Collaborative Planning and Teacher Efficacy Of High School Mathematics Co-teachers

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ABSTRACT

Current educational policies such as NCLB and IDEA have led to the adoption of inclusive classrooms in schools. This presents challenges to teachers because they are held accountable for the learning
experiences of both general and special education students. The situation is especially challenging in high school mathematics inclusion classes where the special education co-teachers may not necessarily possess the content expertise to teach advanced levels of mathematics. Collaboration between co-teachers is necessary in order to successfully plan effective lessons that address the needs of all students. A quantitative research design was used, with follow up interviews for further explanation of the findings. This study provides information about the teacher efficacy of high school mathematics co-teachers when various collaborative planning times were considered. Implications for future studies and school practice were presented, while considering the efficacy of co-teachers in inclusive contexts.

INTRODUCTION

All students should have access to the highest quality mathematics instruction. According to NCTM (2000), excellence in mathematics education requires equity. This means that mathematics educators should have high expectations and provide strong support for all learners. Students who are passionate about mathematics and have a deep interest in pursuing careers in science, engineering, technology, and mathematics should have their talents and interests nurtured. Likewise, students with special needs must have access to support services that can allow them to gain a concrete understanding of mathematics. Youth, who struggle in mathematics, may require additional resources, such as after-school tutoring, extended time on tests, and peer mentoring. Teachers of mathematics should accommodate the unique and range of needs of these students without inhibiting the learning of other students (NCTM, 2000). This is especially true when teaching inclusion mathematics classes.

Co-teaching is an effective means for providing the supplementary aid and services to students, with or without disabilities, who are taught in the general education classrooms (Jennings, 2007; Murawski, 2009; Villa, Thousand, & Nevin, 2008). In an effective co-teaching partnership, both the general and special education teachers are responsible for the delivery of instruction in the inclusion classes (Alper & Ryndak, 1992; Bauwens, Hourcade, & Friend, 1989; Murawski, 2009). In particular, teaching mathematics inclusion classes requires both co-teachers to plan a variety of ways to support all students as they learn advanced mathematical concepts. While this endeavor would seem to be a natural progression in addressing the needs of both general and special education students, it is important to consider certain pre-existing conditions (e.g. teacher perception about teaching inclusion classes, teacher preparation for teaching inclusion classes) that may derail plans for delivering quality instruction in inclusion mathematics classes. Without

adequate training, high school teachers can hold a limited perception about their ability to address the needs of the special education students in their class (Van Reusen, Shoho, & Barker, 2001). On the other hand, even a highly qualified special education teacher may feel overwhelmed by the requirement of providing effective instruction to his or her students with mathematical challenges (Humphrey & Hourcade, 2010). One possible way to address these concerns is to engage general and special education teachers of inclusion classes in collaboration efforts. This collaboration may lead to an increase in teacher efficacy of both collaborating teachers (Shidler, 2009).

CONCEPTUAL FRAMEWORK

Vygotsky's sociocultural theory (1997) posits that learning is determined by a person's social environment. It stresses the interaction of the interpersonal, cultural-historical, and individual factors. Interactions with persons in the environment stimulate development processes and promote cognitive growth (Vygotsky, 1997). Learning is perceived as an act that is embedded in social and cultural contexts. It is best understood when regarded as a form of participation within those contexts. This learning may result in the simultaneous transformation of social practices and the individuals who participate in them, making the social and individual aspects of learning mutually constitutive (Boreham & Morgan, 2004). The interactions of persons, which are conducted through collaboration, stimulate the developmental processes and foster cognitive growth.

Collaborative planning

Studies show that teachers who engage in collaborative work are able to learn from one another (Clark, Moss, Goering, Herter, Lamar, Leonard et al., 1996; Tschannen-Moran, Uline, Hoy, & Mackley, 2000). Members of the leadership team may learn about other's strategies when they collaborate to solve school issues like attendance problems. Teachers learn how to adopt new instructional technology tools when they are provided access to their peers who are expert users of specific programs. Collaborative networks create the momentum for creating action plans geared toward school improvement (DuFour, DuFour, Eacker, & Karhanek, 2004). As teachers learn, they become better with their craft. They learn to reconceptualize their roles as they work together with others. Teacher collaboration may improve school's ability to foster student achievement (Goddard, Goddard, & Tschannen-Moran, 2007).

Collaboration is the foundation of successful inclusive education when two or more teachers are involved (Hourcade & Bauwens, 2001). During collaboration, teachers can share their knowledge about teaching strategies that they have found to be successful in the past, enrich their thinking processes on an ongoing basis, and transform their knowledge for the future (Putnam & Borko, 2000). As collaborating peers, they can review each other's work and share immediate feedback after conducting classroom observations. These educators can also assist one another in solving problems that arise from day to day instruction (Murawski, 2009).

