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Best Practices in Co-teaching Mathematics, Teacher Efficacy, and Teacher and Student
Perceptions

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Chapter 1: Introduction

Special education services are directed by mandates at the federal level, which are then interpreted at the state, followed by, the district level. The Wyoming Department of Education (WDE) performs annual determinations in the form of audits in order to categorize each district on the compliance and performance indicators on the State Performance Plan (SPP). The four determination categories in the state of Wyoming are: meets requirements; needs assistance; needs intervention; and needs substantial intervention. Once determinations are made, districts are required to make changes and document them according to the areas they need improvement in. The WDE, “employs a Continuous Improvement – Focused Monitoring (CIFM) system that focuses on those elements of information and data that most directly relate to or influence student performance...The CIFM system is a major component of the State’s overall general supervision structure” (2016). One of the integral parts of the system, which each district is evaluated on, is the least restrictive environment (LRE). The LRE is determined by what percent of the day the student spends in a special education setting. Lipsky (2003) explained, “While the federal law does not require the placement of all students with disabilities in a general education environment, it presumes inclusion” (p.32). The ultimate goal is for students with individual education plans (IEP’s) to spend the least amount of their day in a special education setting in order for them to have the maximum amount of time with their peers.

One way to address how much time students spend in special education settings is to provide different instructional opportunities. Students are often provided LRE through inclusion, in which students, “receive their core instruction within the general education

classroom...with or without additional support from a special education teacher during core instruction” (Solis, Vaughn, Swanson, & McCulley, 2012, p. 498). One instructional option within the inclusive setting is co-teaching. In this arrangement, “a special education teacher works along with the general education teacher to provide needed supports, precluding the need for students with disabilities to leave the classroom to receive specialized assistance” (Solis et. al, 2012, p. 498-9). This arrangement provides students with the opportunity to remain in the general education setting, provides students with the LRE, all while ensuring they receive the instructional support from a special education teacher.

Co-teaching may vary drastically, depending on the setting, so it is integral to the discussion of co-teaching to define what it is. Sileo and van Garderen (2010) described co-teaching as, “an instructional delivery model applicable to teaching students with disabilities in least restrictive integrated classroom settings in which general and special educators share responsibility for planning, delivering, and evaluating instructional practices for all students” (p. 14). Again, the key components of the definition of co-teaching reflect the importance of the LRE, as well as shared responsibility by both educators. These practices can vary widely depending on co-teaching partnerships and school settings.

One can draw many questions from the shift from simply including students with learning disabilities in general education classrooms to providing instruction from a co-teaching model. What does a co-taught classroom look like? What role does each teacher fulfill? How do teachers maintain a shared responsibility? How are individual student needs met? These questions can morph into many more questions related to

practices in a co-taught classroom. Sweigart and Landrum (2015), “speculated that co-teaching done well could have clear and specific benefits...a co-teaching arrangement has the potential to allow for many evidence-based practices to be implemented at higher rates with the students who need them most” (p. 23). What should this co-teaching arrangement look like? All of these questions tie into one key question. What are best practices in co-taught classrooms to facilitate efficacy to ensure positive perceptions and positive outcomes for students and teachers in this setting?

The bulk of the literature related to co-teaching is noticeably missing quantitative data. Sweigart and Landrum (2015) suggested, “Additional evidence of the purported benefits of co-teaching comes from the literature base on co-teaching, which has been predominately qualitative in nature” (p. 23). Review of the literature provides multiple qualitative and minimal quantitative research studies. Further use of these studies has been completed by researchers using meta-syntheses. Murawski and Swanson (2001) defined meta-analysis as, “a statistical reviewing technique that provides a quantitative summary of findings across an entire body of research (p.259). They narrowed a set of 89 studies to 6 based on criteria they defined, which included: sufficient quantitative data; studies identified the intervention as co-teaching; and co-teaching lasted more than two weeks. A meta-synthesis may be defined through a specific set of conditions for the studies that are included to generate a summary of findings. This will often eliminate many studies that have been completed based on the criteria used to select studies to be included in a meta-synthesis.

Scruggs, Mastropieri, and McDuffie (2007) utilized 32 reports of qualitative research in their synthesis and they, “determined to treat each identified research report as

an individual ‘informant,’ and create a meta-synthesis across all individual research reports” (p.395). This meta-synthesis took consideration of each individual author’s data and did not include an elimination process in order to generate a summary of findings. They utilized findings from previous reviews in order to identify potentially significant variables to focus on.

Research focused on co-taught settings provides an insight to many aspects of co-teaching. One common theme throughout studies is the possible benefit to the teachers involved in the co-teaching relationship. Bouck (2007) concluded:

Given the multiple roles teachers need to play in today’s classrooms, co-teaching can create situations in which teachers can potentially assume fewer roles in general or moment to moment because they know their partner can take on the others, thus becoming better in the roles they do play. (p.49)

This relationship can have many benefits, but there are also limitations due to the intricacies involved in sharing a classroom. Hang and Rabren (2009) found that general education and special education teachers in their study both reported that they took more responsibility for behavior management, so their perceptions of the same role differed. They surmised that these perceptions could be tied to lack of planning time, which impacts the communication between teachers. Overall, the literature contains many references to best practices and benefits of co-teaching, as well as, challenges with co-teaching.

The literature available on inclusion in math, and specifically co-teaching math, is limited. However, the concerns, limitations, and benefits of co-teaching in different content areas also apply to mathematics classrooms. The efficacy of co-teaching is directly related to teacher practices and those practices can be implemented in any content settings. DeSimone and Parmar (2006) determined, “many of the current studies

report attitudes of teachers in general” (p. 99), rather than a focus specifically on one content area. The lack of focus on mathematics in co-teaching studies limits the conclusions that can be drawn on success of co-teaching in that specific content area. However, the studies that are available are consistent with the findings in other general education content area co-taught classrooms. DeSimone and Parmar (2006) suggested, “One of the first steps toward understanding successful instruction in inclusive mathematics classrooms is to understand general educators’ beliefs and attitudes regarding inclusion and students with LD” (p. 98). The success of mathematics inclusion is tied directly to the bigger picture of what co-teaching practices are and the perspectives of both teachers.

Based on the relationship of co-teaching success and the teachers involved, one has to consider student and teacher perspectives. Student perspectives in the co-taught setting are a key element to the success of co-teaching. Their engagement, participation, and growth are all indicators of the success of this teaching model. Frenzel, Pekrun, and Goetz (2007) stated, “that anxiety, anger, and boredom in relation to the subject of mathematics are differentially affected by facets of the classroom environment as perceived by students (p. 491). How they view their environment has a critical impact on success when implementing this teaching model.

The perspectives of both general education and special education teachers are also important to consider for co-teaching relationships and the efficacy of co-teaching. Sakiz, Pape, and Hoy (2012) suggested, “Teacher support is one of the strongest correlates with youth adjustment, social and motivational development, and achievement” (p. 235). Teachers are responsible for establishing a successful learning

environment and this can become difficult when two teachers are sharing one classroom. Monsen, Ewing, and Kwoka (2014) found “that whether a teacher has a positive or negative attitude towards inclusion has an impact on how they manage their classroom learning environments” (p. 124). This suggests that teacher attitude impacts management of their classroom, which will impact the perceptions of students. The interplay of teacher and student perception will either foster or hinder the success and effectiveness of co-taught classrooms.

In order to address all of these questions, a comprehensive search was completed. The search for related articles was based on key words or phrases related to best practices for co-teaching, co-teaching and math, and student and teacher perceptions of co-teaching. The terms used to search for related material on best practices in co-teaching included: co-teaching; effective co-teaching practices; effectiveness of co-teaching; implications of co-teaching; approaches to inclusion; collaborative models of instruction, and examining co-teaching. Co-teaching and math were searched for with: mathematics and inclusion and co-teaching mathematics. Finally, student and teacher perceptions were searched for with: student attitudes toward co-teaching; student perceptions of co-teaching; teacher attitudes and co-teaching; teacher perceptions of co-teaching; and perspectives of teachers toward inclusive schools. The literature contained a wealth of items related to co-teaching. However, the results were significantly narrowed for student and teacher perceptions, and even further for inclusion in mathematics.

