Examining the Relationship between Co-teaching and Special Education Teachers' Self-efficacy for Teaching Elementary Mathematics

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ABSTRACT

This study examined the relationship between co-teaching and elementary special education teachers' self-efficacy for teaching mathematics. A combined *Co-Teacher Relationship Scale* and *Self-Efficacy for Teaching Mathematics Instrument* was administered to 103 elementary special education teachers from Superintendent's Regions 2 and 3 in the Commonwealth of Virginia who co-taught mathematics for at least one class period per day yielding a 54% response rate ($N = 56$). Employing a Spearman's Rho, analysis revealed moderate, positive, statistically significant correlations between the co-teaching relationship and self-efficacy for teaching mathematics ($r_s = 0.41$, $p = 0.002$) and between the grade level co-taught and self-efficacy ($r_s = 0.43$, $p = 001$). There was also a small, positive correlation between the number of years a special education teacher co-taught mathematics and self-efficacy for teaching mathematics ($r_s = 0.20$); however, that relationship was not statistically significant ($p = 0.14$). A one-way ANOVA revealed that special education teachers who co-taught Grade 5 had the highest self-efficacy score ($M = 92.85$, $SD = 13.39$) compared to those who co-taught Grade 2 ($M = 83.38$, $SD = 13.49$), Grade 3 ($M = 81.00$, $SD = 12.49$), Grade 4 ($M = 80.90$, $SD = 15.61$), Grade 1 ($M = 74.33$, $SD = 11.74$), Kindergarten ($M = 73.25$, $SD = 13.15$), and pre-Kindergarten ($M = 68.33$, $SD = 22.23$). The implications include providing co-teachers with time to develop collaborative relationships prior to co-teaching, increasing training and implementing effective scheduling and planning practices for co-teaching teams, and increasing job-embedded mathematics training for special education teachers.

Keywords: *Co-teaching, Elementary mathematics teaching, Self-efficacy for teaching mathematics, Special education teachers, Teacher self-efficacy, Teacher collaborative relationships.*

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Highlights of this paper

- In order to provide high-quality mathematics instruction to students with disabilities, elementary special education teachers must have an understanding of mathematics content, how to teach it, and believe in their ability to teach mathematics to others, which can be measured as teachers' self-efficacy for teaching mathematics.
- When special education teachers have a perceived positive relationship with their general education co-teachers, they have greater self-efficacy for teaching mathematics.
- Elementary special education teachers can feel more prepared and improve their self-efficacy for teaching mathematics through effective co-teaching relationships, job-embedded training, and opportunities to plan, analyze, and reflect on practices with others.

1. INTRODUCTION

In Virginia public schools, 65% (n = 100,252) of students with disabilities (SWD) are included in regular classrooms 80% or more of the day (U.S. Department of Education, 2018; Virginia Department of Education, 2017) therefore, many are learning content in the general education setting. While the overall SWD pass rate on the mathematics Standards of Learning (SOL) test has averaged 50% for the three years immediately preceding the COVID-19 pandemic, the achievement gap between general education students and SWD has been 31% (Virginia Department of Education, 2019b). In order to improve academic outcomes and close that gap, it is imperative that general and special education teachers have a positive collaborative relationship and the specific content knowledge needed to meet the needs of all students.

2. BACKGROUND / LITERATURE REVIEW

A recent national survey completed by 1,467 special education teachers found that only 8% rated their general education teacher colleagues as well-prepared to work with students with exceptionalities, and although only 29% of those special education teachers reported frequent use of co-teaching as a collaborative approach frequently used in their school district, 67% cited working collaboratively with others as a very or extremely important area on which they are evaluated (Fowler, Coleman, & Bogdan, 2019). Regarding planning and teaching subject-specific content, 53% of special education teachers reported they were not confident in teaching content related to high stakes testing. The data further revealed that although general and special education teachers are tasked with working together in co-taught settings to improve outcomes for all students, there is a need to build the content and pedagogical knowledge of special educators, the special education knowledge of general educators, and the co-teaching and collaboration skills of both groups of educators.

For just over a decade, teacher-education scholars have noted that the preparation special education teachers receive does not always prepare them to provide specific content area instruction, and the broad knowledge they *do* obtain may not always translate into practice (Brownell et al., 2009; Leko & Brownell, 2009; Sweigart & Collins, 2017). In order to develop mathematical knowledge and be well-prepared to implement research-validated strategies and routines, special education teachers need time, opportunity, and a nurturing environment that encourages them to make sense of the mathematics they teach (Leko & Brownell, 2009; The American Mathematical Society, 2012). One recommended vehicle to facilitate this understanding is school-based collaboration that joins the knowledge bases of both general and special education teachers (Leko & Brownell, 2009).

