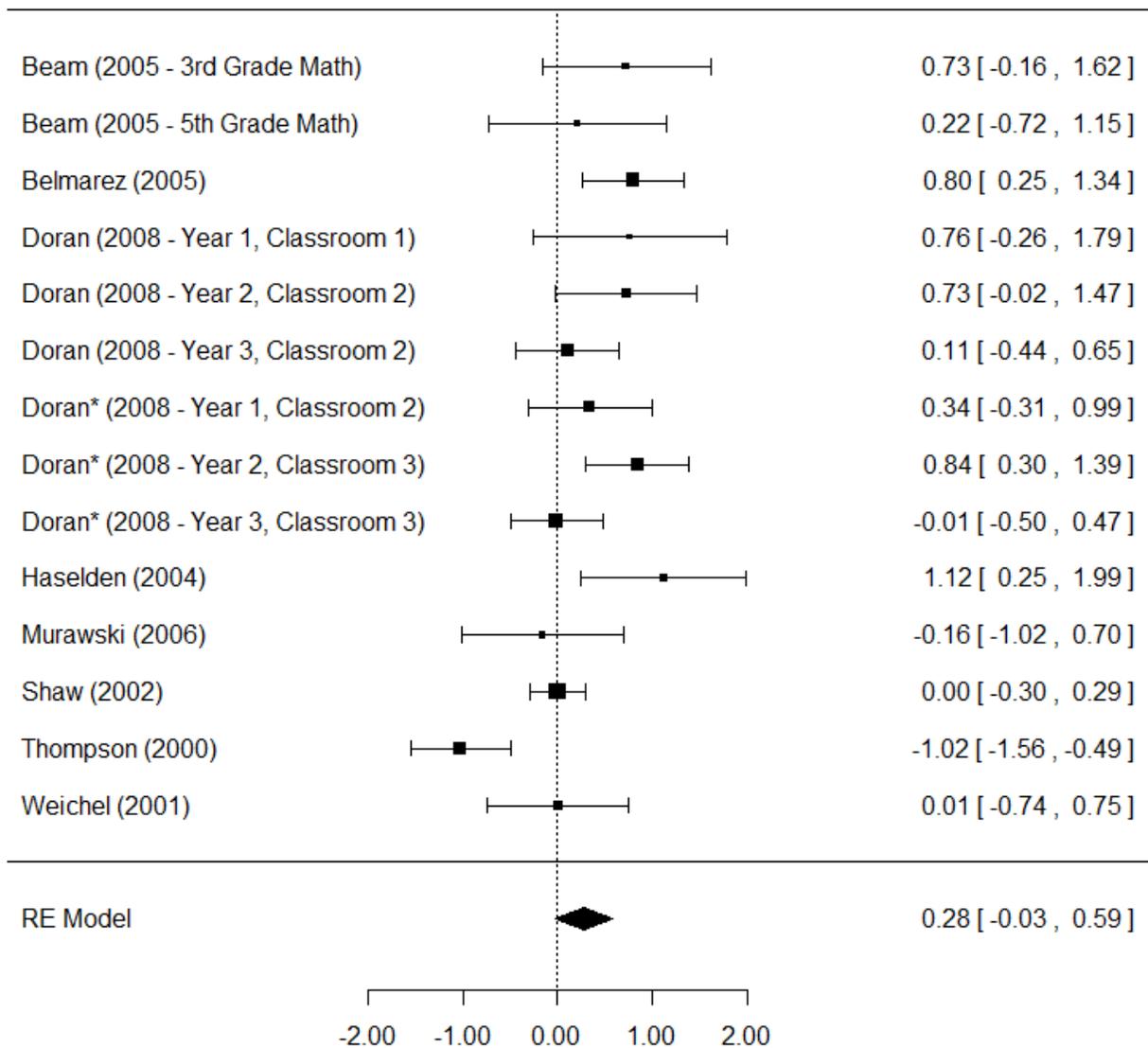


Figure 3. Forest plot of effects of co-teaching (math/science). (*Science outcome)

Table 3

Mean Effect Sizes (g), 95% Confidence Intervals (CI), Number of Effect Sizes (k), and random Effects Homogeneity Statistics (Q) for Weighted Analyses

Target		Verbal/Language Arts					Math/Science				
		g	95% CI		k	Q	g	95% CI		k	Q
Comparison	Res.	.330**	.145	.515	17	26.70*	.482**	.226	.738	16	39.73***
	Main.	-.378	-1.267	.511	4	18.13**	-.708	-1.52	.107	4	12.56**
Level	Prim.	.110	-.366	.586	7	27.02***	.440**	.199	.680	10	13.83
	Sec.	.264	-.153	.691	5	12.56*	.141	-.630	.911	8	49.81***
Study Type	Pub.	-.377	-.855	.102	4	7.33	-.299	-.875	.278	7	25.62***
	Diss.	.314*	.055	.574	17	52.35***	.539**	.232	.847	13	37.52***

Note. * $p < .05$; ** $p < .01$; *** $p < .001$; $\psi p < .10$; negative g indicates decreased score across comparison; Res. = Resource; Main. = Mainstream; Prim. = Primary; Sec = Secondary; Pub. = Publication; Diss. = Dissertation

Examination of Continuous Moderators

To test the potential moderating effect of length of co-teaching exposure on student learning outcomes, a meta-regression was conducted. The overall tests of heterogeneity was significant, $Q = 109.05$, $p < .001$, indicating that the variance in outcomes was not a simply a function of sampling error. The regression model, however, did not find a significant relationship between length of exposure to co-teaching and student outcomes, $z = 1.18$, $p = .24$, indicating that amount of time in the intervention was not associated with student outcomes. A Baujat plot is outlined in Figure 4.

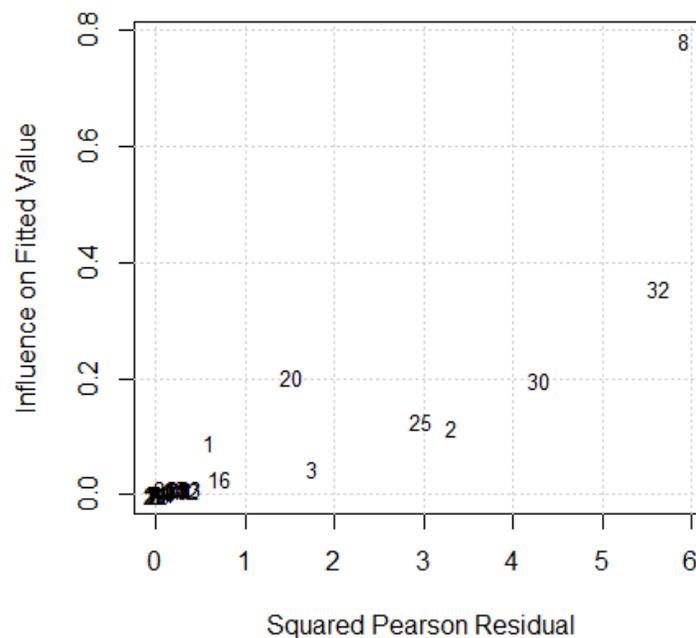


Figure 4. Baujat plot meta-regression using length of intervention.

The Baujat plot can be used in a meta-analysis in order to examine heterogeneity by showing how each study contributes to the overall Q-test statistic. The plot shows the contribution of each study to the overall Q-test statistic for heterogeneity on the horizontal axis versus the influence of each study (defined as the standardized squared

difference between the overall estimate based on a fixed-effects model with and without the fifth study included in the model) on the vertical axis (Baujat, Mahé, Pignon, & Hill, 2002).

Examination of Multiple Moderators

In order to examine the potential interaction effects of key moderators, a series of meta-regressions were conducted. Results from this meta-regression yielded no significant findings; all were $p > .05$, indicating that there does not appear to be an interaction effect of predicted moderators (i.e., length of study, school level, study type, comparison group).

Publication Bias

To investigate the potential impact of publication biases, a funnel plot of all used studies was created (see Figure 4). As shown, effect sizes from studies of small sample sizes ranged from the true zero effect size, which provides support that publication biases did not heavily impact this meta-analysis. Funnel plots provide a visual estimation of the impact of potential publication biases, but the nature of publication biases (i.e., inability to review data that is not available) do not allow researchers to fully determine the exact impact of publication biases on given meta-analyses. Further examination of publication bias was addressed utilizing Rosenthal's fail safe N indicating that there would have to be 230 studies that were not included in this analysis need for the results of this study to be significantly impacted by a publication bias.

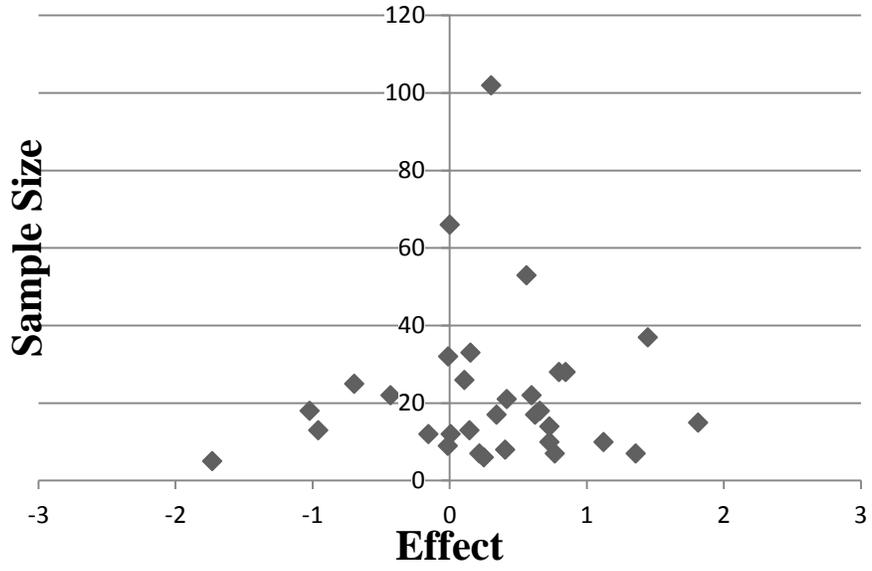


Figure 5. Funnel plot investigating publication bias.

DISCUSSION

Since the passage of the IDEA of 1997, co-teaching has been a more prevalent teaching model used in public schools to deliver rich content of general education curricula to students with disabilities (Nichols, Dowdy, & Nichols, 2010). As the number of public schools using co-teaching continues to increase, quantitative research must be used to help determine how co-teaching impacts academic achievement for students who have disabilities. Several qualitative studies have suggested that co-teaching increases academic achievement of students with disabilities, but quantitative research studies have provided mixed results. This study attempts to clarify the impact of co-teaching on the academic outcomes of students with disabilities by synthesizing the quantitative findings across the body of research examining this relationship, to determine if there are positive academic outcomes from co-teaching students who have disabilities.

Overall Effect Size

The overall effect size across the 20 analyzed studies was $g = .281$, $k = 32$, $p > .05$, indicating that co-teaching did have a significant effect on increasing academic outcome measures of students with disabilities, compared to other instructional settings. These results help support the finding by Fontana (2005) where students with disabilities in a co-taught setting had statistically significant higher academic outcomes than those with disabilities not taught in a co-teach setting. Conversely, these data refutes Packard, Hazelkorn, Harris, and McLeod's (2011) research, which revealed that co-teaching does not lead to higher academic outcomes of students with disabilities.

Further examination of these studies within the current meta-analysis shows that co-teaching was more effective than instruction in the resource class setting. Though other factors may have contributed to the increase in academic gains, it is important to acknowledge the academic gains of students with disabilities in co-teach versus resource room settings. Co-teaching provides students with instructional options and increases performance and participation of students with disabilities in general curricula (Mastropieri, Scruggs, Graetz, Norland, Gardizi, & McDuffie, 2005). This finding helps support the notion that students with disabilities can perform at higher levels in the general education classroom with the right supports.