Success and best practices in math co-taught classrooms need to be generalized from research in co-taught classrooms in all content areas because of the lack of research that has been completed specifically in math classroom settings. Also, student and

teacher perspectives are both key components of the success of co-teaching. Teachers have a direct effect on implementation of best practices when teaching in these settings, but their perspectives and beliefs also impact best practices. The interplay of co-teaching implementation, teacher efficacy, and student and teacher perceptions all play a part in the bigger picture of best practices in co-teaching.

Chapter 2: Literature Review

The primary focus in the review of literature pertained to general education co-taught classrooms, which included a special education teacher providing some aspect of instruction. Within the literature, there is a divergence in the common practices of teachers, specifically in how instruction is delivered in the classroom. Also, the focus here was on students with learning disabilities, which are higher incidence disabilities, rather than including students with lower incidence disabilities. The review of literature provided multiple facets of this instructional model, and the practices, limitations, and benefits of implementation of this form of instruction. Overall, the utilization of co-teaching can be viewed as a philosophy of best practices for providing the least restrictive instructional setting for students with mathematical disabilities. Throughout the literature, multiple facets of co-teaching are discussed, however, the primary focus here is on student performance and outcomes in co-taught settings, best practices for co-teaching, co-teaching in mathematics, and student and teacher perceptions of co-teaching. These components are all useful in answering the following overarching question: What are best practices in co-taught classrooms to facilitate efficacy to ensure positive perceptions and positive outcomes for students and teachers in this setting?

Student Performance and Outcomes

The research available on co-teaching is largely qualitative in nature (Sweigart & Landrum, 2015). Research encompasses a wide spectrum, from focusing on single co-teaching relationships, to analyses of numerous studies in the form of meta-analysis. There are implications that have to be considered with each of these types of studies. Friend, Cook, Hurley-Chamberlain, and Shamberger (2010) suggested that most studies

that are conducted on co-teaching are focused on practices rather than outcomes, such as student achievement. Magiera and Zigmond (2005) specifically stated that their study was limited because student outcome measures were not included, which prevented them from determining if there was evidence of possible benefits for students in co-taught settings. They suggested that co-teaching appears, on the surface, to be just two teachers simply coming together and blending their expertise. However, co-teaching is a complex approach to teaching that has many working parts. The complexity of co-teaching makes it difficult to study and researchers need to determine if the practices they are observing are, in fact, true co-teaching. The research base, to date, on co-teaching is limited and needs to be studied across grade levels and content areas.

Also, some studies focus on a co-teaching pair, which can provide a wealth of information about practices, but it limits generalizability of findings because it lacks diversity. On the other hand, meta-analyses can be used to find significance levels across studies, but there are limitations in meta-analyses because of variations in the included studies. Researchers define variables or specific characteristics in order to determine which studies should be included in a meta-synthesis. Parameters placed on these studies may also limit the number included, and thus, the generalizability of the study.

Scruggs, Mastropieri, and McDuffie (2007) reported that most of the teachers involved in the studies they included happened to be outstanding examples of co-teachers. Unfortunately, the authors did not define what would qualify as an outstanding example of co-teachers. This is a factor that should be considered when drawing conclusions from co-teaching research. One should question whether or not the participants that are studied are randomly selected, or if the selection process is

determined by picking partners considered to be exemplars in co-teaching practices. The results of those studies could only be attributed to the most successful teaching partnerships, rather than to co-teaching practices in general. Therefore, the results of these studies have limited generalizability.

Another example of this can be found in Solis, Vaughn, Swanson, and McCulley (2012). They utilized meta-analysis with reviews using the criteria of a focus on co-teaching or inclusion, quantitative or qualitative studies, and they had to be peer-reviewed. There were 146 studies included in this analysis of studies, and a minimal number of the studies (15%) included data on student outcomes. They found that co-teaching is likely to be associated with small gains when the instructional model is correctly followed. This is further evidence that one major concern with co-teaching is that student success is directly tied to how co-teaching is implemented by co-teaching partners, but the data is often not collected on outcomes.

One of the concerns with reviewing studies on co-teaching is determining what the implementation of co-teaching is by the participants in the study, and, more importantly, who is involved in co-teaching. Mastropieri, Scruggs, Graetz, Norland, Gardizi, and McDuffie (2007) specifically cautioned that approximately one third of the studies they reviewed included exemplar co-teaching partnerships, with the remaining two thirds of the studies still including participants that chose to participate in co-teaching partnerships. Co-teaching may not be a choice made by individuals, and this can impact the efficacy and outcomes of co-teaching, depending on their perceptions. The people involved and how they got involved in co-teaching needs to be considered when reviewing studies.

The conclusions drawn from results in studies reviewed in the research are inconsistent. Some researchers have reported that there is a significant difference in the performance of students in inclusive classrooms, rather than students receiving services in a special education setting. These studies suggest that students perform at a higher level in co-taught classrooms than they do in classrooms in which one teacher guides students.

Also, Tremblay (2013) found co-teaching to be more effective for students than the special education setting. They studied students in first and second grade in Belgium, over two years, and focused on the student outcomes in reading/writing and math. They found a significant drop in performance for students with learning disabilities in math at the end of the school year when they received instruction in a special education setting. The students in the co-taught setting showed improvement, but the differences when compared to students in the general education setting were not significant. They found that students receiving instruction in the special education setting had a much greater drop in their scores, while the students in the co-taught setting showed growth. The outcomes for students in math were positive, although they were not significant. One of the limitations they addressed in their study was that 25% of the students in the inclusive setting were redirected back to the special education setting due to the rigor and demands of the general education study. The loss of students from the co-taught setting removed that particular set of student data from being included in the summary of findings. Students showed greater gains in the general education co-taught classes than in special education classes.

Strogilos and Avramidis (2016) also had significant findings in support of co-teaching in Greek schools. They constructed multiple hypotheses to test for studying co-taught classrooms. They included co-taught and non-co-taught classrooms in order to make comparisons. Their first hypothesis stated that grouping arrangements would differ between co-taught and non-co-taught settings, which they found weak support. The second hypothesis stated that student engagement levels would differ between co-taught and non-co-taught settings, which they found strong support. The third hypothesis stated that student interactions would differ between co-taught and non-co-taught settings, which they found weak support. The fourth hypothesis stated that the nature of student interactions would differ between co-taught and non-co-taught settings, which they found strong support. Finally, the last hypothesis stated that all of the studied learning experiences for students with autism spectrum disorder and intellectual disabilities would differ between co-taught and non-co-taught settings, which they found strong support for a difference in level of engagement for students with autism spectrum disorder. Their overall conclusion was that co-teaching has some positive effects, but there is room for improvement in the implementation of co-teaching, specifically in Greek co-taught classrooms. One limitation they acknowledged with their study was they could have had observed different results if the participants in this study had training in co-teaching. They reported that none of the teachers had any training on co-teaching, which can impact the efficacy and final outcomes for students.

Another example of documented successes for students with learning disabilities in co-taught classrooms was by Hang and Rabren (2009). The focus of their study was on 45 co-teachers and 58 students with disabilities in public schools in the southeastern

United States. They completed observations, surveys, and reviewed records as data sources. The records included SAT scores, attendance, and discipline. They concluded that, based on students with disabilities performance on the SAT's, students with disabilities performance was as typical as the general education population. They suggested that students with disabilities in co-taught classrooms received adequate support based on their performance on standardized tests. The authors concluded that co-teaching is an effective instructional delivery option.

Despite the positive results that have been documented, there is also evidence that co-teaching does not have a significant, positive impact on student performance, or there is not sufficient evidence to conclude the efficacy of co-teaching. Murawski and Swanson (2001) completed a meta-analysis of co-teaching studies and found a range from low to high on effect size, which averaged out to an effect size of 0.40. They determined that further research should be completed on co-taught settings in order to determine if it is an effective instructional practice. Their study started with a pool of 89 articles, which they reviewed and subsequently narrowed down to 6 studies. The authors initially eliminated 52 of the articles because they lacked data. They eliminated an additional 31 articles based on lack of quantitative data, insufficient quantitative data to calculate effect size, and/or characteristics described in study did not denote co-teaching. This elimination process was necessary because the remaining six studies were the only studies that had sufficient quantitative data to synthesize and calculate an effect size.