While extensive research focusing on teacher self-efficacy for teaching mathematics (Althauser, 2015; Amankonah, 2013; Kahle, 2008; McGee, 2012; Pacinello, 2018) and factors influencing special education teachers' mathematics teaching efficacy (Aerni, 2008; Flores, Thornton, Franklin, Hinton, & Strozier, 2014; Sylne, 2015)

exists, a gap in the literature remains concerning how the co-teaching relationship impacts the relationship between these two variables.

2.1. Self-Efficacy

A social learning approach based on a microanalysis of perceived coping capabilities, *self-efficacy* is focused on judgments of how well one can organize and execute courses of action (Bandura, 1977; Bandura & Schunk, 1981). People with high self-efficacy approach difficult tasks as challenges, while dichotomously, others see them as threats (Bandura, 1993). Both task- and situation-specific and focusing on beliefs about whether behaviors can be performed (Bandura, 1986; Dellinger, Bobbett, Olivier, & Ellett, 2008) self-efficacy relates to one's self-perception rather than an actual level of competence.

Emanating from this construct, *teacher self-efficacy* specifically focuses on a teacher's individual belief in their capacity to successfully perform explicit teaching tasks in a given situation regardless of external factors such as background, Intelligent Quotient, or school conditions (Dellinger et al., 2008; Gibson & Dembo, 1984). In fact, research (Holzberger, Phillipp, & Kunter, 2013; Woolfolk & Hoy, 1990; Zee & Koomen, 2016) has indicated that a strong sense of teacher self-efficacy lays the groundwork for a high-quality classroom environment that advances students' abilities and involves them in meaningful instructional activities.

When the concept of *mathematics self-efficacy* is expanded to teaching, there is a clear distinction between teachers' mathematics self-efficacy and teachers' self-efficacy for teaching mathematics. The former refers to a teacher's own belief in their ability to perform mathematical tasks, while the latter is a teacher's belief in their ability to teach mathematics to others (Kahle, 2008; McGee, 2012; McGee & Wang, 2014).

2.2. Content Knowledge

As students are held to higher standards of mathematics achievement, focus on teachers' content knowledge has magnified, making it necessary for them to be confident in their abilities to teach mathematics effectively (Ball, 1990; Flores, Patterson, Shippen, Hinton, & Franklin, 2010; Newton, Leonard, Evans, & Eastburn, 2012). Considering teachers' self-efficacy is linked to their knowledge and their instructional practices (Althauser, 2015; Ekstam, Korhonen, Linnanmaki, & Aunio, 2017; Manouchehri, 1997; McGee, 2012) practitioners must identify methods for improving teachers' self-efficacy for teaching mathematics. Recommendations include strengthening both mathematical content knowledge and developing pedagogical content knowledge (Ekstam, Korhonen, Linnanmäki, & Aunio, 2018; Hinton, 2011; Manouchehri, 1997).

2.2.1. Mathematical Content Knowledge

To teach mathematics effectively, educators must not only have knowledge of the subject, but also an explicit conceptual understanding of its principles; the various skills in instructional practices; and an understanding of the underlying meaning of its topics, rules, and definitions (Ball, 1988a; Ekstam et al., 2018; Flores et al., 2010; Manouchehri, 1997). Furthermore, elementary teachers should also know ways to use mathematical drawings, diagrams, manipulative materials, and other tools to illuminate and explain mathematical concepts and procedures and to support students' construction of ideas (Battista, 1999; The American Mathematical Society, 2012). To develop more substantial content knowledge and self-efficacy for teaching mathematics, teachers need guidance to identify practices that yield positive learning experiences, models of effective mathematics instruction, practice using the acquired knowledge, and successful experiences in lesson design and implementation (Althauser, 2015; Weiss, Pasley, Smith, Banilower, & Heck, 2003).

2.2.2. Pedagogical Content Knowledge

In addition to considerable content knowledge, teaching mathematics requires a special form of pedagogical content knowledge and skills as these influence teachers' effectiveness (Ekstam et al., 2018; Graham & Fennell, 2001; Hill, Rowan, & Ball, 2005; Manouchehri, 1997). Pedagogical knowledge incorporates content knowledge of the discipline with teachers' "knowledge of students and of learning; knowledge of curriculum and school context; and knowledge of teaching" (Manouchehri, 1997). In preparing lessons, teachers must be able to make decisions based on their knowledge of mathematics, consider students' instructional needs, evaluate and select appropriate activities, and choose representations that will bring the mathematics concepts into focus (Graham & Fennell, 2001; The American Mathematical Society, 2001).

2.2.3. Special Education Teachers' Mathematical and Pedagogical Content Knowledge

At the elementary level, qualified special education teachers who have direct responsibility for providing mathematics instruction should possess the same level of mathematical knowledge as general educators (Brownell et al., 2009; Flores et al., 2014; The American Mathematical Society, 2012). Quality mathematics instruction by special education teachers is dependent on an understanding of (a) the content and how to teach it, (b) specific problems that students with disabilities (SWD) may experience in mathematics, and (c) the role of specific interventions in providing more intensive and explicit instruction (Brownell, Sindelar, Kiely, & Danielson, 2010). As with general educators, the "importance of special educators' knowledge of content and how to teach in mathematics cannot be underestimated" (van Garderen, Scheuermann, Poch, & Murray, 2018) because both are needed to provide high-quality instruction for SWD (Leko & Brownell, 2009).