Additionally, co-teaching was most effective on academic outcomes when students with disabilities are in co-teaching settings for a year or longer. Dissertations used in the meta-analysis showed statistically significant academic outcomes of co-teaching. This finding may be attributed to the length of time these studies were conducted. Of the dissertations, 11 of the 13 analyzed contained interventions lasting one year or longer. This further supports the finding that positive academic outcomes of co-teaching are likely to result with longer intervention time in the co-teaching setting.

Continuous Moderator: Length of Time of Studies

The meta-regression was conducted with length of time as a continuous variable, and the length of time of intervention was significant, $Q = 109.05$, $p < .001$, $p < .001$. Length of time for intervention of co-teaching is strongly related to academic outcomes, so the longer students are exposed to co-teaching, the higher the academic gains are of those students. This finding should be noted when future researchers examine

academic gains of students that have only been exposed to co-teaching for a short period of time. The peer-reviewed journal articles were not significant in the study, which this result could be attributed to this finding. There may be several reasons for this. First, that it takes time for the co-teachers to create a cohesive bond necessary for working effectively together. It is possible that the longer teachers co-teach together, the more effective the co-teaching can be. Another explanation might be the amount of time necessary transition between settings, resource to co-teaching. If a student has spent several years in a resource setting, it might take time to adjust to the expectations and demands of the general education classroom.

Students with Disabilities in Co-teaching vs. Non-Co-teaching

Academic outcomes of students with disabilities in co-teaching were compared to academic outcomes those receiving services in resource rooms, and significant effects were found for verbal/language arts ($g = .330, k = 17, p < .05$) and math/science ($g = .226, k = 16, p < .001$). Students who attend resource classes need more specially designed instruction. Because of the nature of this setting, students may not be, exposed to the rich content and instruction that can be obtained in the general education setting. Therefore, moving students from resource to co-teaching environments is increasingly becoming the method schools use to educate students with disabilities. Result of this study indicate that the students will perform at a higher level while in a co-teach setting as opposed to a resource setting in both math/science and verbal/language arts, therefore, providing evidence that the co-teaching setting is a better alternative than resource. While many of the studies used in the analysis that

measured both math and English, it was rare to have positive outcomes on co-teaching in both areas. This finding suggests that students with disabilities do preform at a higher level in both areas.

Significant Moderator Effects

There was a significant effect for dissertations ($g = .439$, $k = 25$, $p < .001$). This study's data may be the result of the length of time it took for the studies to take place. As mentioned previously, studies that lasted longer had higher statistically significant results. Many reviewed dissertations contained studies with co-teaching data that lasted longer, but most peer-reviewed journal articles consisted of co-teaching research that lasted several months less than did the dissertation research studies. A significant effect for dissertations should have been expected, given a significant effect of co-teaching interventions that lasted longer, and most dissertations contained co-teaching research of one year or longer. This finding further supports that the length of time co-teaching is implemented relates to the positive academic outcomes of students with disabilities in co-teaching settings. It should be noted that many reviewed dissertations resulted in statistically significant academic achievement of special education students in co-teaching, but they did not result in peer-reviewed publications for a variety of unknown reasons.

In dissertations, there was a significant effect of co-teaching on verbal/language arts scores ($g = .314$, $k = 17$, $p < .05$) and math/science scores ($g = .539$, $k = 13$, $p < .001$). This finding indicates that compared to publications, studies that contained special education students exposed to co-teaching tended to have greater academic

outcomes. However, this contradicts what Murawski (2006) noted, which was that results indicated that reading and writing academic outcomes of students with disabilities in co-taught classrooms were not statistically significant, compared to three other groups of students. Murawski's (2006) study only lasted 10 weeks, which could be the reason her results were not significant, based on results discussed previously. When researching implementation of co-teaching based on subject areas, further research should be focused on academic outcomes of students with disabilities in co-teaching for at least one year to derive the most accurate data.

Co-Teaching vs. Non Co-Teaching: Non-Significant Effects

There is not a significant effect of co-teaching for control groups of students in either primary or secondary schools. Examining grade levels of students is not a factor of academic achievement outcomes in co-taught settings. This result indicates that regardless of age or grade level, success of co-teaching is dependent on other factors, such as length of time students are exposed to co-teaching settings. It is possible that as more research is conducted and co-teaching has been implemented and improved, the grade levels and age differences may become more prevalent.

Limitations

This meta-analysis was conducted to better understand relationships and efficacy of co-teaching on student achievement outcomes of students with disabilities. Before generalizing results, limitations of this study should be discussed and the results should be used with caution. The first limitation of this study is how academic

outcomes are measured. Academic outcome measurements vary from state assessment data to teacher-made assessments. The level of difficulty of these academic outcomes could vary drastically based on the rigor of assessments, the subject content being assessed, the grade level of students, and the amount of content being addressed in assessments. Therefore, results of the study may be skewed because academic outcomes are not standard across all studies.

Another limitation is that extraneous variables may not have been measured but could have directly impacted success/failure of co-teaching settings. For example, the cohesiveness of co-teaching teams could play roles in students' academic achievement outcomes. It can be argued that if co-teaching teams do not work in tandem or are not working well together as a team, students' academic outcomes could be lower. This variable was not measured, but it may have influenced academic achievement outcomes.

Other variables that may have influenced academic outcomes of students with disabilities in co-teach settings are the type of disability, amount of planning time co-teachers had, number of years co-teachers had co-taught (together or with other team members), type of co-teaching settings being implemented, students' prior experience with co-teaching (or lack thereof), class size, number of students with disabilities in the class, types and levels of disabilities, and support from administration. Many variables seem important to measure, but few studies reported them, probably because they are difficult to quantify or collect data. Without having the information for these variables, it is difficult to truly explain if the gains in academic achievement in a co-teaching setting

is due to the co-teaching itself, or do to other factors that benefit students with disabilities.

Finally, the last limitation is the lack of quantitative, peer-reviewed journal articles that measure the effectiveness of co-teaching. The researcher only found seven quantitative peer-reviewed journal articles, dating back to 1995, containing enough information to determine an effect size. This small number of studies does not truly reflect the overall number of public schools implementing co-teaching. Though 13 other studies were used in this analysis, peer-reviewed publications are more highly revered and accepted in the educational community. The dissertations used in the study should be viewed with caution given that these articles have not been approved or submitted in a peer-review journal. This could be due to the lack of acceptance of the findings or due to the methods used. Taken as a whole, these limitations may have hindered the generalizability of results.

Future Research

Quantitative research measuring the academic achievement of students with disabilities in co-taught settings has been limited. In order to better meet the federal mandates of IDEA and NCLB and to ensure increased participation of students with disabilities in the co-teach setting, much more research is needed to determine the effectiveness of co-teaching and to make educational decisions in the future. Based on this study's findings, students with disabilities in co-teaching settings have higher academic gains than do students with disabilities in resource classes. This result should be further examined, and future research should be focused on measuring

academic outcomes of co-teaching settings after one year or longer. Measuring academic outcomes of implementing co-teaching for less than one year is likely not to produce positive results; therefore, research will not provide practitioners information needed to implement successful co-teaching. Furthermore, examining co-teaching implementation for a number of weeks instead of at least one school year does not seem practical, given increasingly positive results of students' academic achievements when students are co-taught for longer periods of time and negative results of students' academic achievements when students are co-taught for shorter periods of time.

It is also strongly suggested that future research include other variables such as the classroom setting, type of disabilities, teacher characterizes, school climate and method of co-teaching implemented. Even though results of this study show statically significant academic gains of students with disabilities in a co-teaching setting versus students with disabilities in a resource setting, it is difficult to determine that this result hinged on the co-teaching setting alone. Many other important factors (i.e., models of co-teaching used) could have explained the academic gains of the co-teaching setting. Analyzing these other variables, along with the co-teaching setting, should yield better results that better explain the increases in academic gains.

Additionally, future researchers should strive to measure similar academic outcomes, such as using state assessments only. Future researchers should be cautious when comparing different types of data and should understand that it is unrealistic to effectively compare academic achievement on state examinations to teacher-made assessments. Limiting results based on same types of academic outcomes will help ensure results are more accurate and generalizable. This can be

achieved by ensuring reporting standards are examined and put in place based on future research. Determining standards will insure future research regarding co-teaching is more streamlined and variables that are commonly used can be better examined to investigate the factors that best promote successful co-teaching on the academic achievement of students with disabilities.

Summary

Implementations of co-teaching in public schools have been steadily increasing since the passage of IDEA of 1997, and even more so since NCLB of 2001 and IDEIA of 2004. A limited number of quantitative peer-reviewed journal articles have been used to determine co-teaching effects on academic outcomes of students with disabilities. Additionally, quantitative articles that have been published have yielded inconclusive results with a wide range of positive and negative results. Although the overall effect size of this study was significant ($g = .281$, $k = 32$, $p > .05$), more data from co-teaching implementations for students with disabilities is needed in order to provide better and more reliable co-teaching for practice in the classroom. The most prevalent finding from this study was the statistically significant difference between academic outcomes of special education students in co-teaching settings compared to academic outcomes of special education students in resource classes. Many special education students are candidates of participating in co-taught settings and come from resource classes, so knowing these students outperformed special education students in resource classes is valuable information. Additionally, academic outcomes of students in co-teaching settings significantly increased as the intervention continued for longer periods of time.

With this study's data, researchers who study co-teaching should consider length of the study and correlation of academic achievements with students who have disabilities in co-teach settings before making conclusions or conducting future research. It is apparent from this research that the longer students with disabilities are exposed to co-teach settings, the higher their academic gains tend to be. Therefore, conducting shorter co-teaching interventions would not truly represent the effectiveness of co-teaching on academic outcomes of students with disabilities. Future researchers studying how implementing co-teaching impacts academic outcomes should first consider how long students will be exposed to co-teaching. Used to serve students with disabilities in the general education classroom, co-teaching has been steadily growing as a service delivery model since the turn of the century. More long-term data should be available for researchers to use and analyze. As more long-term data is analyzed, researchers can begin to focus more on other variables that will increase the effectiveness of co-teaching on academic achievement outcomes of students with disabilities.

Other variables not analyzed in this study should also be researched. There are many other factors that could have explained the increase in academic gains of students with disabilities in the co-teach setting. Of the 20 articles used in this study, only 5 produced information about the type of student disability, 5 provided information about teacher training and planning time, 5 provided information about teacher experience and no articles noted the model of co-teaching implemented. Other variables such as the classroom setting, school climate and support from the administration were not reported, and rarely discussed. These factors must be

considered in future research in order to better explain the various reasons co-teaching may be beneficial, rather than the co-teaching itself. It is important to analyze as many possible contributing factors as possible in order to make the findings in future research more generalizable.

This study has indicated that students with disabilities who are in co-taught environments and who would otherwise be in resource have significantly higher educational gains in verbal/language arts and math/science than do special education students who continue their placements in resource settings. This evidence supports the notion that implementing co-teach settings to deliver content to special education students is more effective than is using resource as educational placement. Future research is recommended to better examine this result by including more variables examining the co-teaching setting and teacher characteristics. Additionally, future research should examine the academic effects of the co-teaching intervention for a year or longer. The results of this study should be used with caution until further research is conducted.

THE EFFECT OF CO-TEACHING ON THE ACADEMIC ACHIEVEMENT OUTCOMES OF STUDENTS WITH DISABILITIES: A META-ANALYTIC SYNTHESIS.

Introduction

The use of teacher collaboration is not a new ideology when serving students with special needs, as it has been used in special education for several decades. However, in recent decades the call for certified general education and special education teachers to work as partners in the provision of instruction in the same classroom setting (i.e., co-teaching) has sharply increased (Friend & Cook, 2010). The Individuals with Disabilities Act of 1997 (IDEA) emphasized students with disabilities who receive instruction in general education settings. Passing the IDEA showed more prevalence of co-teaching with a general and special education teacher as a delivery model for educational service for supporting students who receive special education services in general education settings.