Overall, these studies provide evidence that more research is needed on co-teaching in order to draw reliable conclusions or suggest significant findings. The specific outcome variables focused on by researchers differed by studies. There are many

approaches that researchers can take when studying co-teaching. Some studies focus on co-teaching partners solely, while others include numerous sets of co-teaching partners. This variation in studies creates difficulty in generalizing findings, particularly in the case of meta-syntheses. Studies focused on a meta-synthesis inevitably narrow down the research they include because many do not meet requirements that are set for the investigations in the meta-synthesis. One suggestion for future research is to focus on student performance in order to determine efficacy of co-teaching practices. The literature is extensive with recommendations for effective co-teaching practices, but it is limited for student outcomes.

Best Practices in Co-teaching

Recommendations for best practices in co-teaching are plentiful in the literature because the primary focus is research on practices. Despite valiant efforts, not all co-teaching practices are effective, efficient, or purposeful. Throughout the literature three main themes were identified as necessary for successful implementation of co-teaching: teacher preparation and choice in participating; planning and collaboration; and school/district support.

The importance of teacher training and willingness cannot be stressed enough. This is the starting point, and, for the point from which successful partnerships need to build. Piechura-Couture, Tichenor, Touchton, Macisaac, and Heins (2006) suggested that once teachers have agreed to willingly participate, they should complete an inventory to determine their philosophy of teaching in order to determine if partners have shared beliefs. They suggested using Leahy's Educational Philosophy Inventory. It identifies six perspectives on educational philosophy, and the items in the inventory are statements

about the aims of education. The purpose behind completing inventories is to identify similarities and differences between teaching partners in order to create optimal pairings. This process should be intentional from the beginning so that partnerships are set up for success and both partners will benefit from further training.

Mastropieri, Smith, Zigmond, and Gebauer (2005) identified one of the main components in co-teaching as co-teacher compatibility. They found that conflicting beliefs could inhibit positive relations. Interestingly, they found that teachers that had not volunteered to be part of a co-teaching partnership could still be successful. This could be attributed to their finding that co-teaching seemed to be most successful when both teachers demonstrated effective teaching practices. They found increased academic achievement and greater collaboration between teachers that individually had effective teaching practices. One caveat is that co-teaching is not intended to be used to remediate a struggling teacher or to provide a mentor for an inexperienced teacher. Partnerships should be established based on equitable pairings (Walther-Thomas et. al, 1996). The relationship forged between co-teachers can determine the success or failure of the practice and the outcomes for the students in the setting.

Once partnerships have been determined, the next focus needs to be on what planning and collaboration will look like. Most studies on co-teaching focus on what the practices are, how it is implemented, and difficulties educators experience. Co-teaching may create stressors for teachers, but it can also decrease the roles they have to assume because they have a partner to share in these responsibilities (Bouck, 2007). Many researchers have provided suggestions for practices based on their research, in order to lead to success. Bouck (2007) identified the importance of considering role allocation,

and explained further that partners need to consider how identified roles and responsibilities will affect both of them. In this study the teachers chose to participate in co-teaching and were partnered with a teacher with whom they shared teaching philosophies. The teachers involved reported they had experienced co-teaching that was unpleasant with other staff members prior to their current partnerships, which provides additional evidence of the importance of teachers sharing philosophical perspectives of teaching. In order for a successful partnership to be forged, role division needs to be considered to determine what will be shared and what will be divided roles and responsibilities. This division needs to be considered for physical space, instructional roles, and procedures for management and discipline. Clear communication of what each partner expects is paramount for success in collaboration.

DeSimone and Parmar (2006) completed a study on middle school mathematics classrooms and found three issues central to implementation of co-teaching. The first issue was limited understanding of learning needs for students with disabilities. The second issue was teacher collaboration as a resource for general education teachers teaching students with learning disabilities in mathematics. The third issue was that teacher education programs and in-service professional developments do not prepare teachers for co-teaching. The issue of limited understanding of the students with learning disabilities can be addressed through collaboration between the co-teachers. The final issue about training is something that should be addressed because it would better prepare teachers for the demands of co-teaching.

Planning and collaboration can vary greatly, but researchers have found certain practices that increase successful collaborations. All of the identified recommendations

for collaboration tie to the theme of shared responsibilities. Sweigart and Landrum (2015) identified the importance of teacher training and effective use of evidence-based practices as critical to achieving desired outcomes from co-teaching. Teachers can also focus on using specific teaching approaches and teaming strategies. Piechura-Couture et. al (2006) suggested six teaching approaches, identified by Croteau (2000), and seven teaming strategies. The teaching approaches included: one teaching, one observing; one teaching, one circulating; team teaching; parallel teaching/split class; and small group pull out. One teach, one observe seems to be the dominant co-teaching approach found in partnerships. One teacher takes the dominant role, while the other teacher plays a supportive role. This can be beneficial with more complex content, but it may lead to the special education teacher continually playing a supportive role. One teach, one circulate is similar to one teach, one observe, but the circulating teacher has more purpose. Team teaching occurs when teachers share the lead and work as a team. Station teaching includes both teachers providing supervision or instruction at stations. Parallel teaching/split class provides a smaller ratio of students to teacher, but the teachers do not interact in this approach. Finally, small group pull out is used for the purpose of providing intensive instruction, which can be instructed by either a teacher or a paraprofessional.

The teaming strategies included: proximity sweep; proximity dance; active interplay; passive interplay; good cop, bad cop; smart teacher, dumb teacher; and peat, repeat (Piechura-Couture et. al, 2006). Proximity sweep occurs when one teacher teaches while the other teacher monitors student engagement and behavior. Proximity dance is a step beyond proximity sweep because the lesson is planned so that both teachers take on

each role during instruction. Active interplay involves both teachers in instruction, includes bantering of ideas, and interjecting by both teachers. Passive interplay occurs when the co-teacher interjects in a casual way, instead of it being completely planned. This strategy is not recommended with novice teachers because confidence levels might not be where they should be in order for this to be a comfortable interaction. Good cop, bad cop requires one teacher as the primary disciplinarian. This strategy should be used with caution because both teachers need to have positive interactions with students. Smart teacher, dumb teacher is demonstrated by one teacher asking questions students should be asking, and that teacher asks the teaching partner as if they do not know the answer. The “smart” teacher provides the correct response. The authors did not include a cautionary note with this strategy, but it seems that this strategy could communicate to students that one teacher lacks expertise and they would not be able to help them. This strategy seems to be the least effective for maintaining positive perceptions of both teachers as being capable of teaching the content. Peat, repeat involves one teacher teaching the lesson and the co-teacher providing additional examples to further explain concepts. This is especially effective when formative assessment indicates many students are not understanding the content. They suggested using these approaches selectively based teacher strengths and what they want to accomplish.

One major concern consistently reported in the literature is the role of special education teachers as primarily subordinate to general education teachers (Scruggs et. al, 2007, Solis et. al, 2012, Sweigart and Landrum, 2016), and the primary instructional practice utilized as one teach, one assist (Scruggs et. al 2007). The common theme found across the literature was a need for training for teachers involved in co-teaching (Scruggs

et. al 2007). The subordinate role is more evident at the secondary level due to content knowledge demands, and level of content knowledge is the biggest determination of who the dominant teacher in the pairing is (Mastropieri, Smith, Zigmond, & Gebauer, 2005). These findings are all evidence of the need for training co-teachers. Teaching typically emphasizes self-reliance and independence, so co-teaching can often be a difficult approach for some teachers. Early experiences in co-teaching may feel contrived or uncomfortable for teachers until they establish a cooperative teaching dynamic that works for them and exploits their individual, as well as collaborative, strengths.

One way that special educators can purposefully contribute is through evidence-based strategy instruction. Conderman and Hedin (2013) suggested that special education teachers in co-teaching roles should add strategy instruction to the classroom. They can use general strategies, specialized strategies by content, and create strategies for individuals with specific needs. The focus on using specific strategies can help keep the special education teacher engaged in instruction, rather than assuming a supportive role.