Since special and general education elementary mathematics teachers are specialized in different areas, developing ways of organizing educational support to take advantage of the knowledge of both teacher groups is imperative (Ekstam et al., 2018). Collaboratively planning, co-teaching, analyzing, and reflecting upon mathematics lessons could not only improve instructional practices, but more importantly strengthen special education teachers' self-efficacy for teaching mathematics (Althauser, 2015; Ekstam et al., 2018; Kahle, 2008).

2.3. Self-Contained to Collaboration

As Brownell et al. (2010) noted, in the early stages of educating SWD in public schools, special educators primarily worked in either self-contained classrooms or resource rooms. However, with the legislation of the Individuals with Disabilities Education Improvement Act (IDEIA) of 2004, which demanded more accountability and individualization in special education, and with a heightened focus on SWD being served in the least restrictive environment, schools have begun to embrace the need for genuine collaboration between general and special education teachers to provide high-quality instruction to diverse groups of students (Murawski & Lochner, 2011; Potts & Howard, 2011). The placement that best allows SWD the opportunity to access the general education curriculum and receive services with peers without disabilities is in the general education classroom, which highlights the need for effective service delivery models to accommodate these students (Brownell et al., 2010; Gately, 2005).

2.4. Co-Teaching

Bauwens, Hourcade, and Friend (1989) coined the term *cooperative teaching* to describe the merger between general and special education teachers to provide direct educational programming to all students within a general education setting. In cooperative teaching, "both general and special education teachers are simultaneously present

in the general classroom maintaining joint responsibilities for specified education instruction that is to occur within that setting" (Bauwens et al., 1989). Cook and Friend (1995) later shortened the term to *co-teaching* and defined it as "two or more professionals delivering substantive instruction to a diverse or blended group of students in a single space" (p. 2). While co-teaching can occur between a general education teacher and any other specialist, it most frequently merges the expertise of a general and special education teacher to jointly deliver instruction to a cluster of students with special needs in a general education setting, enabling SWD access to the general education curriculum, while at the same time specially designing instruction to meet their individual needs (Friend, Reising, & Cook, 1993; Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010; Weiss & Glaser, 2019).

Common models used in co-teaching are *one teaching, one assisting*; *station teaching*; *parallel teaching*; *alternative teaching*; *team teaching*; and *one teaching, one observing* (Cook & Friend, 1995; Friend et al., 2010). It should be noted that even though co-teaching provides support for SWD in an inclusive setting, co-teaching is not synonymous with inclusion; it is an approach used *to facilitate* the inclusion of students (Cook & Friend, 1995; Potts & Howard, 2011). Intending to have students respond to both teachers in the classroom as equals, Cook and Friend (1995) asserted that co-teachers must collaboratively assess students' strengths and weaknesses, determine educational goals, design intervention strategies and plan for their implementation, evaluate student progress, and evaluate the effectiveness of the co-teaching process.

Although the amount of co-teaching time scheduled in classrooms depends on the number of SWD and the extent of their individual needs, co-teachers should always capitalize on their strengths sharing the responsibility of actively engaging students, using a variety of co-teaching approaches (Friend et al., 1993; Murawski & Lochner, 2011; Potts & Howard, 2011; Pugach & Winn, 2011). In this partnership, special educators who specialize in strategy instruction and making the curriculum accessible, complement general educators who specialize in understanding, structuring, and pacing the content (Cook & Friend, 1995; Potts & Howard, 2011; Walther-Thomas, Bryant, & Land, 1996).

While co-teaching is intended to fuse inclusive practices into general education classrooms by way of shared planning and instruction, research (Cook & Friend, 1995; Fennick & Liddy, 2001; Mastropieri et al., 2005; Murawski & Lochner, 2011) has identified several barriers to this approach: (a) lack of training, (b) issues with sharing responsibility, (c) ineffective scheduling practices, and (d) lack of time to co-plan. Moreover, in an examination of factors influencing special and general educator attitudes about the implementation of co-teaching in the elementary classroom, Haimowitz (2018) found that co-teaching issues such as personality conflicts, lack of common planning time, and teacher schedules were most influential in determining teachers' attitudes about co-teaching and its implementation. As Cook and Friend (1995); Friend et al. (2010) and Scruggs and Mastropieri (2017) emphasized, co-teaching is significantly different from the *one teacher per classroom* model and specific instruction is needed for teachers to be successful in co-teaching. Opportunities for additional skill development in communication skills, content mastery, instructional strategies, and collaborative planning need to be provided.