Though including students who have special needs in general education classrooms was already taking place, IDEA of 1997 sparked public schools to create improved models of instruction to ensure students who have disabilities are educated in the least restrictive environment (LRE; Nichols, Dowdy, & Nichols, 2010). Prior to IDEA of 1997, students with disabilities were often educated outside general education classrooms, and it was common for these students to be removed from accountability ratings, either by not being required to take the state assessments or by having their scores eliminated (McLaughlin & Rhim, 2007).

Reauthorization of the Individuals with Disabilities Education Improvement Act (IDEIA) of 2004 reaffirmed that all students (including students in general education and

students receiving special education services) must be measured using the same content area assessment, be exposed to the same curricula, and be educated in the LRE (Murawski & Lochner, 2010; Rice, Drame, Owens, & Frattura, 2007; Van Garderen, Scheuermann, Jackson, & Hampton, 2009; Zigmond, Kloo, & Volonino, 2009). Students who have disabilities, more than ever, needed to be exposed to general education curricula to have the opportunity to learn concepts in which they would be evaluated with high-stake assessments (Murawski & Lochner, 2010).

Co-Teaching

The goal of co-teaching is for two teachers to deliver high-quality instruction to all students, students in general education and students with disabilities, by having a general and special education teacher work to support each other in the same classroom (Pugach & Winn, 2011). Co-teach strategies should provide students' instructional options while increasing performance and participation of students with disabilities in general curricula (Mastropieri, Scruggs, Graetz, Norland, Gardizi, & McDuffie, 2005). Friend et al., (2010) outlined six co-teaching approaches:

1. *One teach, one observe*, in which one teacher leads large-group instruction while the other gathers academic, behavioral, or social data on specific students or the class group;
2. *Station teaching*, in which instruction is divided into three nonsequential parts and students, likewise divided into three groups, rotate from station to station, being taught by teachers at two of the stations and working independently at the third;
3. *Parallel teaching*, in which the two teachers, each with half the class group, present the same material for the primary purpose of fostering instructional differentiation and increasing student participation;

4. *Alternative teaching*, in which one teacher works with most students while the other works with a small group for remediation, enrichment, assessment, preteaching, or another purpose;
5. *Teaming*, in which both teachers lead large-group instruction by both lecturing, representing opposing views in a debate, illustrating two ways to solve a problem, and so on; and
6. *One teach, one assist*, in which one teacher leads instruction while the other circulates among the students offering individual assistance. (p. 12)

Previous Research

Several researchers have explored various outcomes and benefits of co-teaching. For instance, Scruggs, Mastropieri, and McDuffie (2007) conducted a meta-synthesis of 32 qualitative research articles from 1995 to 2005 and found several benefits of co-teaching for students with disabilities, including student report of extra attention and support, as well as increased academic gains and social benefits. Scruggs et al. (2007) noted only a few students in co-taught classrooms were unsuccessful, but as this was a qualitative review, the study did not attempt to quantify the impact of co-teaching on student academic outcomes. Mageria and Zigmond (2005) also found a positive benefit of co-teaching was that students with disabilities receive more individualized instruction, but noted when special education teachers were present, less one-on-one instruction was provided by general education. This finding suggested that the perceived equally shared responsibility of co-teaching for students with disabilities in classrooms diminishes when special education teachers are present.

Nevertheless, Nichols (2010) asserted that co-teaching is not the educational setting of choice because of the assumed quality of instruction but is rather primarily chosen just to meet the mandates of NCLB. The need still exists for more empirical

evidence of quantitative academic outcomes of co-teaching. Of the six articles analyzed, only two contained academic achievement outcomes specific to students with disabilities. Since the time of their study, Murkowski (2006) again stated that there is a lack of and a need for empirical student-based outcomes research on the academic impact of co-teaching.

Other researchers have questioned the benefits of co-teaching and lack of evidence-based academic outcomes for students with disabilities (Mastropieri & Scruggs, 2001; Volonino & Zigmond, 2007; Weiss, 2004). Specifically, their questions involve whether students with disabilities are better served in a co-taught setting or special education settings in which students receive specially designed instruction generally at a slower pace than they would in the general education setting (i.e., resource classes). Packard, Hazelkorn, Harris, and McLeod (2011) found that 9th grade students with disabilities who were placed in resource classes had larger gains in language area exams than their peers with disabilities placed in co-taught classes.

Limitations of Previous Research

Friend et al. (2010) noted that an issue with academic outcomes based research in co-teaching was that teachers are able to vary their delivery of co-teaching content, so controlling additional factors poses a problem. Additional factors such as co-teachers' planning time, types and severity of special education disabilities in classrooms, ratio of special education students to general education students, teachers' knowledge of content, amount of co-teacher training, and chemistry between teachers may also impact the effects and be difficult to control or assess..

Another perceived limitation may include the lack of theoretical frameworks for co-teaching (Thousand, Nevin, & Villa, 2007). Given the lack of theory on collaboration teaching, research in this area tends to be atheoretical, in which the research is driven by practitioner's institutional needs rather than scholarly inquiry, and is often difficult to generalize due to the lack of methodological control allowed to researchers.

Research Questions

The purpose of this meta-analytic research study is (a) to review and combine all empirical research studies based on quantitative academic outcomes to determine an overall effect size for co-teaching inclusion strategies and (b) to determine which dependent variables best influence the academic outcomes of students with disabilities in co-teach settings. Specifically asking:

- What is the impact of co-teaching on students with disabilities academic achievement?
- What models of co-teaching have the greatest impact on student achievement?
- Do effects vary by subject (i.e., verbal/language arts, math/science)?
- Do effects vary by grade level (primary or secondary)?
- Do effects vary by length of intervention (i.e., shorter than or longer than one year)?
- Do other moderators (i.e., study type, sample size, type of disability, school level, or type of outcome measure) affect co-teaching outcomes?

Methods

According to Murawski (2001), the statistical method of meta-analyses summarizes the findings from several research articles and combines results into one

overall estimated effect size. Overall estimated effect size is then analyzed to determine overall effects of a particular intervention. This research was used to focus on the main effect of co-teaching interventions on the academic achievement of students with disabilities. Moderator analyses were also conducted to better understand relationships and roles that specific contextual factors may play.

The following moderator variables were examined: school level (i.e., primary or secondary), length of co-teaching intervention (measured in years [continuous]), study type (i.e., dissertation or peer-reviewed article), comparison group type (i.e., resource or mainstream), academic subject area of outcome measure (i.e., math/science or verbal/language arts), and length of study. Further moderators could not be tested due to insufficient reported cases within the studies included in this analysis.

Inclusion and Exclusion Criteria

Because this research was designed to specifically address academic outcomes of special education students in co-teaching settings, the following list includes some required criteria for studies to qualify for analysis:

1. Specifically focused on use of co-teaching (one special education teacher and one general education teacher instructing together in the same class) as instructional model in grades Pre-K through 12.
2. Contained quantitative data measuring academic outcomes of students with disabilities in co-teaching settings.
3. Included data that permits calculation of a numeric effect size for at least one eligible outcome variable.
4. Used a true- or quasi-experimental research design.
5. Study contained a comparison group (i.e., control, alternative to co-teaching).
6. Was not a master thesis.

Articles that met search criteria dated from the early 1970s to present. However, articles dated prior to 1992 were excluded from this analysis because the co-teaching model employed in these studies (referred to as team teaching) consisted of two general education teachers, and outcomes focused on general education students outcomes (Meehan, 1973). Therefore, articles dated prior to 1992 did not meet criteria set for inclusion in this analysis. Articles were also excluded from this analysis if the results did not provide quantitative academic outcomes, there was not sufficient information to determine an effect size, only outcomes for students in general education were reported, or the instruction involved one certified teacher and one non-certified teacher.

Search Strategy

Electronic searches of ERIC, Education Research Complete, and PsycInfo were conducted using the EBSCO Host database. Combinations of descriptor terms used in searches included *co-teach*, *team teach**, *collaborative teaching*, and *cooperative teach** with *achievement*, *outcomes*, *efficacy*, and *effect**. No publication date limits were set in databases software for this article search. However, publication and document type limiters were set, including, books, full text digests, and journal articles.

The complete literature review process resulted in locating 65 potential reports to further review (i.e., 23 journal articles, 32 dissertations from electronic searches, and 10 articles from reference searches). Of these 65 potential reports, 45 reports were excluded from the final meta-analysis for not meeting all of the inclusion criteria (e.g., insufficient data reported, missing information, etc.). As such, the final meta-analysis

included 20 studies (i.e., 4 journal articles, 13 dissertations from electronic searches, and 3 journal articles from reference searches) that meet this study's inclusionary criteria and were coded.

Coding Procedures

After all studies pertinent to this meta-analysis were chosen, each report was coded for demographic and co-teaching variables. Demographic variables consisted of student age, gender, grade, ethnicity, and type of disability, as well as control group information (i.e., educational setting; number of students; disability types). Co-teaching variables selected for coding included: the co-teaching model implemented, grade or grades being co-taught, number of co-taught students with disabilities, type of measures used for analysis, type of statistical analysis in study, and teacher information (i.e., number of special education and general education teachers participating, amount of co-teach training prior to implementation, amount of co-teach planning time, number of years of teaching experience, number of years as a co-teacher, level of teacher education, and types of teacher attitudes towards co-teaching). Interobserver agreement (IOA) was conducted by the author and a trained coder on five (25.0%) studies to determine the level of agreement in determining study characteristics. The percent agreement between the two raters was 100.0%, indicating perfect agreement across raters. An overview of IOA coding is outlined in Appendix A.

Statistical Methods

Effect Size Metric and Calculation

Effect sizes were calculated based on the pretest adjusted standardized mean difference (SMD) between pre- and post-intervention scores for co-teaching exposure and non-co-teaching exposure; effect sizes were expressed as Hedge's *g*. Effect sizes were calculated utilizing the Comprehensive Meta-Analysis software (CMA, v2). Based on Hedges' (1982) recommendation, there were differences in sample sizes (notably among small samples), so effect sizes of studies were adjusted using the small sample correction defined as $1 - (3/4n - 9)$. Due to various sample sizes across studies, Hedge's *g* was used as the measure of effect size for all studies. For this study, effect sizes will be interpreted as small ($\sim.15$), medium ($\sim.45$), and large ($\sim.90$), based on Lipsey and Wilson's (2001) recommendation.

Statistical Procedures

Before the primary meta-analysis was conducted, exploratory analyses were completed to examine the potential impact of outliers on primary analyses. Specifically, extreme outliers of computed effect sizes and sample sizes were examined utilizing SPSS version 19 based on criteria of set by Tukey (1977). None of the obtained and/or calculated effect sizes met criteria of an extreme outlier, so effect sizes were not modified. Additionally, before primary meta-analyses were conducted, weights were assigned to each study based on an average weighted index in order to counter balance the potential impact of sample size on effect sizes and were computed utilizing the CMA software, (see Appendix B for weighted values; Cooper, 2009).

Next, the homogeneity of studies utilized in this meta-analysis was examined by computing the *Q* statistic, as follows:

$$Q = \sum w_i * (g_i - \bar{g})^2$$

Where w_i refers to the weight assigned, g_i refers to the effect size (expressed as Hedge's g), for each study, and \bar{g} refers to the sum of effect sizes. The Q statistic is based on the chi-square distribution, and df is defined as $k - 1$ (Lipsey & Wilson, 2001). A significant Q statistic indicates that differences in effect sizes may not be fully accounted for by sampling error.