Planning and collaboration incorporates multiple components for consideration. The planning time teachers have needs to be intentional and purposeful, and the makeup of the students in these classrooms needs to be considered in planning. Scruggs et. al (2007) found that successful co-teachers identified a need for planning time, compatibility of co-teachers, training, and consideration of the skill level of the students included in this setting. Concern over students placed in this setting was also mentioned by Walther-Thomas, Bryant, and Land (1996). Co-taught classrooms should be heterogeneous groupings. They cautioned against randomly generating class rosters, and, instead, opting for hand picking the students in order to guarantee a heterogeneous

grouping. They found that this task is easier to accomplish at elementary and middle schools. No more than six students out of 25 should have identified mild or moderate disabilities. Wilson and Blednick (2011) also identified the concern over classroom make-up, and they identified 30% as the upper limit for placing students with IEP's in general education co-taught classrooms. Higher percentages of students with learning disabilities may lead to an ineffective classroom. Students that do not have learning disabilities should also be considered in this limit based on abilities. The student make-up of co-taught classrooms can impact the student outcomes just as much as the teachers and their collaboration and instructional strategies.

All of the recommendations for co-teaching partnerships, from the pairing of individuals to daily practices, are extremely important for success, but it is also important to emphasize the support of school personnel, including administration. Co-teaching cannot occur without support. The necessity of involving other school personnel is indicative of the idea that co-teaching is a philosophical approach that has to be accepted and supported by more than the individuals directly involved in co-teaching partnership. The approach is system-wide and includes the classroom level, building level, and district level. The teachers have to determine how they will share instruction and classroom responsibilities. The building level concerns include logistical aspects, such as, who will co-teach, where will they co-teach, scheduling staff and students, and providing preparation. Finally, the district level determines resource allocation, implementation of the plan, evaluation of the plan, navigation of public relations, and providing staff development (Walther-Thomas et. al, 1996). As with all of the parties included in co-teaching, administration plays a key role in successful practices and showing support for

inclusion of students with learning disabilities in the least restrictive educational setting.

Kohler-Evans (2006) suggested that it is most important for support to come from administration. A starting point can be facilitated by administration initially asking for volunteers, and beginning with a small group of co-teaching partnerships. This opportunity can be viewed as a means for professional growth. It is also important to emphasize and create understanding that inclusive practices should not occur in isolation, but, rather, it should be systemic. All students should be viewed as part of the learning community as a whole. This is the core concept behind co-teaching and inclusion and administration needs to provide support in order to help teachers facilitate success.

Administrators play an important role in facilitating co-teaching, but other school personnel can be instrumental in the success of this partnership. Collaboration of co-teachers with other personnel, including school psychologists (Solis et. al, 2012) and other specialized school personnel can also have a positive impact on the implementation of co-teaching. They can provide additional feedback and suggestions for practices that will benefit specific students or the group as a whole.

The practices of teachers in co-taught partnerships can be complex. Analysis of what occurs in co-taught settings continues to need further analysis (Sweigart & Landrum, 2015). This area of study is largely qualitative, with minimal quantitative data from which to draw conclusions. Co-teaching has many more individuals involved than the co-teaching partnerships alone, and there are many important factors to consider in order to facilitate success. The overall theme in the literature is the importance for every partnership to provide the opportunity for each teacher to be on equal footing (Scruggs et. al, 2007). Teacher preparation and choice in participating, planning and collaboration,

and school/district support are all major components of setting the optimal conditions for co-teaching to thrive and provide beneficial outcomes for students.

Co-teaching in Mathematics

The literature available on inclusion in math, and specifically co-teaching math, is limited, and this limitation requires some generalization of findings from other content to supplement the paucity in the literature. The concerns, limitations, and benefits of co-teaching in different content areas also apply to mathematics classrooms. This lack of research may be due to the identification of mathematics as the most difficult area to merge special education with because of dependency on spiraling and cumulative knowledge (Dieker, Stephan, & Smith, 2012/2013). This difficulty in joining special education and mathematics is what leads to a common practice of students with mathematics learning disabilities receiving instruction in a self-contained setting. Co-teaching mathematics takes an evident decline at the high school level. Mastropieri, Smith, Zigmond, & Gebauer (2005) found that mathematics has the least amount of lead teaching carried out by a special educator. The content area expertise is especially evident at the high school level and the role of the general education teacher is the content expert, while the special educator's expertise is on individual learning needs (Magiera, Smith, Zigmond, & Gebauer, 2005). The focus of the special education teacher at the secondary level can be to teach the processes used to understand the content that the general education teacher is teaching. Again, as in all content areas, the emphasis is on training of co-teachers, providing time for planning, and familiarization of standards by both partners.

Students with learning disabilities in mathematics have multiple barriers to overcome in order to have success in mathematics. Dieker, Stephan, and Smith (2012/2013) summarized issues that students with disabilities may encounter in mathematics classrooms. They may face perseveration, language issues, reasoning issues, perceptual limitations, and memory problems. Perseveration will likely present itself in difficulty with switching between differing procedures. New information may be confused with prior steps the student has learned. Language issues can present in the form of reading, writing, and speaking. Reading comprehension and fluency can impact students when they are reading math textbooks or other materials. Writing can be difficult for students when they are defending their responses by explaining their work in written form. Speaking can also be an issue when defending work or participating in classroom or group discussions. Reasoning skills can impact the student's abilities to interpret word problems. Struggles with perceptual skills can create difficulties in geometry. Finally, memory difficulties can impact recall of information, but students can be supported through use of accommodations (calculators, formulas, etc.). Co-teachers can identify areas of concern for individual students and decide what each teacher's role is in addressing the problems. All of these issues can create barriers for student success, but with careful planning by co-teachers, instructional strategies and research-based practices can be selected and implemented in order to provide opportunities for success for all students in the classroom.

One of the obstacles to address related to teaching mathematics to students is how to accommodate the needs for all students in the classroom. This issue of a necessity for differentiation applies to all classrooms, but it especially affects co-taught classrooms.

Teachers participating in co-teaching can pick strategies for instruction from a plethora of options in order to address differentiation. The main focus should always remain on maintaining a collaborative model as well as utilizing research-based practices from general education and special education. Sileo and van Garderen (2010) specifically identified the need to blend co-teaching structures with research-based instruction in mathematics classrooms. They also identified three challenges for blending co-teaching and research-based practices. The first challenge is identifying research-based practices for specific mathematics content areas, particularly for geometry, algebra, and data and probability. The second identified challenge is that some instructional practices may not be appropriate for all ages and all individuals. The final identified challenge is that some research-based practices will not work well in a co-taught, general education setting. In order to address these concerns they suggested that teachers could take problem-solving strategies and simplify the steps and the vocabulary. Also, instructional strategies used in other content areas can be applied when teaching mathematics. They can identify specific vocabulary techniques in order to have systematic vocabulary instruction. Mathematical strategies, which are typically implemented, could be modified by providing additional opportunities for guided practice that address specific needs of students with learning disabilities. Teachers can use think aloud strategies to model problem solving, provide opportunities for practice and review of cumulative information, provide immediate feedback, use real-world examples and/or activities, use different representational forms for reinforcement and problem solving, and use dialogue and cooperative learning. Different representations can be especially effective in the forms of symbols, diagrams, models, etc. These strategies can be incorporated within co-

teaching structures. Teachers can determine what strategies are most effective and what their student population will benefit from the most. The strategies used to accommodate the needs of students with learning disabilities may also help other struggling learners and can be used for differentiation in the classroom as a whole.

Hughes and Kolstad (1995) identified general and specific strategies that can be implemented by co-teaching partners in mathematics classrooms. The general strategies included: spending more time on group activities than whole class instruction; use a variety of materials and technology; provide activity choices and maintain structure and organization; meet individual learning styles; and provide ongoing feedback. The specific strategies they recommended included: selection of appropriate instructional objectives; identify specific materials and manipulatives; student groupings; identify individual and group performance criteria; and a plan for extension and expansion of concepts that are taught. These authors also came to the conclusion that activities that are constructed with students with disabilities in mind can also be used for instruction with all students. Also, providing the opportunity for other students to utilize these strategies prevents students with disabilities from being singled out.