2.4.1. Co-Teaching Relationships

Mastropieri et al. (2005) asserted that the relationship between co-teachers is a critical component impacting the success or failure of SWD. While it may be assumed that a classroom with two teachers is more beneficial than a classroom with only one, teachers who do not know each other are not able to relate to one another, or do not like each other have *invisible walls* that separate the teaching and learning space (Gately, 2005; Gately & Gately Jr, 2001; Noonan, McCormick, & Heck, 2003). In addition, if co-teachers do not share similar beliefs about the capabilities of

all children to learn regardless of their ability level, and their role in student learning, they are likely to experience difficulties in the shared classroom (Cook & Friend, 1995).

Personal compatibility is integral to co-teaching success, and interpersonal skills are the means through which cooperative teaching occurs (Bauwens & Hourcade, 1991; Pugach & Winn, 2011). Teachers working collaboratively should openly discuss and come to an agreement on providing feedback, asking questions, and negotiating to solve differences (Bauwens & Hourcade, 1991; Friend et al., 1993). While researchers (Fennick & Liddy, 2001; Friend et al., 2010) noted that co-teaching is time-consuming and requires strong interpersonal skills, co-teaching relationships built upon mutual trust and respect for one another's abilities lead to healthy co-teaching situations that benefit both teachers and students (Mastropieri et al., 2005).

2.4.2. Co-Teaching Roles and Responsibilities

At a genuinely collaborative level of co-teaching, both teachers actively participate in the delivery of the lesson, provide instruction, and organize learning activities. Dissatisfaction occurs when special education teachers are relegated to the role of classroom *assistant* or *helper* (Gately & Gately Jr, 2001). Students are quick to notice the disproportionality as well, weakening the special educators' position of authority and equitable partnership in the teaching process, which in turn, diminishes their input in instructional lessons (Gately, 2005). In a review of qualitative studies describing over 400 classrooms, Scruggs, Mastropieri, and McDuffie (2007) reported that the most common mode of co-teaching was that of the general education teacher in charge using whole-class methods, with the special education teacher in a subordinate role providing support. As Fennick and Liddy (2001) previously emphasized, "Without changes in teachers' traditional responsibilities and classroom practices the classroom environment [will not] become more inclusive" (p. 238).

2.4.3. Co-Teaching Planning and Content Knowledge

When general educators plan lessons alone, special educators are unaware of the content and goals of the lessons, leaving them unprepared to participate fully in instruction (Fennick & Liddy, 2001). When there is no co-planning, special educators are at an apparent disadvantage; at best in that situation, the teachers work together in a reactive manner (Gately, 2005; Murawski & Lochner, 2011). To provide quality instruction in inclusive classrooms, co-teachers must be adequately prepared for collaboration as planning *on the fly* lacks the coordinated effort needed to properly execute lessons (Austin, 2001; Solis, Vaughn, Swanson, & Mcculley, 2012). Effective co-teaching is dependent upon co-teachers engaging in an authentic partnership, one in which the special educator helps design and implement instruction with strategies known to be effective for SWD (Scruggs & Mastropieri, 2017).

The most significant barrier to a productive co-teaching relationship between special and general educators may be the knowledge of the content being taught (Scruggs & Mastropieri, 2017; Scruggs et al., 2007). Special education teachers' unfamiliarity with the content, curriculum, and methodology used by general education teachers may create a lack of confidence in both teachers, leading the general education teacher to be reluctant to *give up the chalk* to the special education teacher or be open to suggestions for accommodations and modifications (Gately, 2005; Gately & Gately Jr, 2001). When Mastropieri et al. (2005) and Scruggs et al. (2007) looked across four case studies and 35 qualitative studies consecutively, they found that overall, special education teachers continued to play secondary roles in co-taught classrooms because they lacked adequate content knowledge to take on a more prominent position. Having a solid understanding of the curriculum content and knowledge of the scope and sequence of instruction is essential in the co-teaching relationship; therefore, special educators must be competent and confident in the general education curriculum (Gately, 2005; Gately & Gately Jr, 2001). To assess learning

difficulties, and subsequently plan and implement effective instructional techniques, special education teachers must first have knowledge and understanding of the content being taught (Scruggs & Mastropieri, 2017). Once special educators possess the content knowledge needed, they can play a more active and equal role in instruction and assume greater instructional responsibility (Pugach & Winn, 2011; Scruggs & Mastropieri, 2017).

3. METHODOLOGY

Based upon a thorough review of the literature, the following three research questions emerged:

RQ1: Is there a statistically significant relationship between the co-teaching relationship and elementary special education teachers' self-efficacy for teaching mathematics?

RQ2: Is there a statistically significant relationship between the number of years a special education teacher has co-taught mathematics and self-efficacy for teaching mathematics?

RQ3: Is there a statistically significant relationship between the grade level being co-taught by a special education teacher and self-efficacy for teaching mathematics?