The primary meta-analyses used a random effects model, as recommended by Field and Gillett (2010). Multiple effect sizes within a single study were retained in analyses; however, these effect sizes were parceled out to investigate potential impact of moderators. Categorical moderators were tested by conducting random effects model of data split by categorical moderator. Further interactions of multiple categorical moderators were tested by taking multiple splits of moderators by key moderators of interest: in this case, outcome measure type (e.g., verbal/language arts and math/science). Continuous moderators were tested using meta-regressions and predicting outcome effect size from length of intervention. To further examine impacts of outcome measure types, meta-regressions were also conducted on split files to detect potential differences in relationships between intervention length and effect size as a function of outcome measure type. In addition to these analyses, forest plots, funnel plots (to examine publication bias), and scatter plots were used as visual representations of this study's findings. These analyses used CMA software and the metafor package for R (Vietchbauer, 2010).

Results

The primary objective of this meta-analytic review was to examine the efficacy of co-teaching on student achievement outcomes of students with disabilities. A secondary purpose of this review was to examine roles potential moderators play in relationships between co-teaching and student achievement outcomes. Reviewed studies allowed for examination of the following moderators: identified specific disability, school level (i.e., primary or secondary), length of co-teaching intervention, study type, co-teaching comparison group (i.e., resource or mainstream), and academic subject area of outcome measure (i.e., math/science or verbal/language arts). In addition to meta-analysis procedures discussed above, forest plots are presented in Figures 1–3. In these figures, effect sizes are reported with confidence intervals and larger effect sizes are shown with proportionately large icons on figures.

Article Descriptives

Descriptives of studies included in the meta-analysis are presented in Table 1. The majority of studies included were conducted in secondary schools ($n = 11$, $k = 10$, 64.7%). In addition, 65.0% ($n = 13$) of studies included co-teaching interventions for one year or longer. A greater number of studies included were dissertations ($n = 13$, $k = 25$, 61.9%), compared to peer-reviewed publications ($n = 8$, $k = 7$, 38.1%). Over half of the studies also included verbal/language arts outcome measures. While this study planned on investigating teacher-level characteristics in the primary analyses, coding revealed that an inadequate number of studies provided sufficient information about co-

teachers for further analysis to be conducted. Further study descriptives are outlined in Appendix B and Appendix C.

Other potential moderators coded were not able to be analyzed due to the limited number of studies that reported these characteristics. Among these characteristics were the co-teaching method used, the type of student disability and co-teacher characteristics (i.e., education level, number of teaching years, co-teaching training, planning time). The reported measures for each article coded is displayed in Appendix D.

Table 4

Study Characteristics for Comparative Analysis

		<i>n</i>	%	<i>M</i>	<i>k</i>	<i>SD</i>
School Level Identified	Primary	8	44.4		12	
	Secondary	10	55.5		10	
Comparison Group	Resource	15	75.0		27	
	Mainstream	5	25.0		5	
Study Type	Peer Reviewed Publication	7	35.0		7	
	Dissertation	13	65.0		25	
Subject Identified	Math/Science	14	45.2		14	
	Verbal/Language Arts	17	54.8		17	
Length of Study		18		.92	30	.55

Note. Percentages reported are percentages within subheading; frequencies not summing to 20 reflect studies that did not provide enough information to determine subgrouping domain

Summary of Effect Sizes

As shown in Table 52, the Q-test for overall estimated effect size was significant, indicating that studies in analyses were heterogeneous and that differences in variance

were likely due to factors other than sampling bias. The overall effect size for all studies included ($k = 32$), was significant, $g = .281$, $p < .05$, indicating that students with a disability who were exposed to co-teaching had superior learning outcomes compared to students with disabilities who were not exposed to co-teaching. Figure 6 displays the obtained effect sizes, confidence intervals, and random effects model of studies in meta-analysis.

Table 5

Mean Effect Sizes (g), 95% Confidence Intervals (CI), Number of Effect Sizes (k), and Random Effects Homogeneity Statistics (Q) for Weighted Analyses

Target Sample	g	95% CI		k	Q	
All Studies	.281*	.041	.521	32	126.43***	
School Level	Primary	.285	-.068	.637	12	44.01***
	Secondary	.188	-.431	.807	10	52.55***
Study Type	Publication	-.343	-.903	.216	7	24.60***
	Dissertation	.439***	.202	.676	25	82.53***
Subject	Math/Science	.278	-.029	.585	14	42.87***
	Verbal/Language Arts	.275	-.097	.646	17	82.70***
Comparison Group	Resource	.435***	.256	.615	27	56.52***
	Mainstream	-.660	-1.537	.218	5	22.53***

Note. * $p < .05$; ** $p < .01$; *** $p < .001$; negative g indicates decreased score across comparison group.

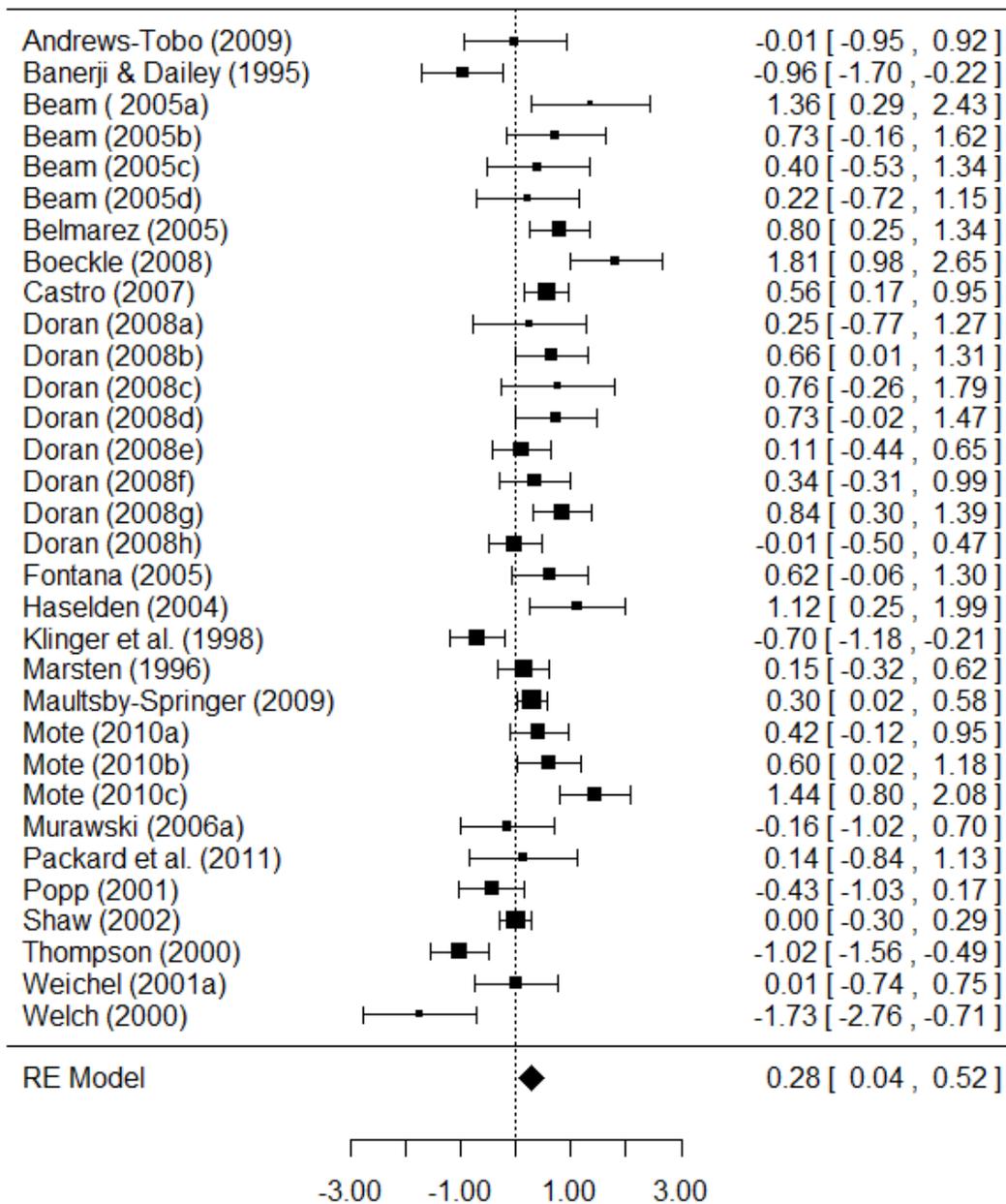


Figure 6. Forest plot of effects of co-teaching (all studies).

Examination of Moderators

Simple Moderators

An overview of the analysis of dichotomous moderators is outlined in Table 2. As shown, the Q-test was significant across all moderators tested (i.e., school level, study

type, subject, and comparison group), indicating that factors other than sampling biases likely contributed to differences in variance across studies. A significant estimated effect size among reviewed dissertations showed that students who were exposed to co-teaching had significantly greater outcomes than did students who were not exposed to co-teaching ($g = .439$, $k = 25$, $p < .05$). Across studies included in this meta-analysis, a significant estimated effect size depended on the comparison group to which the co-teaching was being compared. Compared to students who were put in a resource room, students who were exposed to co-teaching tended to perform better, ($g = .439$, $k = 27$, $p < .001$). The remaining dichotomous moderators (e.g., school level, subject, mainstream comparison group). failed to yield a significant effect of co-teaching on academic outcomes across school level or subject matter (all $p > .05$).

Interaction of Dichotomous Moderators

To investigate potential differences in estimated effect sizes by outcome measure, additional analyses were conducted, stratified by outcome measure type (see Table 3). An overview of the estimated effect sizes obtained is outlined in Figures 2 and 3. There was a significant estimated effect size for school level on math outcomes, with those in primary school exposed to co-teaching having significantly higher learning outcomes ($g = .440$, $k = 10$, $p < .05$). Additionally, further analyses were conducted to test for significant effects of co-teaching by subject and other dichotomous moderators to investigate any potential interaction effects of dichotomous moderators by subject type of outcome measures (see Table 3). Analyses split by outcome measure types yielded similar findings, indicating that relationships among co-teaching exposure and

students' learning outcomes tended to have the same degree of efficacy, regardless of outcome measure type.