Students with disabilities in mathematics may struggle with solving math applications problems because of complex steps and processes. However, students need to solve real-world problems, which are stressed in the Common Core State Standards. Students with learning disabilities benefit from systematic strategy instruction to solve real-world problems. Wilson (2013) suggested that use of the Math Frame is an effective approach for teaching mathematics to students with learning disabilities in the general education setting. The Math Frame is a systematic approach that visually scaffolds

problem-solving. The problems are broken down into steps, visualizations are used, and students can see similarities and differences in approaches. Overall, the Math Frame is a thinking organizer. Using this approach can help students with learning disabilities by having a guide for problem solving. Students proceed through a series of questions when solving problems, and this can be done independently, with groups, or teacher direction. This provides options for scaffolding for appropriate independence depending on individual student needs. The questions the students work through include: what information is given; what are you asked to solve; what strategy might help you solve this problem; what steps are needed to find the solution; what calculations are needed to find the solution; and what is the solution and does it make sense? Teachers can determine gaps or errors in student thinking by reviewing the steps students complete. The Math Frame is a structured way to provide support for problem-solving instruction and individualize it for specific student needs.

Another approach that can be used to enhance the likelihood of success for students, with learning disabilities, in co-taught classrooms is peer-assisted learning. Kroeger and Kouche (2006) suggested that peer-assisted learning strategies (PALS) facilitate co-teaching and support student engagement. The authors cautioned that, without use of effective strategies, students are set up for failure in the academically demanding general education setting. This can lead to feelings of failure and learned helplessness for students with learning disabilities. Use of PALS can facilitate success for these students. PALS is formed from, “creating clear objectives, presenting one new concept at a time, reviewing prior knowledge, making explanations explicit, utilizing effective instructional time, creating opportunities for adequate practice and review and

providing effective feedback” (Kroeger & Kouche, 2006, p.8). Co-teaching partners can implement these practices in order to provide systematic instruction to benefit all of the learners in the classroom. Student engagement increases by the use of partner dialogue, and they learn to use discourse to share problem-solving strategies. Teachers provide more of a supporting role in this model, while the students take the lead in teaching each other.

Also, enhanced anchored instruction is another delivery option that can be beneficial in co-taught classrooms. Bottge, Toland, Gassaway, Butler, Choo, Griffen, & Ma (2015) were focused on using enhanced anchored instruction (EAI) through use of interactive media and applied projects as part of mathematics instruction. They enhanced the anchored instruction by developing media-based interactive tools and hands-on activities to provide practice for problem solving. The researchers also developed computer-based modules to address the need for additional attention to be paid to fraction computations, which additional problem solving alone did not address. They included five EAI units that co-teachers implemented in their study. These units included computer-based activities, video-based anchored problems, and hands-on application of problem solving. Teachers in the study attended a workshop in EAI prior to the start of the school year. One finding they had, which is consistent with co-teaching classrooms in general, was that the co-teaching approach most commonly used was one teach, one assist (44% of partnerships) and team teaching was infrequently observed (17% of partnerships). The special education teachers typically fulfilled a secondary role and provided assistance to students individually, instead of whole group instruction. One very interesting finding was the effect size for fraction computations was greater than one

standard deviation when the special education teacher shared direct teaching responsibilities, while it was only about one quarter of a standard deviation in classrooms where the special education teacher did not share in instruction. This finding suggests that the co-teaching model is as impactful as the specific mathematical instructional strategies that are utilized.

Co-teaching in mathematics can have a powerful impact on student performance. The area continues to need further research in order to determine the best strategies and approaches for co-teaching partners to implement in their mathematics classrooms. The evidence in the literature indicates that co-teaching models and specific mathematical instructional strategies play integral roles in the success of co-teaching.

Teacher and Student Perspectives of Co-teaching

The practices involved in co-teaching impact the teaching partners as well as all of the students in the classroom. The ultimate goal is for a successful co-teaching dynamic that is measured by success of all students in the classroom. Teachers that are caring, show interest, show concern, provide encouragement, and have high expectations provide a positive climate for the classroom and impact student engagement and learning (Sakiz et. al, 2012). Teachers' perceptions and approaches directly impact student perceptions of the classroom.

As previously discussed, when the process of co-teaching is initiated, the first step is selecting the individuals to participate in the partnership. This process includes addressing individual thoughts and perceptions of co-teaching. Teacher attitudes toward including students with special education needs in the general education classroom have a significant impact on how they managed their classroom, and teachers with positive

attitudes toward inclusion had students that reported greater satisfaction in the classroom and fewer difficulties (Monsen, Ewing, & Kwoka, 2014). Monsen et. al (2014) suggested that there is a need to study what teachers with positive attitudes do differently to facilitate a positive learning environment. Frenzel et. al (2007) provided further support of this in their study. They found that perceived teacher enthusiasm in mathematics classrooms was positively related to individual student academic enjoyment. These findings indicate the importance of teacher attitudes and perceptions in creating a positive, productive, learning environment.

Another factor in teacher perceptions is how the teachers perceive the division of work. The overwhelming pattern in the literature is the trend of one teach, one assist. Austin (2001) found that special education and general education teachers both feel that the general education teacher does more instructionally than the special education teacher does. He attributed this to the idea that the special educator is the “visitor” in the classroom. The special education teacher is viewed as the adapter of curriculum and remediator, while the general education teacher is viewed as the curriculum expert. These roles may take this rigid form early on in a co-teaching relationship, but collaboration and planning can create greater cooperation and teachers can learn from each other’s roles in order to create a team teaching partnership. In spite of the perceived unequal division of work in the classroom, teachers believed that co-teaching contributed to positive student academic growth.

An important aspect of teacher and student perceptions is how the classroom environment is structured, and integral to this structure is the interaction between the students. A benefit for students in inclusive settings is that it provides opportunities for

students with learning disabilities to expand their social networks. Providing the opportunity for students with learning disabilities instruction in inclusive settings promotes friendships with peers and increases social satisfaction (Pavri & Monda-Amaya, 2001). Similar to many studies already mentioned, Pavri and Monda-Amaya (2001) found that only some special educators participated in team teaching, and special educators would often intervene to solve problems for students, even when the students appeared to be able to problem solve for themselves. This is a cautionary tale of providing too much support in a general education setting. This issue can be addressed through communication between co-teaching partners. The ultimate goal of inclusive practices is for students with disabilities to be included with their peers, while still ensuring their educational needs are being met. Farmer and Farmer (1996) found that students with exceptionalities were well integrated into the classroom's social structure. Students are included in the social structure through creation of peer clusters around shared characteristics. In their study students were typically only associated with one peer cluster, but a few belonged to more than one. The classrooms in this study had well-defined social structures. Students belonged to clusters based on specific characteristics. The overall positive outcome determined in this study is there was no evidence to support the claim that students with disabilities are outcasts from social groups. The benefit of providing access to peers in co-taught classrooms is that students with disabilities can collaborate with peers, while they would not have that opportunity in a special education classroom (Tapasak & Walther-Thomas, 1999).

Also, Hang and Rabren (2009) found evidence of students' positive perceptions of co-teaching. Teachers and students all reported greater self-confidence for students with

disabilities, they learned more and had sufficient support, and their behavior was better.

The most interesting finding was general education teachers and special education teachers both identified themselves as providing the most behavior management. This finding indicates a disconnect in perceived roles versus actual roles by the teaching partners. Again, this is an issue that can be addressed in planning and collaborative discussions of roles and responsibilities.

Student perspectives on co-teaching can provide a wealth of information too. Vaughn and Klinger (1998) found that students with learning disabilities preferred to receive instruction outside the general education setting, and they felt that the resource room setting was fun, easier, and they got more help than in their regular classroom. Students reported that they liked the inclusion setting because they could make friends. They valued support from the special education teacher in the general education class, but they did not know it was a special education teacher. The students also did not know why they were in special education. These findings indicate that students were not involved in discussion about having an individual education plan, and they do not know what their specific goals are. Furthermore, these findings provide evidence of the importance of including students in discussions about their education. Students should know what their accommodations or modifications are and they need this information in order to advocate for themselves. Also, it is important to include students in discussions of what their specific goals are and their progress toward their goals. This is especially important in mathematics instruction when students might need more practice on specific skill deficits than what their peers need.