3.1. Population and Sample

This study focused on 912 pre-K-5 special education teachers who co-taught mathematics in all 32 school divisions in Virginia Superintendent's Regions 2 (Tidewater; n=15) and 3 (Northern Neck; n=17; (Virginia Department of Education, 2019a)). A combination of metropolitan and rural communities (Policom Corporation, 2019) the demographic makeup of elementary public school students was similar to those across the commonwealth; however, there were two notable differences: (a) the percentage of English learners in pre-K-5 in these regions was considerably lower (4.1%) than across Virginia (11.9%), and (b) these regions had a significantly higher percentage of Black students (34.9%) than Virginia overall (22.2%).

After an initial email query, from the 151 who responded, the sample was then narrowed to those who co-taught mathematics in a collaborative pre-K-5 setting. While 103 met the study criteria, 56 completed the survey, yielding a 54% response rate. Nearly 3/4ths of the respondents (73.2%) were from schools in Region 2 who had co-taught either 1-3 years (35.7%) or 4-6 years (30.4%), and over half (57.2%) co-taught mathematics in Grades 3-5.

3.2. Instrumentation and Data Collection Procedures

Two instruments were combined for participants' ease: Noonan et al. (2003) 19-item *Co-Teacher Relationship Scale (CRS)* and McGee and Wang (2014) 22-item *Self-Efficacy for Teaching Mathematics Instrument (SETMI)*. In addition, demographic questions were included to collect data on the number of years teaching, the number of years co-teaching, the grade-level mathematics was co-taught, and the Virginia region represented. The word *current* was added to the survey directions to clarify that participants should focus responses on their present mathematics co-teaching experience. To determine the amount of time needed to complete the combined *CRS-SETMI*, a pilot study was conducted with five former special education teachers. Study participants had three weeks to respond.

3.3. Data Analysis

Assumptions for the Pearson product-moment correlation were not met, so Spearman's Rho was used to determine if there was a statistically significant relationship between special education teachers' co-teaching relationships and self-efficacy for teaching mathematics. In addition, the demographic data collected was also analyzed using Spearman's correlation and a one-way analysis of variance (ANOVA) to determine if there was an

association between special education teachers' self-efficacy for teaching mathematics and either the number of years in mathematics co-teaching experience or grade level taught.

4. RESULTS

4.1. The Co-Teaching Relationship

With a possible sum of responses ranging from 19 to 95, the perceived co-teaching relationship was measured using the *CRS* portion of the *CRS-SETMI*. With 10 statements focused on beliefs and approaches and nine on co-teachers' perceived similarities and differences, the mean *CRS* score was 77.5 with a standard deviation of 15.94. Using a 5-point Likert scale, the overall mean scaled score of responses on the *CRS* was 4.08. Concerning beliefs and approaches, the lowest score pertained to *views about how to manage inappropriate behavior* (M = 3.79), while the highest highlighted *views regarding parent involvement* (M = 4.45; see Table 1).

Table 1. CRS beliefs and approaches.

Statement	*N*	Min.	Max.	*M*	*SD*
1. Views about how to manage inappropriate behavior	56	1	5	3.79	1.35
2. Views about how to adapt and individualize activities	56	1	5	3.86	1.20
3. Views regarding the physical arrangement of the classroom	56	1	5	3.87	0.99
4. Beliefs about how children learn	56	1	5	3.88	1.25
5. Views regarding how to structure class activities	56	2	5	3.93	0.97
6. Beliefs about inclusion	56	1	5	3.96	1.29
7. Beliefs about teacher roles and responsibilities	56	1	5	4.14	1.12
8. Views regarding classroom scheduling	56	1	5	4.20	0.98
9. Beliefs about what the curriculum for children should be	56	1	5	4.30	0.97
10. Views regarding parent involvement	56	1	5	4.45	0.85

Focusing on perceived similarities and differences, *dedication to teaching* (M = 4.52) had the highest mean scaled score, while *approaches to educational planning* (M = 3.86) and *ways of dealing with colleagues, supervisors, parents, and other professionals* (M = 3.87) had the lowest (see Table 2).

Table 2. CRS perceived similarities and differences.

Statement	*N*	Min.	Max.	*M*	*SD*
11. Approaches to educational planning	56	1	5	3.86	1.27
12. Ways of dealing with colleagues, supervisors, parents, and other professionals	56	1	5	3.87	1.18
13. Interest in learning new things	56	1	5	4.04	1.26
14. Flexibility in dealing with unforeseen events	56	1	5	4.04	1.19
15. Confidence as an educator	56	1	5	4.11	1.16
16. Desire to try new things	56	1	5	4.13	1.11
17. Ability to be supportive to colleagues and other staff	56	1	5	4.23	1.08
18. Sense of humor	56	1	5	4.38	0.95
19. Dedication to teaching	56	1	5	4.52	1.08

4.2. Self-Efficacy for Teaching Mathematics

With a possible sum of responses ranging from 22 to 110, self-efficacy for teaching mathematics was measured using the second portion of the *CRS-SETMI*. The mean *SETMI* score was 81.45 with a standard deviation of 15.88. Part 1 of the *SETMI*, *efficacy for pedagogy in mathematics* (EPM), contained seven statements, while Part 2, *efficacy for teaching mathematics content* (ETMC), contained 15 items. Again, using a 5-point Likert scale, the overall mean scaled score was 3.70. When looking at teacher efficacy for pedagogy, the lowest score pertained to *the extent teachers believed they could motivate students who showed low interest in mathematics* (M = 3.98), while the highest concerned *the*

extent they could provide an alternative explanation or example in mathematics when students were confused (M = 4.20; see Table 3).