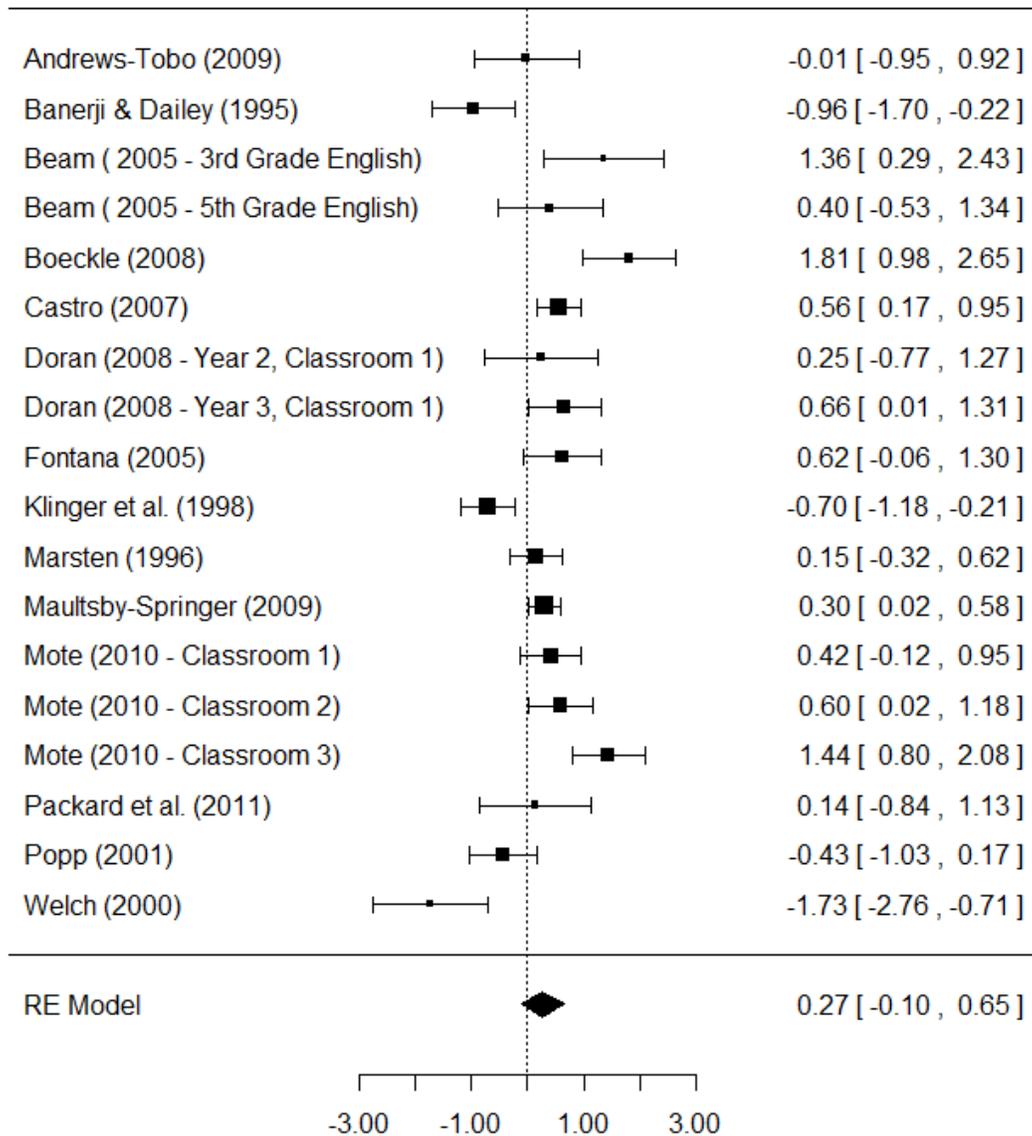


Figure 7. Forest plot of effects of co-teaching (verbal/language arts).

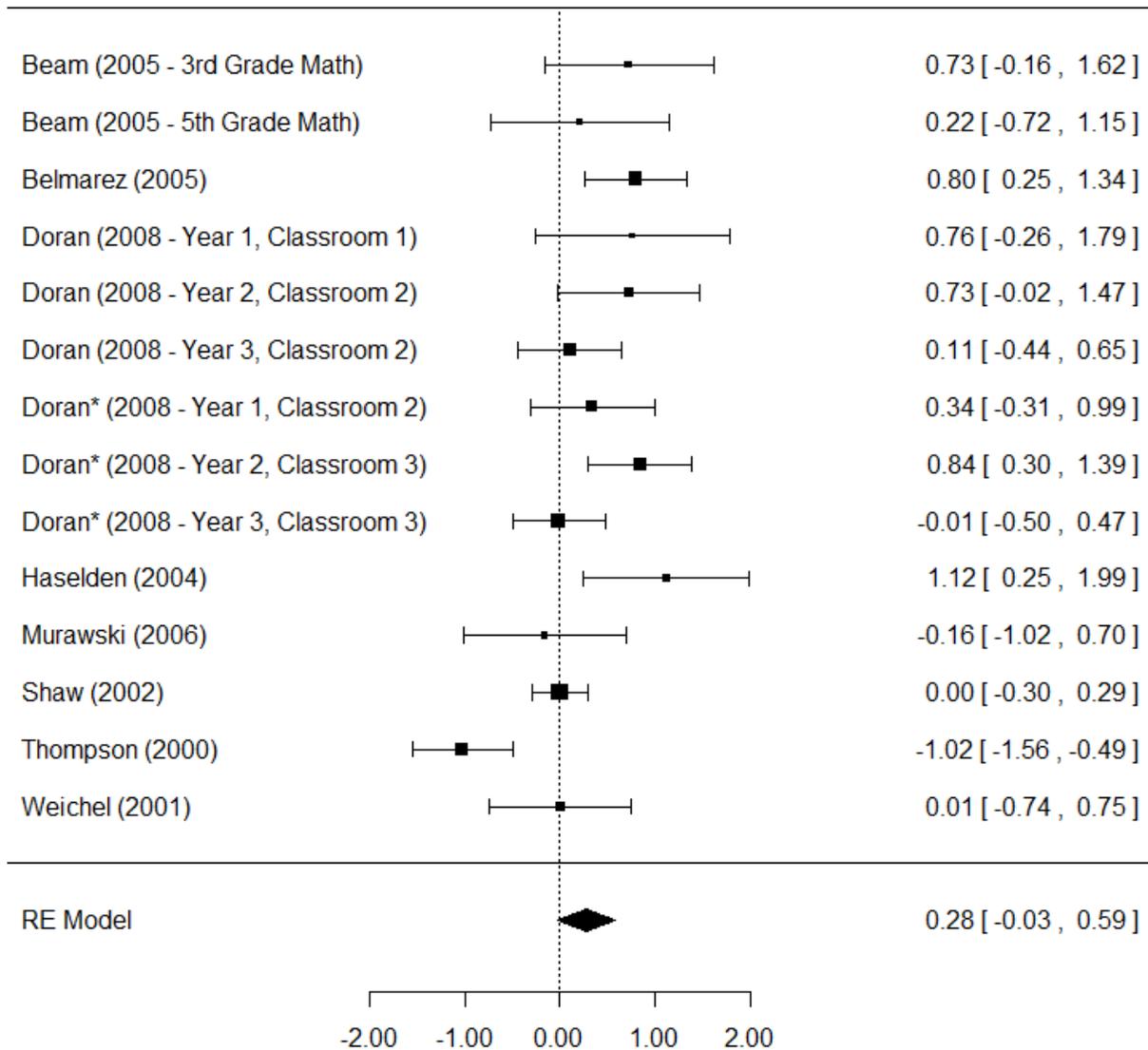


Figure 8. Forest plot of effects of co-teaching (math/science). (*Science outcome).

Examination of Continuous Moderators

To test the potential moderating effect of length of co-teaching exposure on student learning outcomes, a meta-regression was conducted. The overall tests of heterogeneity was significant, $Q = 109.05$, $p < .001$, indicating that the variance in outcomes was not a simply a function of sampling error. The regression model, however, did not find a significant relationship between length of exposure to co-

teaching and student outcomes, $z = 1.18$, $p = .24$, indicating that amount of time in the intervention was not associated with student outcomes. In order to examine heterogeneity by showing how each study contributes to the overall Q-test statistic, a Baujat plot was used. This is outlined in Figure 4.

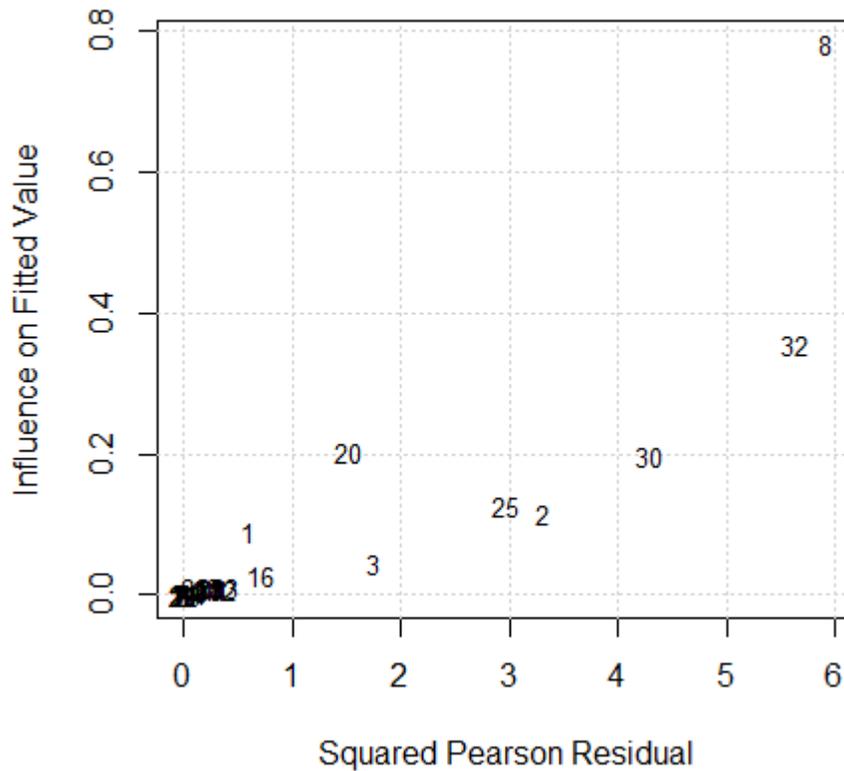


Figure 9. Baujat plot meta-regression using length of intervention.

Examination of Multiple Moderators

In order to examine the potential interaction effects of key moderators, a series of meta-regressions were conducted. Results from this meta-regression yielded no significant findings; all were $p > .05$, indicating that there does not appear to be an interaction effect of predicted moderators (i.e., length of study, school level, study type, comparison group).

Table 6

Mean Effect Sizes (*g*), 95% Confidence Intervals (*CI*), Number of Effect Sizes (*k*), and Random Effects Homogeneity Statistics (*Q*) for Weighted Analyses

Target	Verbal/Language Arts					Math/Science				
	<i>g</i>	95% <i>CI</i>		<i>k</i>	<i>Q</i>	<i>g</i>	95% <i>CI</i>		<i>Q</i>	
Comparison										
Res.	.330 **	.145	.515	17	26.70 *	.482 **	.226	.738	16	39.73 ***
Main.	-.378	-1.267	.511	4	18.13 **	-.708	-.152	.107	4	12.56 **
Level										
Prim.	.110	-.366	.586	7	27.02 ***	.440 **	.199	.680	10	13.83
Sec.	.264	-.153	.691	5	12.56 *	.141	-.630	.911	8	49.81 ***
Study Type										
Pub.	-.377	-.855	.102	4	7.33	-.299	-.875	.278	7	25.62 ***
Diss.	.314 *	.055	.574	17	52.35 ***	.539 **	.232	.847	13	37.52 ***

Note. * $p < .05$; ** $p < .01$; *** $p < .001$; $\psi p < .10$; negative *g* indicates decreased score across comparison; Res. = Resource; Main. = Mainstream; Prim. = Primary; Sec = Secondary; Pub. = Publication; Diss. = Dissertation

Publication Bias

To investigate the potential impact of publication biases, a funnel plot of all used studies was created (see Figure 10). As shown, effect sizes from studies of small sample sizes ranged from the true zero effect size, which provides support that publication biases did not heavily impact this meta-analysis. Funnel plots provide a visual estimation of the impact of potential publication biases, but the nature of publication biases (i.e., inability to review data that is not available) do not allow researchers to fully determine the exact impact of publication biases on given meta-analyses. Further examination of publication bias was addressed utilizing Rosenthal's fail safe *N* indicating that there would have to be 230 studies that were not included in

this analysis need for the results of this study to be significantly impacted by a publication bias.