Another important aspect of student perceptions is what their view of instruction is. Klingner and Vaughn (1999) synthesized 20 studies that included student perceptions of inclusion. They found that students with learning disabilities preferred the same activities, homework, books, grading, and grouping as the rest of the class. They also valued teachers adjusting instruction to their pace when needed, teachers providing clear explanations, use of learning strategies, and teaching content in multiple ways. These findings are important for teachers to reflect upon because they can be used to help guide practices and to ensure the aspects that the students valued match up with practices that are recommended in co-taught classrooms.

The practice of co-teaching is complex and has interdependent parts. The players involved in co-teaching include the teaching partners, administrators, students in the classroom, and other school support personnel. First, co-teaching partners need to be identified, which should be followed by training teachers. Districts need to ensure that teachers understand co-teaching approaches and can determine which approaches will work best for their partnership. Once this is established, teachers can focus on mathematics content, determine what research-based practices they will use to teach the content, and who will teach what. Ultimately, the goal is to avoid the typical roles of one teach, one support as the primary instructional model. In order to achieve this, co-teachers need to have dedicated planning and collaboration time. This was a concern that was addressed repeatedly throughout the literature. This can be achieved through support of administration and willingness to collaborate by the partner teachers. Facilitating positive attitudes for co-teachers was emphasized because of the impact it has on the dynamic between teachers and the overall classroom environment. Again, this needs to

be supported by administration and support of co-teaching needs to be school wide. Mathematics classrooms have not received as much attention in studies of co-teaching. The demands of the content make it a challenging setting for students and teachers. In the future, it would be beneficial for more studies to be completed in co-taught mathematics classrooms, and for the focus of these studies to include teacher practices and student outcomes. The ultimate goal is including students with learning disabilities in general education mathematics classrooms and providing the necessary support for these students to show progress academically and socially with their peers. Careful planning by co-teaching partnerships will provide a positive, supportive learning environment for all students, and will provide the least restrictive setting for students with learning disabilities in mathematics classrooms.

Chapter 3: Discussion

In this chapter, the four implications, three limitations, and accompanying areas for future research are provided. It is important to note that such conclusions are based on a comprehensive review of the literature and not empirical data gathered in one single study per se.

Implication #1

The first implication on best practices in co-teaching mathematics is the importance of the specific purpose of the co-taught setting and the selection process of co-teaching partners. The co-taught setting should be created with a targeted purpose. Co-taught classrooms are an advantageous setting because they can provide a balance between providing the necessary special education services, while creating an opportunity for students to access the least restrictive educational setting. Ideally, the co-taught setting is a supportive setting for the teachers and students involved. With thoughtful planning, co-taught classrooms can be beneficial for all parties involved.

Co-teaching is not intended to create an intervention classroom with a population of students that do not meet proficiency expectations. These classrooms should be created with a focus on having a heterogeneous grouping, and classrooms should not be created through a random generation of rosters. Each student needs to be individually selected in order to ensure a heterogeneous class (Walther-Thomas et. al, 1996). In short, the creation of groups and consideration of social dynamics needs to be purposeful. This can be a time consuming activity, but it is worth investing time in order to create a classroom makeup that will foster an environment for success. Walther-Thomas et. al, (1996) suggested no more than six students out of a classroom of 25 should have mild or

moderate disabilities, while Wilson and Blednick (2011) suggested an upper limit of 30% for placing students with disabilities in general education co-taught classrooms. Placing a limit on how many students with disabilities are in any individual classroom can provide a basis to create a heterogeneous environment. Teachers should also factor in students that do not qualify for special education services, but perform at a similar level to students with learning disabilities, into that upper limit. The co-taught classroom is likely to become an ineffective classroom for student growth if the group is solely made up of students with learning disabilities and students that are underperforming. The ideal co-taught classroom will include a distribution from high performing to struggling learners.

Along with the careful creation of classroom rosters, the selection process of teachers is critical to implementing co-teaching and creating an environment for student success. Partnerships should be selected carefully in order to ensure equitable pairings (Walther-Thomas, 1996). The typical model of instruction is the general education teacher taking the instructional role, while the special education teacher supports the general education teacher. There are many other approaches to co-teaching, which give special education teachers opportunities with instructional activities and sharing the responsibility of instruction with the general education teacher. Determining a good match of teachers from the beginning will provide a greater chance for effective collaboration and division of roles. Co-teaching partnerships are not intended to provide support for a struggling teacher. This is counterproductive to the basic idea of co-teachers supporting each other. If one teacher is struggling, then it can create stress on the partnership. Also, it is not intended to provide mentoring for new teachers. The

selection process and partnering of co-teachers is a vital first step for creating effective partnerships.

The dynamic established in these partnerships can be set up for success from the beginning by providing co-teaching as a choice for both partners. Making this partnership a choice can help frame co-teaching as a positive endeavor for both individuals involved. This approach to teaching is not typically part of traditional teacher education and requires training of the individuals involved. Also, co-teaching is not a simplistic approach to teaching and requires thoughtful planning by both partners.

Once teachers agree to participate in a partnership, they can learn more about each other by completing an inventory of their teaching philosophy (Piechura-Couture et. al, 2006). This type of activity can make shared beliefs, or differences they have, transparent from the beginning of the partnerships. Understanding differences in perceptions can help individuals forge a relationship from the beginning by having an awareness of each other's perspectives. Inventories can also help teachers determine if they feel they are compatible. Conflicting beliefs and poor compatibility can inhibit positive relations. However, teachers that do not volunteer for co-teaching could be successful if they are highly compatible (Mastropieri et. al, 2005). Student success hinges upon the ability of co-teachers to work together to effectively provide appropriate instruction and support for all students in this setting. The purpose of co-teaching and the individuals selected are tied directly to the perceptions of all individuals involved. Individual perceptions can be used to determine which teachers are initially selected for partnerships and whether or not partnerships will continue, based on student outcomes.

Implication #2

Another implication on best practices in co-teaching mathematics is the impact of teacher and student perceptions of co-teaching and the co-taught classroom. The general attitude of teachers sets the tone for classrooms. This is a factor in all classrooms, but even more so when there are two teachers in the classroom. Student engagement and learning can be positively impacted by teachers that show caring, interest, concern, provide encouragement, and have high expectations (Sakiz et. al, 2012). Co-teachers can have an even greater impact on students if they both demonstrate these positive behaviors while utilizing effective, research-based practices. It would benefit other teachers to find out what teachers with positive attitudes do differently that leads to a positive classroom environment (Monsen et. al, 2014).

The classroom environment can be positively impacted additionally by teachers maintaining positive attitudes and by teachers demonstrating enthusiasm for mathematics. Teachers demonstrating enthusiasm in mathematics classrooms is positively related to student enjoyment of the content (Frenzel et. al, 2007). Positive attitudes and enthusiasm can coincide, but having a positive attitude does not guarantee enthusiasm. Naturally, it is difficult to maintain enthusiasm with a negative attitude. This need for positivity and enthusiasm to foster a healthy learning environment is dependent on shared beliefs of the co-teachers. Demonstrating positivity and enthusiasm needs to be valued by both parties, and they need to have a commitment to maintain practices that foster these feelings in their partnership and classroom. It is important for both teachers to be aware that they create the tone to foster a positive, productive, learning environment. Students are aware

when teachers exhibit a genuine enthusiasm for the content and have shared meaning in their approach to teaching mathematics.

Teacher perceptions and attitudes can be impacted by how the roles have been defined within the co-teaching partnership. Special education teachers are often relegated to a supportive role, while the general education teacher provides most of the instruction. This idea can be attributed to the idea of the special educator as the “visitor” (Austin, 2001). This can be seen in the roles the special education teacher plays, and also the fact that it is typically the general educator’s classroom that the special education teacher goes into for co-taught classes. The view of the special education teacher as a visitor in the classroom can occur because it is not the special educator’s classroom, but this can become less evident if the teachers plan so the instructional role is shared. Collaboration and planning can remedy or alleviate the feeling of the special educator as the visitor by creating a stronger partnership and shared vision.