Table 3. SETMI efficacy for pedagogy in mathematics.

Question	*N*	Min.	Max.	*M*	*SD*
1. To what extent can you motivate students who show low interest in mathematics?	56	3	5	3.98	0.67
2. To what extent can you use a variety of assessment strategies in mathematics?	56	2	5	4.02	0.77
3. To what extent can you help your students' value learning mathematics?	56	3	5	4.02	0.75
4. To what extent can you get your students to believe they can do well in mathematics?	56	3	5	4.13	0.76
5. To what extent can you craft relevant questions for your students related to mathematics?	56	2	5	4.14	0.75
6. How well can you implement alternative teaching strategies for mathematics in your classroom?	56	2	5	4.18	0.79
7. To what extent can you provide an alternative explanation or example in mathematics when students are confused?	56	3	5	4.20	0.75

Focusing on content, the highest score related to teachers' ability to teach students to *measure the length of objects* (M = 4.32), while the lowest (M = 2.77) was their efficacy to teach students to c*onvert between units in a different [measurement] system* (see Table 4).

Table 4. SETMI efficacy for teaching mathematics content.

Statement	*N*	Min.	Max.	*M*	*SD*
8. Convert between units in a different system (i.e., kilograms to pounds, inches to centimeters)	56	1	5	2.77	1.14
9. Manipulate coordinate planes	56	1	5	2.87	1.35
10. Convert between units in the same system (i.e., grams to kilograms, inches to yards)	56	1	5	2.96	1.18
11. Interpret variables in an algebraic equation	56	1	5	3.13	1.24
12. Compare equivalence of fractions and decimals	56	1	5	3.23	1.34
13. Convert a fraction to a decimal and vice versa	56	1	5	3.34	1.35
14. Perform strategies for composing and decomposing numbers by manipulating place value in multiplication and division	56	1	5	3.46	1.19
15. Interpret inverse relationships between operations (i.e., +, - and x, ÷)	56	1	5	3.59	1.26
16. Interpret the probability of outcomes	56	1	5	3.70	1.13
17. Collect, plot, and interpret data (on any type of graph)	56	1	5	3.71	1.12
18. Describe characteristics of Numbers (i.e., whole numbers, rational numbers)	56	1	5	3.86	0.92
19. Perform strategies for composing and decomposing numbers by manipulating place value in addition and subtraction	56	1	5	3.89	.87
20. Measure area and perimeter	56	1	5	3.93	1.17
21. Discover and create mathematical patterns	56	1	5	4.02	0.94
22. Measure the length of objects	56	2	5	4.32	0.88

4.3. Research Question 1 Results

Employing Spearman's Rho, the results indicated a moderate, positive correlation between the co-teaching relationship and self-efficacy for teaching mathematics (r_s = 0.41), and the outcome was statistically significant (p = 0.002). Therefore, the null hypothesis that there was no statistically significant relationship between the co-teaching relationship and elementary special education teachers' self-efficacy for teaching mathematics was rejected.

4.4. Research Question 2 Results

First, once again using Spearman's Rho, the results indicated a small, positive correlation between the number of years a special education teacher had co-taught mathematics and self-efficacy for teaching mathematics ($r_s = 0.20$), but that relationship was not statistically significant ($p = 0.14$). Therefore, the null hypothesis that there was no statistically significant relationship between the number of years a special education teacher has co-taught mathematics and self-efficacy for teaching mathematics could not be rejected.

Second, a one-way ANOVA was implemented to determine if there were any statistically significant differences between the number of co-teaching years and self-efficacy. The results indicated that on average, special education teachers who co-taught mathematics for 28 years or more had the highest self-efficacy score ($M = 107.50$, $SD = 0.71$) compared to teachers who co-taught for 13-15 years ($M = 93.00$, $SD = 13.23$), 16-18 years ($M = 86.50$, $SD = 13.00$), 4-6 years ($M = 82.18$, SD = 15.20), 10-12 years ($M = 80.17$, $SD = 12.34$), 1-3 years ($M = 78.90$, SD = 14.96), and 7-9 years ($M = 66.25$, $SD = 21.38$). However, the differences observed were not statistically significant ($p = 0.06$; see Table 5).

Table 5. ANOVA for SETMI and years co-teaching mathematics.