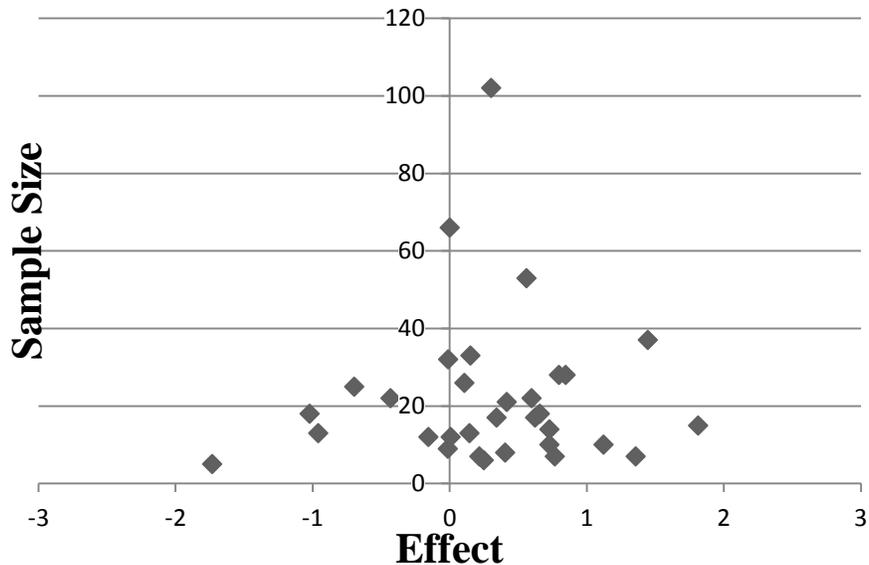


Figure 10. Funnel plot investigating publication bias.

Discussion

Since the passage of the IDEA of 1997, co-teaching has been a more prevalent teaching model used in public schools to deliver rich content of general education curricula to students with disabilities (Nichols, Dowdy, & Nichols, 2010). This study attempts to clarify the impact of co-teaching on the academic outcomes of students with disabilities by synthesizing the quantitative findings across the body of research examining this relationship, to determine if there are positive academic outcomes from co-teaching students who have disabilities. The examination included studies that resulted in positive and negative academic outcomes. Moderators were also examined to determine how implementing co-teaching affected students with disabilities.

Overall Effect Size

The overall effect size across the 20 analyzed studies was $g = .281$, $k = 32$, $p > .05$, indicating that co-teaching did have a significant effect on increasing academic outcome measures of students with disabilities, compared to other instructional settings. These results help support the finding by Fontana (2005) where students with disabilities in a co-taught setting had statistically significant higher academic outcomes than those with disabilities not taught in a co-teach setting. Conversely, these data refutes Packard, Hazelkorn, Harris, and McLeod's (2011) research, which revealed that co-teaching does not lead to higher academic outcomes of students with disabilities. Further examination of these studies show that co-teaching was more effective than instruction in the resource class setting. Even though there are other factors that may have contributed to the increase of academic gains, it is important to see the academic gains of students with disabilities in co-teach rather than resource. Co-teaching provides students with instructional options and increases performance and participation of students with disabilities in general curricula (Mastropieri, Scruggs, Graetz, Norland, Gardizi, & McDuffie, 2005). This finding helps support the notion that students with disabilities can perform at higher levels in the general education classroom with the right supports.

Additionally, co-teaching was most effective on academic outcomes when students with disabilities are in co-teaching settings for a year or longer. Dissertations used in the meta-analysis showed statistically significant academic outcomes of co-teaching. This finding may be attributed to the length of time these studies were conducted. Of the dissertations, 11 of the 13 analyzed contained interventions lasting

one year or longer. This further supports the finding that positive academic outcomes of co-teaching are likely to result with longer intervention time in the co-teaching setting.

Continuous Moderator: Length of Time of Studies

The meta-regression was conducted with length of time as a continuous variable, and the length of time of intervention was significant, $Q = 109.05$, $p < .001$, $p < .001$. Length of time for intervention of co-teaching is strongly related to academic outcomes, so the longer students are exposed to co-teaching, the higher the academic gains are of those students. This finding should be noted when future researchers examine academic gains of students that have only been exposed to co-teaching for a short period of time. The peer-reviewed journal articles were not significant in the study, which this result could be attributed to this finding. There may be several reasons for this. One being that it takes time for the co-teachers to create a cohesive bond to better work together. It is possible that the longer the teachers co-teach together, the more effective the co-teaching can be. Another explanation could be the amount of time it takes a student with disabilities in co-teach to transition from a resource setting. There may be times in which a student has spent several years in a resource setting, and it could take several weeks for the student to make the transition and understand the expectations and demands of the general education classroom. Lastly, the dissertations used in the study should be viewed with caution given that these articles have not been approved or submitted in a peer-review journal. This could be due to the lack of acceptance of the findings or due to the methods used.

Students with Disabilities in Co-teaching vs. Not in Co-teaching

Academic outcomes of students with disabilities in co-teaching were compared to academic outcomes of special education students in resource rooms, and significant effects were found for verbal/language arts ($g = .330, k = 17, p < .05$) and math/science ($g = .226, k = 16, p < .001$). Special education students who attend resource classes need more specially designed instruction. Because of the nature of this setting, special education students are not exposed to the rich content and instruction that can be obtained in the general education setting. Therefore, moving this student from resource to a co-teaching environment may be the method schools use to educate special education students in the general education classroom in order to provide the quality of education needed to promote increased academic outcomes. This result indicates that the special education students will perform at a higher level while in a co-teach setting as opposed to a resource setting in both math/science and verbal/language arts, therefore, providing evidence that the co-teaching setting is a better alternative than resource. While many of the studies used in the analysis that measured both math and English, it was rare to have positive outcomes on co-teaching in both areas. This finding suggests that students with disabilities do perform at a higher level in both areas.

Significant Moderator Effects

There was a significant effect for dissertations ($g = .439, k = 25, p < .001$). This study's data may be the result of the length of time it took for the studies to take place. As mentioned previously, studies that lasted longer had higher statistically significant results. Many reviewed dissertations contained studies with co-teaching data that

lasted longer, but most peer-reviewed journal articles consisted of co-teaching research that lasted several months less than did the dissertation research studies. A significant effect for dissertations should have been expected, given a significant effect of co-teaching interventions that lasted longer, and most dissertations contained co-teaching research of one year or longer. This finding further supports that the length of time co-teaching is implemented relates to the positive academic outcomes of students with disabilities in co-teaching settings. It should be noted that many reviewed dissertations resulted in statistically significant academic achievement of special education students in co-teaching, but they did not result in peer-reviewed publications for a variety of unknown reasons.

In dissertations, there was a significant effect of co-teaching on verbal/language arts scores ($g = .314$, $k = 17$, $p < .05$) and math/science scores ($g = .539$, $k = 13$, $p < .001$). This finding indicates that compared to publications, studies that contained special education students exposed to co-teaching tended to have greater academic outcomes. However, this contradicts what Murawski (2006) noted, which was that results indicated that reading and writing academic outcomes of students with disabilities in co-taught classrooms were not statistically significant, compared to three other groups of students. Murawski's (2006) study only lasted 10 weeks, which could be the reason her results were not significant, based on results discussed previously. When researching implementation of co-teaching based on subject areas, further research should be focused on academic outcomes of students with disabilities in co-teaching for at least one year to derive the most accurate data.

Future Research

Much more research is needed to determine the effectiveness of co-teaching and to make educational decisions in the future. Based on this study's findings, students with disabilities in co-teaching settings have higher academic gains than do students with disabilities in resource classes. This result should be further examined, and future research should be focused on measuring academic outcomes of co-teaching settings after one year or longer as well as investigate other possible variables that may influence the co-teach setting. When researchers measure co-teaching implementation after one year or longer and it is established that co-teaching increases academic achievements of students with disabilities, researchers can then look at specific variables (i.e., models of co-teaching used) to determine which characteristics of co-teaching are strongest predictors of academic achievements. Additionally, future researchers should strive to measure similar academic outcomes, such as using state assessments only.

Summary

Implementations of co-teaching in public schools have been steadily increasing since the passage of IDEA of 1997, and even more so since NCLB of 2001 and IDEIA of 2004. A limited number of quantitative peer-reviewed journal articles have been used to determine co-teaching effects on academic outcomes of students with disabilities. Additionally, quantitative articles that have been published have yielded inconclusive results with a wide range of positive and negative results. Although the overall effect size of this study was significant ($g = .281$, $k = 32$, $p > .05$), more data from co-teaching

implementations for students with disabilities is needed. The most prevalent finding from this study was the statistically significant difference between academic outcomes of special education students in co-teaching settings compared to academic outcomes of special education students in resource classes. Many special education students are candidates of participating in co-taught settings and come from resource classes, so knowing these students outperformed special education students in resource classes is valuable information. Additionally, academic outcomes of students in co-teaching settings significantly increased as the intervention continued for longer periods of time.

With this study's data, researchers who study co-teaching should consider length of the study and correlation of academic achievements with students who have disabilities in co-teach settings before making conclusions or conducting future research. It is apparent from this research that the longer students with disabilities are exposed to co-teach settings, the higher their academic gains tend to be. Therefore, conducting shorter co-teaching interventions would not truly represent the effectiveness of co-teaching on academic outcomes of students with disabilities. Future researchers studying how implementing co-teaching impacts academic outcomes should first consider how long students will be exposed to co-teaching. Used to serve students with disabilities in the general education classroom, co-teaching has been steadily growing as a service delivery model since the turn of the century. More long-term data should be available for researchers to use and analyze. As more long-term data is analyzed, researchers can begin to focus more on other variables that will increase the effectiveness of co-teaching on academic achievement outcomes of students with disabilities.

Other variables not analyzed in this study should also be researched. There are many other factors that could have explained the increase in academic gains of students with disabilities in the co-teach setting. Of the 20 articles used in this study, only 5 produced information about the type of student disability, 5 provided information about teacher training and planning time, 5 provided information about teacher experience and no articles noted the model of co-teaching implemented. Other variables such as the classroom setting, school climate and support from the administration were not reported, and rarely discussed. These factors must be considered in future research in order to better explain the various reasons co-teaching may be beneficial, rather than the co-teaching itself. It is important to analyze as many possible contributing factors as possible in order to make the findings in future research more generalizable. This can be achieved by ensuring reporting standards are examined and put in place based on future research. Determining standards will insure future research regarding co-teaching is more streamlined and variables that are commonly used can be better examined to investigate the factors that best promote successful co-teaching on the academic achievement of students with disabilities.

This study has indicated that students with disabilities who are in co-taught environments and who would otherwise be in resource have significantly higher educational gains in verbal/language arts and math/science than do special education students who continue their placements in resource settings. This evidence supports the notion that implementing co-teach settings to deliver content to special education students is more effective than is using resource as educational placement. Future research is recommended to better examine this result by including more variables

examining the co-teaching setting and teacher characteristics. Additionally, future research should examine the academic effects of the co-teaching intervention for a year or longer. The results of this study should be used with caution until further research is conducted.