The structure of the classroom environment and interaction between students also impacts teacher and student perceptions. Special education students in this setting have access to their peers and can create friendships. This opportunity provides greater social satisfaction for students (Pavri et. al, 2001). Students have the opportunity to collaborate with peers in the co-taught setting, while they would not have this opportunity in resource classrooms (Tapasak & Walther-Thomas, 1999). The resource setting limits the peer relationships the students can form.

Many students report positive perceptions of co-teaching (Hang & Rabren, 2009). Students with learning disabilities can develop greater self-confidence, learn more challenging content, and improve their behavior under appropriate circumstances and

interventions. Having peers that model learning strategies and demonstrate appropriate behavior can be an asset that students with learning disabilities may not get exposure to in the resource setting. In some cases, students with disabilities may prefer the resource setting because they perceive it to be easier and less demanding, however, forming friendships with their general education peers remains a priority (Vaughn & Klingner, 1999). A preference for the resource setting is understandable because the academic demands in the resource setting are typically not as high as they are in the general education setting. The resource setting is focused on the student's instructional level, rather than the grade level standards in the general education classrooms. Students in inclusive settings want to fit in with their peers and do not want to be singly identified. Such students may often want to complete the same activities, homework, use the same books, and receive the same grading as the rest of the class. Students with learning disabilities also value teachers adjusting instruction pace, clear explanations, explicit learning strategies, and different approaches to teaching (Klingner & Vaughn). Student preferences should be used to help inform collaboration, approaches used, and strategies teachers choose to implement in co-taught classrooms. Student and teacher perceptions are also impacted by the use of effective co-teaching practices.

Implication #3

Yet another implication on best practices in co-teaching mathematics is the use of effective co-teaching practices. Co-teaching can create extra planning time for teachers, but it can also decrease the workload for both teachers. They have a partner that can share the classroom responsibilities (Bouck, 2007). Once teachers have established their shared beliefs about teaching they can begin to identify roles and responsibilities and how

those will be divided. Shared roles and responsibilities are important, but divided roles and responsibilities are important to consider too. Some aspects of the partnership will be unique to the individual teacher. For instance, the special education teacher will write, collect data, and report progress on individual goals for each student with an IEP. These tasks are unique to the role of the special education teacher. Likewise, the general education teacher would determine the scope and sequence of the mathematics curriculum. An example of a shared responsibility could be grading assignments and tests based upon an agreed upon rubric. Co-teaching partners need to discuss and determine the division of physical space in the room, instructional roles, and procedures for management and discipline. This process takes a commitment by both parties to take the time to address all of these areas and create an agreed upon plan.

One way to establish a collaborative effort between teachers is to provide training on the process and practices. Teachers are typically not trained in co-teaching approaches in teacher education programs. Training specifically in effective use of evidence-based practices is critical for the successful outcome (Sweigart et. al, 2015). Teachers should focus on specific strategies and teaming approaches. Some strategies and approaches are more appropriate depending on the content being taught, so what would be most appropriate and effective needs to be considered for each lesson. The most often reported strategies/approaches are: one teaching, one observing; one teaching, one circulating; team teaching; parallel teaching/split class; and small group pull out (Piechura-Couture et. al, 2006). Most researchers report these approaches in some variation. Again, teachers need to select which approach is most appropriate according to the content they are teaching. Co-teachers also need to consider which approaches they

would be more effective with in their teaching partnership. Implementing different approaches can create variety for students and can help teaching partners identify approaches that are the most effective for their students. A trial and error approach can also be used to determine effective teaming strategies. Teaming strategies can include: proximity sweep; proximity dance; active interplay; passive interplay; good cop, bad cop; smart teacher, dumb teacher; and peat, repeat (Piechura-Couture et. al). Teachers can also blend strategies, or use more than one strategy during a lesson. The options for co-teaching approaches and teaming strategies provide teachers with flexibility to engineer their lessons to utilize each teacher's strengths and minimize their weaknesses.

As previously mentioned, the role of the special education teacher is typically relegated to a supportive role. Special education teachers are usually subordinate to the general education teacher (Scruggs et. al 2007, Solis et. al 2012, & Sweigart et. al 2016). This is evident in the typical approach to co-teaching, which is one teach, one assist (Scruggs et. al 2007). The unfortunate effect of this approach is that students often perceive the general education teacher as the "real" teacher in the classroom. Once this perception is formulated, it is hard to change, so it will often stay the sole approach used for instruction. Use of one teach, one assist is more prevalent at the secondary level, which is likely due to the content demands (Mastropieri et. al 2005). This leads to the general education teacher taking the role as the dominant teacher. Co-teachers need to make a concerted effort to avoid relying solely on the model one teach, one assist in order to reap the greatest benefits from their partnership. The use of effective co-teaching practices impact instructional approaches, as well as the use of effective mathematics teaching strategies.

Implication #4

The final implication on best practices in co-teaching mathematics is the use of effective mathematics teaching strategies and appropriate accommodations in co-taught mathematics classrooms. The focus in mathematics classrooms cannot solely be on the co-teaching approaches used for instruction. Part of the balance for successful mathematics co-teaching is the use of strategies specific to mathematics.

There are many issues specific to mathematics classrooms that need to be taken into consideration. DeSimone and Parmar (2006) identified three issues related to co-teaching partners in mathematics classrooms. These issues include: a limited understanding of learning needs for students with disabilities; teacher collaboration as a resource for general education teachers; and teacher education programs and in-service professional developments do not prepare teachers for co-teaching. Many issues may become evident over time for co-teachers. The key to success in addressing issues that arise is for the teachers to have training and to maintain collaboration throughout their partnership. Access to the necessary training and availability of collaborative time is dependent, not only on the co-teaching partners, but also from support of administration. The focus during collaborative time needs to include, not only planning for instruction, but also addressing specific issues and problem solving for these issues.

Other concerns directly apply to the students with disabilities in co-taught mathematics classrooms. The difficulties they may encounter may be tied to perseveration, language issues, reasoning issues, perceptual limitations, and memory problems (Dieker et. al, 2012/2013). Students may perseverate when they switch from procedure to procedure, which necessitates that the teachers provide clear processes

during instruction and clearly identify and prepare students for when procedures will change. Students that persevere also need to be provided with examples and non-examples. Activities that include reading, writing, and speaking will present challenges for students with language issues. Students may struggle with comprehending math word problems or reading text in their math books. It is critical to check for understanding with these students in order to determine if they understand what they are reading. Checking for understanding can also identify language issues when students explain their procedures for solving. Difficulties with writing will also become evident when students explain their reasoning in written form. Organizers, models, and templates can be used to help these students to organize their thoughts. Difficulties with reasoning may impair a student's ability to explain how they found an answer or they may struggle with connecting concepts. Deficits with perceptual skills can impair recognition of sequencing, recognition of position, etcetera. Teachers need to be aware of this for these students because they may struggle with interpreting graphs, overheads, images on computer screens, etc. Finally, memory difficulties will consistently present in many facets of mathematics. Students may be impacted on recalling basic facts, formulas, procedures for solving, etc. Teachers can accommodate these students by providing use of calculators for facts, providing formula resources, listing steps for solving problems/providing organizers, etc. The most important consideration teachers should have is that each individual student's needs may vary, and students will benefit from teachers collaborating in order to address their needs and provide the specific support they require for success. This is an ongoing process and individual needs may change as the content changes. Students that excel with algebra concepts may struggle with

geometry concept and vice versa. Once teachers become familiar with individual student needs they can begin to anticipate where struggles may occur when they plan lessons, and they can address these issues and provide supports accordingly.