	SS	df	MS	F	Sig.
Between groups	2932.49	6	488.75	2.19	0.06
Within groups	10941.35	49	223.29		
Total	13873.83	55			

4.5. Research Question 3 Results

As with RQ 2, Spearman's Rho was first performed to determine the possible relationship between the grade level co-taught by a special education teacher and self-efficacy for teaching mathematics. The results indicated a moderate, positive correlation between the grade level co-taught and self-efficacy for teaching mathematics ($r_s = .43$), and the relationship was statistically significant ($p = 0.001$). Therefore, the null hypothesis that there was no statistically significant relationship between the grade level taught by a special education teacher and self-efficacy for teaching mathematics was rejected. Again, a one-way ANOVA was employed to determine if there were any statistically significant differences between grade level and self-efficacy. The results indicated that special education teachers who co-taught Grade 5 had the highest self-efficacy score ($M = 92.85$, $SD = 13.39$) compared to teachers who co-taught Grade 2 ($M = 83.38$, $SD = 13.49$), Grade 3 ($M = 81.00$, $SD = 12.49$), Grade 4 ($M = 80.90$, $SD = 15.61$), Grade 1 ($M = 74.33$, $SD = 11.74$), Kindergarten ($M = 73.25$, $SD = 13.15$), and pre-Kindergarten ($M = 68.33$, $SD = 22.23$). In addition, the test confirmed that the relationship was statistically significant ($p = 0.03$; see Table 6).

Table 6. ANOVA for SETMI and grade level co-taught.

	SS	df	MS	F	Sig.
Between groups	3327.96	6	554.66	2.58	0.03
Within groups	10545.88	49	215.22		
Total	13873.84	55			

Finally, to determine which groups had statistically significant differences in mean scores, a Tukey post hoc test was conducted (see Table 7). The test confirmed that self-efficacy for teaching mathematics scores for special education teachers who co-taught Grade 5 ($M = 92.85$, $SD = 13.39$) were significantly higher than teachers who co-taught pre-Kindergarten ($M = 68.33$, $SD = 22.23$), $p = 0.02$. No other group differences were statistically significant.

Table 7. Tukey post hoc comparison of SETMI means by grade level co-taught.

Dependent Variable: Self-Efficacy for Teaching Mathematics						
(I) Grade level	**(J) Grade level**	**M difference (I-J)**	**SE**	**Sig.**	**95% CI**	
					Lower bound	**Upper bound**
Pre-Kindergarten	Kindergarten	-4.92	9.47	0.99	-34.03	24.19
	1st grade	-6.00	8.47	0.99	-32.04	20.04
	2nd grade	-15.04	7.92	0.49	-39.40	9.31
	3rd grade	-12.67	7.73	0.66	-36.44	11.10
	4th grade	-12.57	7.58	0.65	-35.85	10.72
	5th grade	-24.51*	7.24	0.02	-46.77	-2.26
Kindergarten	Pre-K	4.917	9.47	0.99	-24.19	34.03
	1st grade	-1.08	9.47	0.99	-30.19	28.03
	2nd grade	-10.13	8.98	0.92	-37.74	17.49
	3rd grade	-7.75	8.82	0.97	-34.85	19.35
	4th grade	-7.65	8.68	0.97	-34.33	19.03
	5th grade	-19.60	8.39	0.25	-45.38	6.19
1st Grade	Pre-K	6.00	8.47	0.99	-20.04	32.04
	Kindergarten	1.08	9.47	0.99	-28.03	30.19
	2nd grade	-9.04	7.92	0.91	-33.40	15.31
	3rd grade	-6.67	7.73	0.98	-30.44	17.10
	4th grade	-6.57	7.58	0.98	-29.85	16.72
	5th grade	-18.51	7.24	0.16	-40.77	3.74
2nd Grade	Pre-K	15.04	7.92	0.49	-9.31	39.40
	Kindergarten	10.13	8.98	0.92	-17.49	37.74
	1st grade	9.04	7.92	0.91	-15.31	33.40
	3rd grade	2.38	7.13	0.99	-19.54	24.29
	4th grade	2.48	6.96	0.99	-18.92	23.87
	5th grade	-9.47	6.59	0.78	-29.74	10.79
3rd Grade	Pre-K	12.67	7.73	0.66	-11.10	36.44
	Kindergarten	7.75	8.82	0.97	-19.35	34.85
	1st grade	6.67	7.73	0.98	-17.10	30.44
	2nd grade	-2.38	7.12	0.99	-24.29	19.54
	4th grade	0.10	6.74	0.99	-20.62	20.82
	5th grade	-11.85	6.36	0.51	-31.40	7.71
4th Grade	Pre-K	12.57	7.58	0.65	-10.72	35.85
	Kindergarten	7.65	8.68	0.97	-19.03	34.33
	1st grade	6.57	7.58	0.98	-16.72	29.85
	2nd grade	-2.48	6.96	0.99	-23.87	18.92
	3rd grade	-0.10	6.74	0.99	-20.82	20.62
	5th grade	-11.95	6.17	0.47	-30.92	7.02
5th Grade	Pre-K	24.51*	7.24	0.02	2.26	46.77
	Kindergarten	19.60	8.39	0.25	-6.19	45.38
	1st grade	18.51	7.24	0.16	-3.74	40.77
	2nd grade	9.47	6.59	0.78	-10.79	29.74
	3rd grade	11.85	6.36	0.51	-7.71	31.40
	4th grade	11.95	6.17	0.47	-7.02	30.92

Note: CI = confidence interval.
*The mean difference is significant at the 0.05 level.