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APPENDIX A
SUMMARY OF INTERCODER AGREEMENT

Basic Article Information					Subject Measured		Comparison	Co-Teaching		Control Group		
Ref ID	Author(s)	Year of Publication	Length of Study	Publication Type	Grade of Participants	Math	Geometry English/ELA American Literature Reading Biology	Group with	Group		Control Group	
								Numbers	PostTest Mean	PostTest Standard Deviation	PostTest Mean	Standard Deviation
07-01-R1	Doran, Jr.	2008	1 Y	Dissertation				X	68.170	10.260	65.170	12.090
07-01-R2	Doran, Jr.	2008	1 Y	Dissertation				X	68.170	10.260	65.170	12.090
07-02-R1	Doran, Jr.	2008	1 Y	Dissertation				X	67.190	8.120	61.530	8.700
07-02-R2	Doran, Jr.	2008	1 Y	Dissertation				X	67.190	8.120	61.530	8.700
07-03-R1	Doran, Jr.	2008	1 Y	Dissertation		X		X	62.600	9.500	56.780	3.350
07-03-R2	Doran, Jr.	2008	1 Y	Dissertation		X		X	62.600	9.500	56.780	3.350
07-04-R1	Doran, Jr.	2008	1 Y	Dissertation		X		X	63.300	7.120	59.050	3.730
07-04-R2	Doran, Jr.	2008	1 Y	Dissertation		X		X	63.300	7.120	59.050	3.730
07-05-R1	Doran, Jr.	2008	1 Y	Dissertation		X		X	59.590	4.570	59.100	4.540
07-05-R2	Doran, Jr.	2008	1 Y	Dissertation		X		X	59.590	4.570	59.100	4.540
07-06-R1	Doran, Jr.	2008	1 Y	Dissertation				X	71.630	8.910	68.320	9.970
07-06-R2	Doran, Jr.	2008	1 Y	Dissertation				X	71.630	8.910	68.320	9.970
07-07-R1	Doran, Jr.	2008	1 Y	Dissertation				X	62.720	7.350	56.670	6.760

07-07-R2	Doran, Jr.	2008	1 Y	Dissertation				X	X	62.720	7.350	56.670	6.760	
07-08-R1	Doran, Jr.	2008	1 Y	Dissertation				X	X	59.500	5.910	59.590	9.320	
07-08-R2	Doran, Jr.	2008	1 Y	Dissertation				X	X	59.500	5.910	59.590	9.320	
14-01-R1	Fontana	2005	1 Y	Publication	8	X			16	77.700	12.400	74.300	12.120	
14-01-R2	Fontana	2005	1 Y	Publication	8	X			16	77.700	12.400	74.300	12.120	
14-02-R1	Fontana	2005	1 Y	Publication	8		X		16	79.700	11.400	73.400	8.000	
14-02-R2	Fontana	2005	1 Y	Publication	8		X		16	79.700	11.400	73.400	8.000	
					16									
19-01-R1	Welch	2000	wks.	Publication	4		X			2	58.600	14.550	128.153	41.610
										2				
19-01-R2	Welch	2000	< 1yr	Publication	4		X			2	58.600	14.550	128.153	41.610
										2				
					12									
23-01-R1	Packard et al.	2011	wks	Publication	9		X		5					
23-01-R2	Packard et al.	2011	< 1yr	Publication	9		X		5					

APPENDIX B
SUMMARY OF DATA UTILIZED IN META-ANALYSIS

Author	N (CT)	N (CI)	Post Mean (CT)	Post Mean (C)	SD (CT)	SD (C)	<i>g</i>	Weight
Andrews-Tobo (2009)	9	7	793.89	777.43	16.94	13.72	-.014	1.192
Banerji & Dailey (1995)	13	17	4.73	7.55	4.22	3.71	-.961	1.458
Beam (2005)	7	8	400.86	359.88	25.498	30.736	1.356	1.037
Beam (2005)	10	9	402.80	372.11	23.24	53.44	.726	1.254
Beam (2005)	8	8	405.50	390.88	29.53	38.55	.403	1.188
Beam (2005)	7	9	379.57	369.22	46.597	44.39	.216	1.188
Belmarez (2005)	28	27	31.464	24.889	9.211	6.835	.797	1.737
Boeckle (2008)	15	15	23.80	11.0	8.629	4.472	1.812	1.343
Castro (2007)	53	51	44.10	35.10	16.27	15.68	.559	1.932
Castro (2007)	53	51	50.20	34.90	21.38	19.42	.743	1.925
Doran (2008)	6	7	68.17	65.17	10.26	12.09	.247	1.079
Doran (2008)	18	19	67.19	61.53	8.12	8.70	.657	1.589
Doran (2008)	7	7	62.60	56.78	9.50	3.35	.765	1.084
Doran (2008)	14	14	63.30	59.05	7.12	3.73	.726	1.455

Doran (2008)	26	25	59.59	59.10	4.57	4.54	.106	1.737
Doran (2008)	17	18	71.63	68.32	8.91	9.97	.342	1.582
Doran (2008)	28	27	62.72	56.67	7.35	6.67	.844	1.734
Doran (2008)	32	32	59.50	59.59	5.91	9.32	-.011	1.813
Fontana (2005)	17	16	77.70	74.30	12.40	12.12	.270	1.559
Fontana (2005)	17	16	79.70	73.40	11.40	8.00	.621	1.541
Haselden (2004)	10	12	61.0	52.30	8.0	7.01	1.120	1.283
Klinger et al. (1998)	25	52	21.16	27.28	9.23	8.39	-.580	1.822
Klinger et al. (1998)	25	54	4.91	6.78	3.52	3.03	-.699	1.814
Marsten (1996)	33	36	46.85	42.22	33.21	27.31	.151	1.835
Maultsby-Springer (2009)	102	91	1.79	1.62	0.452	0.663	.302	2.044
Maultsby-Springer (2009)	102	91	1.81	1.60	0.54	0.953	.274	2.045
Mote (2010)	21	37	812.24	805.08	10.22	19.80	.415	1.748
Mote (2010)	22	24	803.23	793.67	16.90	14.59	.597	1.682

Mote (2010)	37	16	816.27	797.56	14.03	9.01	1.445	1.606
Murawski (2006)	12	8	36.08	35.25	3.94	4.33	-.157	1.296
Murawski (2006)	12	8	12.75	13.88	5.67	8.46	.194	1.295
Packard et al. (2011)	13	5	17.67	16.60	7.79	4.66	.143	1.144
Popp (2001)	22	20	413.41	433.35	44.10	46.40	-.433	1.654
Popp (2001)	22	20	417.86	430.10	41.98	53.82	-.250	1.661
Shaw (2002)	66	135	39.57	39.61	19.653	21.027	-.002	2.035
Shaw (2002)	66	135	30.379	27.547	19.652	21.946	.133	2.035
Thompson (2000)	18	75	800.0	828.0	27.95	26.92	-1.024	1.755
Weichel (2001)	12	14	36.08	34.64	3.94	2.92	.006	1.449
Weichel (2001)	12	14	12.75	12.71	5.67	7.61	.407	1.439
Welch (2000)	5	27	58.60	128.153	14.55	41.61	-1.734	1.126

Note. C = Control; Ct = Co-Teaching

APPENDIX C
SUMMARY OF STUDY CHARACTERISTICS

Author	Outcome Measure	Unit of Time	Type	Subject	Grade	Group
Andrews-Tobo (2009)	Georgia CRCT Length - Total	2	Dissertation	Verbal	Primary	Resource
Banerji & Dailey (1995)	Sentences	1	Publication	Verbal	Secondary	Mainstream
Beam (2005)	Virginia Standards	1	Dissertation	Verbal	Secondary	Resource
Beam (2005)	Virginia Standards	1	Dissertation	Math	Secondary	Resource
Beam (2005)	Virginia Standards	1	Dissertation	Verbal	Secondary	Resource
Beam (2005)	Virginia Standards	1	Dissertation	Math	Secondary	Resource
Belmarez (2005)	TAAS	3	Dissertation	Math	Primary	Resource
Boeckle (2008)	DIBELS	0.12	Dissertation	Verbal	Secondary	Resource
Castro (2007)	TerraNova	1	Dissertation	Verbal	Secondary	Resource
Castro (2007)	TerraNova	1	Dissertation	Math	Secondary	Resource
Doran (2008)	State end of Course	1	Dissertation	Verbal	-	Resource
Doran (2008)	State end of Course	1	Dissertation	Verbal	-	Resource
Doran (2008)	State end of Course	1	Dissertation	Math	-	Resource
Doran (2008)	State end of Course	1	Dissertation	Math	-	Resource

Doran (2008)	State end of Course	1	Dissertation	Math	-	Resource
Doran (2008)	State end of Course	1	Dissertation	Math	-	Resource
Doran (2008)	State end of Course	1	Dissertation	Math	-	Resource
Doran (2008)	State end of Course	1	Dissertation	Math	-	Resource
Fontana (2005)	Final Class Grade	1	Publication	Math	Primary	Resource
Fontana (2005)	Final Class Grade	1	Publication	Verbal	Primary	Resource
Haselden (2004)	North Carolina EOC	-	Dissertation	Math	-	Mainstream
Klinger et al. (1998)	BASS	0.17	Publication	Verbal	-	Mainstream
Klinger et al. (1998)	Math - Computation	0.17	Publication	Math	-	Mainstream
Marsten (1996)	Curriculum Based	0.52	Publication	Verbal	Primary	Resource
Maultsby-Springer (2009)	TCAP	1	Dissertation	Verbal	Primary	Resource
Maultsby-Springer (2009)	TCAP	1	Dissertation	Math	Primary	Resource
Mote (2010)	Georgia CRCT	1	Dissertation	Verbal	Primary	Resource
Mote (2010)	Georgia CRCT	1	Dissertation	Verbal	Primary	Resource

Mote (2010)	Georgia CRCT TORC Reading	1	Dissertation	Verbal	Primary	Resource
Murawski (2006)	Comp.	0.19	Publication	Math	Primary	Resource
Murawski (2006)	WRAT Math	0.19	Publication	Verbal	Primary	Resource
Packard et al. (2011)	Literature	0.23	Publication	Verbal	Primary	Resource
Popp (2001)	Virgina Standards	-	Dissertation	Verbal	Secondary	Resource
Popp (2001)	Virgina Standards	-	Dissertation	Math	Secondary	Resource
Shaw (2002)	Stanford	1	Dissertation	Math	Secondary	Resource
Shaw (2002)	Stanford	1	Dissertation	Verbal	Secondary	Resource
Thompson (2000)	Georgia CRCT TORC Reading	1	Dissertation	Math	Primary	Mainstream
Weichel (2001)	Comp.	0.19	Dissertation	Math	Primary	Resource
Weichel (2001)	WRAT Math	0.19	Dissertation	Verbal	Primary	Mainstream
Welch (2000)	Great Leaps Reading	0.31	Publication	Verbal	Secondary	Mainstream

APPENIDIX D

SUMMARY OF STUDY CHARACTERISTICS REPORTED FOR EACH ARTICLE

Author	Educational Setting	Ethnicity	Gender	Grade	Subject	Length Of Study	Type of Disability	Co-Teacher Experience	Co-Teacher Attitude	Co-Teacher Education	Co-Teacher Planning	Co-Teacher Training	Co-Teaching Method	Pre-Test	Post-Test
Andrews-Tobo (2009)	X			X	X	X								X	X
Banerji & Dailey (1995)	X			X	X	X								-	X
Beam (2005)	X			X	X	X								X	X
Belmarez (2005)	X			X	X	X								X	X
Boeckle (2008)	X	X	X	X	X	X	X							X	X
Castro (2007)	X			X	X	X		X	X	X	X	X		X	X
Doran (2008)	X				X	X									X
Fontana (2005)	X	X	X	X	X	X					X			X	X
Haselden (2004)	X	X			X										X
Klinger et al. (1998)	X		X	X	X	X	X				X			X	X
Marsten (1996)	X			X	X	X								X	X
Maultsby-Springer (2009)	X			X	X	X		X			X	X		X	X
Mote (2010)	X			X	X	X				X				X	X
Murawski (2006)	X	X		X	X	X		X				X		X	X
Packard et al. (2011)	X		X	X	X	X						X	X		X
Popp (2001)	X			X	X	X	X	X	X						X
Shaw (2002)	X			X	X	X								X	X
Thompson (2000)	X			X	X	X									X

Weichel (2001)	X		X	X	X	X	X		X		X	X
Welch (2000)	X		X	X	X	X				X	X	X

APPENDIX E
CODING MANUAL

This meta-analysis focuses on the effects of co-teaching instruction on the academic achievement of students with special needs. To be eligible for coding, a study must use an eligible intervention with students in grades Pre-K to 12, report data that permits calculation of a numeric effect size for at least one eligible outcome variable, and employ a true or quasi-experimental research design.

A. Interventions

An intervention study is defined as a study looking to test a method or instructional program to determine its effect on participants. That is, participants are presented with some instructional method/program or environmental change/addition and then evaluated on its effect. A co-teaching intervention will be considered a treatment focused on increasing the academic achievement of students with disabilities. Only interventions directly measuring the academic outcomes of students with disabilities in a co-teaching setting will be included.

B. Outcome measures

Eligible co-teaching studies must measure intervention effects for at least one outcome variable measuring the academic achievement of students with disabilities.