The success of co-taught classrooms will be impacted by how issues related to teachers and students are addressed, and a targeted approach to teaching will remedy many of these issues. An effective co-taught mathematics classroom blends co-teaching structures with research-based instruction in mathematics (Sileo & van Garderen, 2010). The challenging aspects of this process include: identifying research-based practices for specific mathematics content areas, particularly for geometry, algebra, and data and probability. Also, some instructional practices may not be appropriate for all ages and all individuals, and some research-based practices will not work well in a co-taught, general education setting. Teachers need to address these issues by taking a targeted approach to teaching problem-solving and vocabulary. Vocabulary should be taught through a systematic approach. Additional strategies may include, but are not limited to, providing additional opportunities for guided practice; use think aloud strategies to model problem solving; provide opportunities for practice and review of cumulative information; provide immediate feedback, use real-world examples and/or activities; use different representational forms for reinforcement and problem solving; and use dialogue and cooperative learning.

It is also important to consider the benefit of peer collaboration in mathematics classrooms. Peer-assisted learning strategies (PALS) can be used to support student engagement (Kroeger & Kouche, 2006). The use of PALS provides a structure for, “creating clear objectives, presenting one new concept at a time, reviewing prior

knowledge, making explanations explicit, utilizing effective instructional time, creating opportunities for adequate practice and review and providing effective feedback”

(Kroeger & Kouche, 2006, p.8). The use of partner dialogue can help students by practicing verbalizing their steps for solving and explaining their thought process. They may also learn new approaches from their partners.

Another approach that can be used in co-taught mathematics classrooms is the Math Frame (Wilson, 2013). The Math Frame utilizes a systematic approach that visually scaffolds problem-solving. The Math Frame is useful to create a thinking organizer for students. It provides a way for student to create a visual that outlines steps and includes similarities and differences in approaches. This has a lot of flexibility because it can be completed as a whole class, with partners, or individually. This is yet another example of a tool that can be used in co-taught mathematics classrooms to facilitate positive outcomes for students.

These are all practical strategies co-teachers can implement to facilitate greater understanding of mathematics concepts and improve student outcomes for all students in their classrooms. The implications from the research reviewed identify key processes that need to be addressed in order to create positive outcomes for teachers and students in co-taught classrooms. The purpose of the co-taught setting and the selection process of co-teaching partners are the building blocks for creating a successful co-taught partnership. Also, teacher and student perceptions of co-teaching and the co-taught classroom have an impact on the co-taught environment. Additionally, the use of effective co-teaching practices and use of effective mathematics teaching strategies and appropriate accommodations in co-taught mathematics classrooms influence the success

of the co-taught classroom. The recommended practices and strategies outlined here for co-teachers are all supported strategies for practical application in co-taught classrooms. The literature revealed many recommendations, and it also uncovered limitations and implications for future research.

Limitations and Future Research

Limitation #1

One limitation from this literature review is a lack of a consistent definition of what effective co-teachers are. Comparing results across studies is difficult when the participant base and operational definition of participants can vary widely. Researchers should have a clearly defined concept of effective co-teachers, and they should share what that is. However, it seems to be borderline unethical to study classrooms that are deemed to have ineffective co-teaching partnerships. This begs the question: Why would ineffective co-teaching partnerships be allowed to continue once they have been determined to be ineffective? Ineffective co-taught settings are detrimental to the teachers involved, and more importantly, the students involved. The most likely reason that these partnerships continue is because it provides the opportunity for students to receive instruction in the least restrictive environment, while receiving the support they need for their individual learning. Keeping students in an ineffective co-taught classroom in order to meet the need for a less restrictive environment does not provide the best setting for the students.

It can also be difficult to generalize results when multiple co-teachers are involved in a study and the effectiveness of their practices is not determined. Co-teaching practices can have significant variation from one classroom to another. It is

logical to predict that effective co-teaching partners will have more positive student outcomes than ineffective co-teaching partners will have. An accepted definition of what effective co-teaching partnerships look like would help researchers determine if they can provide evidence to support a significant relationship between effective co-teachers and successful outcomes for students. It is difficult to make a connection between the two when effective co-teachers are not clearly defined.

Future research should include a specific definition of what effective co-teachers do in the classroom that makes them stand apart from ineffective co-teachers. Researchers should also determine how co-teachers became involved in co-teaching (i.e. volunteer, assigned, etc.), and what kind of training they have had on co-teaching. It would also be interesting to determine if districts have a process in place to address the needs of partnerships deemed to be ineffective. A focus on what effective co-teachers look like can help guide trainings for new co-teachers, and to provide ongoing trainings for established partnerships.

Limitation #2

The second limitation from this research is a lack of focus on student outcomes. Student outcomes are important to include in studies in order to determine if students are showing growth in co-taught classrooms. Many studies report teacher and student subjective perspectives without considering what student performance data can reveal. Most studies overlook outcomes in favor of focusing on practices of co-teachers (Friend et. al, 2010, Magiera & Zigmond, 2005).

Student outcomes are also important to study in order to compare to performance in resource settings. These results are vital because we can use the data to determine if a

co-taught setting indicates more growth than a resource setting. One component that could be studied is comparing individual student data. Students in co-taught settings typically have received instruction in the resource setting as well. It would be interesting to compare how much growth they had while they were in the resource setting versus the growth in the co-taught setting. This data analysis can also be tied to the question of the appropriateness of the co-taught setting for students with learning disabilities. How the students respond should drive co-taught practices (Wilson, Kim, & Michaels, 2011). If students are not progressing, then practices of the teachers should be addressed, as well as looking at individual student needs and if this setting is appropriate for them in order to demonstrate growth.

Future research should include outcomes in co-taught classrooms in order to determine efficacy of co-teaching in mathematics. Most studies focus on practices of teachers, but including outcomes could provide a wealth of information. Researchers could provide evidence in order to determine if specific teacher practices are related to significant outcomes for students. This could be used to further identify quality instructional strategies to implement in mathematics co-teaching classrooms. Student outcomes in co-taught classrooms could also be compared to student outcomes in resource settings. However, these comparisons need to be made carefully because students in the resource settings may perform at different ability levels, therefore growth expectations would be different. Also, student performance, considered along with co-teaching practices, can be used to determine if the co-taught setting is the most appropriate approach for students to receive services.

Limitation #3

The final limitation from this literature review is that there is minimal research on co-teaching in mathematics. Mathematics has been identified in the research as one of the most difficult content areas to merge with special education due to spiraling and cumulative knowledge (Dieker et. al, 2012/2013). This is even more evident at the high school level because of the demands of the content, so effective co-teaching practices are less evident. Special education teachers often minimally participate in lead teaching in mathematics at the high school level as well (Mastropieri et. al, 2005). The special education teacher's teaching endorsements were not included in the studies reviewed here. Information about their endorsements maybe provide further insight into why special education teachers assume a more supportive role at the secondary level.

Another concern is that students with learning disabilities may have deficits that impact their performance in general education settings, and they need specific strategies taught or accommodations made to foster success. There was minimal mention of this in the literature. Dieker, Stephan, and Smith (2012/2013) reviewed specific issues students may face, but most literature did not include issues in their discussion or made minimal mention. This ties to the question of how teachers accommodate the needs of all of the students in the classroom. The benefit of addressing the needs of special education students in co-taught mathematics classrooms is that strategies identified to help these students will also be useful for other struggling students.

Future research should focus on mathematics and specific mathematical strategies that are effective in a co-taught setting. Not only are co-teaching models important to consider, but strategies used to teach mathematics are also a key component for

determining effective practices of co-teachers. A focus on student performance and specific strategies teachers used while instructing could identify the most effective strategies for positive student outcomes.

Also, the teaching endorsements and domain or content background of special education teachers would be an interesting component to include in future research. If special education teachers do not have a general education mathematics endorsement, then they may struggle with providing the direct instruction to a whole class. The importance of expertise in mathematics content is especially evident at the high school level. Special education teachers that do not have mathematics endorsement would be more likely to take the subordinate role, instead of participating in shared instructional responsibilities.

Overall, there are many aspects of co-teaching that can be researched in the future to guide practitioners. The first focus should be placed on who is involved in co-teaching. This focus should include: how the co-teachers became part of this partnership; completion of inventories to identify philosophies of teaching; what their attitudes and perceptions of co-teaching are; and what their endorsement areas are, particularly in the case of special education teachers. Another area of focus needs to be on instructional practices and strategies used in mathematics classrooms. Finally, there should be a focus on investigating student outcomes and appropriateness of the co-taught mathematics classroom for students with learning disabilities.

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