5. IMPLICATIONS, RECOMMENDATIONS FOR FUTURE RESEARCH, AND CONCLUSION

While previous literature (Flores et al., 2014; Flores et al., 2010; Gately & Gately Jr, 2001) highlighted the importance of special education teachers' confidence and competence in teaching content, such as mathematics, as a factor for success in the co-teaching relationship, this study had three implications. First, when special education teachers have more perceived personal and professional similarities with their general education counterparts, they have greater self-efficacy for teaching mathematics. Therefore, confirming the work of Friend et al. (1993) and Walther-Thomas et al. (1996) in order to build stronger co-teacher interpersonal collaborative relationships, teachers must have the opportunity and time to develop rapport, which could be accomplished through semi-

structured interviews, reflection documents, or checklists as a guide prior to beginning a co-teaching experience. As a starting point, teachers could use these formats to begin to discuss and share reactions regarding their personal attitudes and philosophies about teaching and classroom responsibilities and expectations, with the goal of being able to agree, compromise, or agree to disagree about the items discussed.

Second, some of the lowest mean results on the *CRS-SETMI* in this research related to co-teacher's differences in views about approaches to educational planning ($M = 3.86$), ways to adapt and individualize activities ($M = 3.86$), and views regarding how to structure class activities ($M = 3.93$). As noted in previous research (Cook & Friend, 1995; Fennick & Liddy, 2001; Mastropieri et al., 2005; Murawski & Lochner, 2011) this highlights the need for co-teachers to participate in joint training related to co-teaching, implement effective scheduling practices, and have adequate time allocated for co-planning. Administrators play a critical role in ensuring these processes take place as they have the authority to commit resources to enhance the preparation and training of co-teachers, to create teachers' schedules, to ensure and protect planning time for teaching teams, and to work with teachers to develop and arrange balanced student schedules confirming the work of Cook and Friend (1995); Walther-Thomas et al. (1996); Friend et al. (2010) and Pugach and Winn (2011).

The third implication is that special education teachers may need additional preparation in order to feel confident in teaching mathematics content at various levels in elementary school, especially since special education teachers might be moved to a different grade level at any given time. Scruggs and Mastropieri (2017) conjectured that knowledge of the content taught was perhaps the greatest barrier to a fully collaborative relationship between general and special education teachers. Therefore, confirming the literature (Hill et al., 2005; Scruggs & Mastropieri, 2017) preservice and in-service special education teachers should have more time and attention devoted to developing their mathematical and pedagogical knowledge in order to understand how to appropriately plan and present elementary mathematics lessons, evaluate learning, and implement instructional strategies to meet the needs of students in co-taught classrooms. Also, confirming the work of Kahle (2008); Loreman, Sharma, and Forlin (2013); Hamilton-Jones and Vail (2014); Althauser (2015) and Martin (2018) through continuous job-embedded training, mentoring, vicarious experiences with others who are teaching mathematics successfully, and opportunities to plan, analyze, and reflect on practices with others, special education teachers can improve their teacher self-efficacy and feel more prepared to teach mathematics successfully in the elementary general education classroom.

5.1. Recommendations for Future Research

While this study provided insight on the impact of the co-teaching relationship on elementary special educators' self-efficacy for teaching mathematics, four recommendations for future research emerged. First, to provide more generalizability, expanding the sample size to include special education teachers from across the commonwealth or even the country would be beneficial. Second, using random selection could also yield a more representative sample of the population. Third, collecting information on the amount of prior co-teaching professional development one received could provide insight into its potential impact on both the co-teaching relationship and special educators' self-efficacy for teaching mathematics. Last, while the quantitative nature of this study revealed broad patterns in the relationship between variables, adding a qualitative component could provide both additional depth and greater clarity.

5.2. Conclusion

Friend et al. (2010) contended that the most crucial element regarding the current and future status of co-teaching is the need for more research; without research addressing the many variables that could affect co-teaching and its implementation and outcomes, effective practices may be lost in overgeneralizations. This study addressed this gap by examining the impact of the co-teaching relationship on elementary special education teachers' self-efficacy for teaching mathematics with the results indicating a moderate positive correlation between the two. While special education teachers may be less familiar with the mathematics curriculum than their general education partners, their content knowledge and self-efficacy for teaching mathematics can be increased through building effective co-teaching relationships and increased experiences with co-planning and co-teaching mathematics in the general education classroom.

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