C. Outcome data

Quantitative data must be reported for one eligible outcome variable for which an effect size can be derived. Outcome data must pertain to the students in the intervention.

D. Subjects

Subjects must be a student that qualifies for special education services, in grades Pre-K to 12.

E. Research design

The study must use an experimental, quasi-experimental design, or subjects-as-own control with counterbalanced conditions. These are designs that compare subject groups receiving one or more identifiable treatments with one or more control conditions. Control conditions may be “no treatment,” “treatment as usual,” placebo treatment, or any other similar condition that serves as contrast to the treatment condition and is not expected to produce change in the outcomes of interest. To be eligible as an experimental/quasi-experimental design, a study must meet at least one of the following criteria:

- a. Subjects were randomly assigned to treatment and control conditions or assigned by a procedure plausibly equivalent to randomization, e.g., arbitrarily assigned wait-list.
- b. Subjects in the treatment and control conditions were matched and the matching variables included a pretest for at least one qualifying outcome variable.

- c. If subjects were not randomly assigned or matched, the study must have both a pretest and a posttest on at least one qualifying outcome variable (see above) with sufficient statistical information to derive an effect size or to estimate group equivalence from statements of statistical significance. Posttest only non-equivalent comparisons (not randomized or matched) are not eligible.

Single subject designs. Single subject studies are not eligible.

E. Study Setting

The study must be set in the U.S. or another English-speaking developed country, specifically Canada, Britain/UK, Australia, or New Zealand with students reading in English. Also, the study must be reported in English.

F. Date of Publication

The date of publication or reporting of the study must be 1965 or later even though the research itself might have been conducted prior to 1965.

GENERAL STUDY CHARACTERISTICS

[Authors] List all authors as they are listed on the report, using the following format: LastName, Initial.Initial; LastName, Initial.Initial; etc

[Year of Publication] (four digits): If more than one report, choose earliest date.

[Title] Include the entire title here, do not exclude articles such as “a,” “an,” or “the”.

[Overview of Research] Include a brief description of the intervention and control groups.

[Publication Type] If you are using more than one type of publication to code your study, choose the publication that supplies most of the data.

- 1 Dissertation
- 2 Publication
- 3 Other (conference, presentation, book chapter, etc.)

[Co-Teach Approach]

- 0 One Teach, One Observe
- 1 Station Teaching
- 2 Parallel Teaching
- 3 Alternative Teaching
- 4 Teaming
- 5 One Teach, One Assist
- 6 Not Noted

GROUP IDENTIFICATION

Characteristics of Students (Co-Teach and Control)

Complete this section for all types of treatment and comparison groups (all studies).

[Co-Teach Participant Classification w/ Group Numbers] Identify the number of co-teach participants in each group.

- 0 Special Education
- 1 General Education
- 2 English Language Learners
- 3 Not Noted

[Comparison Group] Identify the comparison group of each study.

- 0 General Education Students
- 1 SPED Students in GenEd. w/o Co-Teach
- 2 SPED Students in Resource
- 3 SPED Student in Pullout
- 4 SPED Student Separately Served
- 5 No Comparison Group

[Total Number of Participants]

- 0 Co-Teach
- 1 Non Co-Teach

[Ethnicity Noted] Identify how the ethnicity of the students is noted.

- 0 Participants
- 1 School
- 2 District

[Participant Ethnicity w/ Group Numbers] Ethnicity Description (include numbers if provided)

- 0 Hispanic
- 1 African American
- 2 White
- 3 Asian
- 4 Pacific Islander
- 5 Other

[Gender]

- 0 Male
- 1 Female

[Age of Participants] Include the age of the participants if noted.

[Grade(s) of Participants]

- 0 Kindergarten
- 1 Grade 1
- 2 Grade 2
- 3 Grade 3
- 4 Grade 4
- 5 Grade 5
- 6 Grade 6
- 7 Grade 7
- 8 Grade 8
- 9 Grade 9
- 10 Grade 10
- 11 Grade 11
- 12 Grade 12

General Intervention Characteristics

Note page number and any problems coding following variables.

[Types of Special Education Disability]

- 0 No Disability
- 1 Specific Learning Disability
- 2 Emotional/Behavioral Disorder
- 3 Other Health Impairment (OHI)
- 4 Autism
- 5 Cognitive Impairment
- 6 Visual Impairment
- 7 Auditory Impairment
- 8 Multiple Disabilities
- 9 Other

[Content Subjects] Identify the content subject(s) measured.

- 0 Math
- 1 Reading/Writing
- 2 Social Studies
- 3 Science
- 4 Other

[Duration of the Study] Frequency of instruction

- (1) <1 Year
- (2) 1 Year
- (3) 2 Years
- (3) >2 Years

INTERVENTION CHARACTERISTICS SPECIFIC TO PARTICIPATING CO-TEACHERS

[Total Number of Participating Teacher] If noted in the study, record the total number of special education and general education teachers noted in the study.

[Teacher Attitudes]

- 0 Positive
- 1 Negative
- 2 Not Noted

[Mean Teacher Total Years of Experience Teaching] Note years of co-teaching and non co-teaching.

- 0. <3 Years
- 1. 3-5 Years
- 2. 6-10 Years
- 3. >10 Years
- 4. Not Noted

[Mean Teacher Years of Experience Co-Teaching] Co-Teaching only.

- 0. <3 Years
- 1. 3-5 Years
- 2. 6-10 Years
- 3. >10 Years
- 4. Not Noted

[Mean Teachers Years of Experience Co-Teaching with Same Partner]

- 0. 1 Year
- 1. 2-3 Years
- 2. 3-4 Years
- 3. >4 Years
- 4. Not Noted

[Teacher Education Level and Number of Each] Note the number of teachers that have acquired each educational level.

- 0. Bachelors
- 1. Masters
- 2. Doctorate

[Teacher Trained in Co-Teaching, and if so, how much] Identify if the teachers were specifically trained to co-teach, and if so, how much training was noted.

- 0. Yes
- 1. No
- 2. Not Noted

[Is Co-Teacher Planning Time Provided, and if so, how much] Identify if the teachers had planning time specifically for co-teaching, and if so, how much planning time was noted.

0. Yes
1. No
2. Not Noted

[Were the Teachers Forced to Co-Teach] Identify if the teachers were required to co-teach, rather than by choice.

0. Yes
1. No
2. Not Noted

[Did the Co-Teachers Choose their Teaching Partner] Identify if the teachers were able to choose their co-teaching partner.

0. Yes
1. No
2. Not Noted

METHODOLOGICAL CHARACTERISTICS--ASSESSMENT

DEPENDENT VARIABLES CODING (MEASUREMENT)

Measurement Properties

[Type of Outcome Measure] Type of measure used

0. Standardized Tests
1. School/District Tests
2. Pre/Post Tests

[Type of Data Effect Size is Based on] Identify the type of statistic used to measure the outcome measure..

0. Means and Standard Deviation
1. T-Value or F-Value
2. Chi-Square
3. Correlations: r

[Page Number Effect Size was Found]

[Additional Information Including the Reported Statistics]

APPENDIX F
CODING FORM

Author(s):

Year of Publication:

Title:

Overview of Research:

Publication Type:

- | | |
|------------------|----------------------------------------------------------|
| (0) Dissertation | (2) Other (conference, presentation, book chapter, etc.) |
| (1) Publication | |

Co-Teach Approach:

- | | | |
|----------------------------|--------------------------|---------------------------|
| (0) One teach, one observe | (3) Alternative Teaching | (5) One teach, one assist |
| (1) Station Teaching | (4) Teaming | (6) Not Noted |
| (2) Parallel Teaching | | |

Co-Teach Participant Classification w/ Group Numbers:

- | | |
|------------------------|--------------------------------|
| (0) Special Education- | (2) English Language Learners- |
| (1) General Education- | (3) Not Noted- |

Comparison Group:

- | | |
|------------------------------------------|------------------------------------|
| (0) General Education Students | (3) SPED Student in Pullout |
| (1) SPED Students in GenEd. w/o Co-Teach | (4) SPED Student Separately Served |
| (2) SPED Students in Resource | (5) No Comparison Group |

Total Number of Participants:

- | | |
|--------------|------------------|
| (0) Co-Teach | (1) Non Co-Teach |
|--------------|------------------|

Ethnicity Noted As:

- | | | |
|------------------|------------|--------------|
| (0) Participants | (1) School | (2) District |
|------------------|------------|--------------|

Participant Ethnicity w/ Group Numbers:

- | | | |
|-----------------------|------------|-----------------------|
| (0) Hispanic- | (2) White- | (4) Pacific Islander- |
| (1) African American- | (3) Asian- | (5) Other- |

Gender:

- | | |
|----------|------------|
| (0) Male | (1) Female |
|----------|------------|

Age of Participants:

Grade(s) of Participants:

- | | | |
|------------------|-------------|---------------|
| (0) Kindergarten | (5) Grade 5 | (10) Grade 10 |
| (1) Grade 1 | (6) Grade 6 | (11) Grade 11 |
| (2) Grade 2 | (7) Grade 7 | (12) Grade 12 |
| (3) Grade 3 | (8) Grade 8 | |
| (4) Grade 4 | (9) Grade 9 | |

Types of Special Education Disability:

- | | |
|-----------------------------------|---------------------------|
| (0) No Disability | (5) Cognitive Impairment |
| (1) Specific Learning Disability | (6) Visual Impairment |
| (2) Emotional/Behavioral Disorder | (7) Auditory Impairment |
| (3) Other Health Impairment (OHI) | (8) Multiple Disabilities |
| (4) Autism | (9) Other |

Content Subject(s):

- | | |
|---------------------|-------------|
| (0) Math | (3) Science |
| (1) Reading/Writing | (4) Other |
| (2) Social Studies | |

Duration of the Study:

- | | |
|-------------|--------------|
| (0) <1 Year | (2) 2 Years |
| (1) 1 Year | (3) >2 Years |

Total Number of Participating Teachers:

Teacher Attitudes:

- | | | |
|--------------|--------------|---------------|
| (0) Positive | (1) Negative | (2) Not Noted |
|--------------|--------------|---------------|

Mean Teacher Total Years of Experience Teaching:

- | | | |
|---------------|----------------|---------------|
| (0) <3 Years | (2) 6-10 Years | (4) Not Noted |
| (1) 3-5 Years | (3) >10 Years | |

Mean Teacher Years of Experience Co-Teaching:

- | | | |
|---------------|----------------|---------------|
| (0) <3 Years | (2) 6-10 Years | (4) Not Noted |
| (1) 3-5 Years | (3) >10 Years | |

Mean Teachers Years of Experience Co-Teaching with Same Partner:

- | | | |
|---------------|---------------|--------------|
| (0) 1 Year | (2) 3-4 Years | (4) No Noted |
| (1) 2-3 Years | (3) >4 Years | |

Teacher Education Level and Number of Each:

- | | | |
|----------------|--------------|----------------|
| (0) Bachelors: | (1) Masters: | (2) Doctorate: |
|----------------|--------------|----------------|

Teacher Trained in Co-Teaching, and if so, how much?

- | | | |
|----------|--------|---------------|
| (0) Yes- | (1) No | (2) Not Noted |
|----------|--------|---------------|

Is Co-Teacher Planning Time Provided, and if so, how much?

(0) Yes- (1) No (2) Not Noted

Were the Teachers Forced to Co-Teach?

(0) Yes (1) No (2) Not Noted

Did the Co-Teachers Choose their Teaching Partner?

(0) Yes (1) No (2) Not Noted

Type of Outcome Measure:

(0) Standardized Tests (1) School/District Tests (2) Pre/Post Tests

Type of Data Effect Size is Based on:

(0) Means and Standard Deviation
(1) T-Value or F-Value
(2) Chi-Square
(3) Correlation: r

Page Number Effect Size was Found:

Additional Information Including the Reported Statistics:

COMPREHENSIVE REFERENCE LIST

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