Collaborative planning is a potential source of teacher learning (Clark et al., 1996; Eisenman, Pleet, Wandry, & McGinley, 2011; Hargreaves, 1996; Lalik & Niles, 1990). It opens up the discussions around pedagogical knowledge and provides opportunities for reflection and shared critique of practice (Clarke et al., 1996). Learning content-specific material from the general education teacher, sharing accountability, developing shared

instructional practices through professional learning meetings, being physically accessible to the co-teacher and students in the co-taught classroom, and anticipating service needs and priorities with the co-teacher also help improve co-teaching (Eisenman et al., 2011). Maccini and Gagno (2000) shared their recommendations on designing and implementing lessons for students with disabilities in a mathematics classroom. They proposed that teachers incorporate elements of effective instruction, such as use of manipulatives, real world connections, teacher modeling, guided and independent practice, monitoring of student performance, use of pro-active classroom management strategies, and group work. They also recommended that co-teachers create individualized mathematics instruction plans based on students' numeracy and literacy skill levels.

Collaborative planning does not occur simply by forming a group of two or more teachers and allowing them to spend some time to communicate. It requires the professional commitment of both co-teachers to the process and a consistent focus on students' needs, curriculum decisions, and planning teaching strategies. It is during the collaborative planning phase when most of the learning agenda is established and this is why it is important to ensure that all participants establish a level of ownership in the collaboration process. The same benefits of collaboration are realized in this phase. In the current study, the mathematics and special education co-teachers may benefit from the collaborative planning phase in two ways: gaining knowledge as a result of the professional learning experience, and developing a better understanding of the content of mathematics. First, collaborative planning is a potential source of teacher learning (Clark et al., 1996; Hargreaves, 1996; Lalik & Niles, 1990). The special education teacher can share strategies for teaching students with learning disabilities while the mathematics teacher can share techniques for teaching certain mathematical concepts. Through collaboration, both teachers can raise issues that team members may not have thought of independently (Kotelawala, 2010). Collaborative planning opens up the discussions around pedagogical knowledge and provides opportunities for reflection and shared critique of practice (Clarke et al., 1996). Second, both teachers learn specialized content knowledge for teaching mathematics (Hill & Ball, 2004). Teachers use the teaming as an opportunity for professional development by working together on tasks and discussing possible treatments of the mathematical idea that is about to be taught. While differences in the background knowledge and preparation that special and general education teachers possess may cause some arguments about who is best equipped to teach the students, the main focus should be the promotion of a collaborative partnership between co-teachers to ensure that they can provide all students in their class the opportunity to master the standards (Maccini & Gagnon, 2000).

Teacher efficacy

Researchers claim that teacher efficacy relates to student achievement as it results in teachers' efforts to adapt instructional practices that support student learning (Allinder, 1995; Almog & Shecktman, 2007; Ashton & Webb, 1986; Caprara, Barbaranelli, Steca, & Malone, 2006; Dembo & Gibson, 1985; Goddard, Hoy, & Hoy, 2004; Ross, 1994). Teachers with higher efficacy levels are more apt to plan engaging lessons and interact with students to encourage their participation in the lesson (Schunk, 2008). They are also more likely to use varied strategies to meet the needs of their students (Goddard et al., 2004). These educators work longer with struggling students (Almog & Shecktman, 2007; Dembo

& Gibson, 1985) and are less likely to refer a difficult student to special education (Poddell & Soodak, 1993). When assigned to teach special education students who were placed in the mainstream classes, teachers with high levels of efficacy are willing to involve special education students in class discussions and persist in educating them (Brownell & Pajares, 1996; Nunn, Jantz, & Butikofer, 2009), while maintaining better control of an inclusion class (Woolfson & Brady, 2009).

Teacher efficacy can determine the likelihood that a teacher will provide the desired level of expected outcomes such as incorporating appropriate response interventions strategies to help support struggling students (Raudenbush, Rowan, & Cheong, 1992; Wertheim & Leyser, 2002; Wolters & Daugherty, 2007). It should be noted that because conditions in the school setting continually change, a teacher's level of efficacy may vary from one class to another, much like a student's efficacy (Raudenbush et al., 1992; Ross, 1994). Bandura's social cognition theory provides the primary support for the study of teacher efficacy. However, Vygotsky's sociocultural theory provides a framework for the development of teacher efficacy in the context of the collaborative partnership between co-teachers of secondary mathematics inclusion classes. Interactions with persons in the environment stimulate development processes and promote cognitive growth (Vygotsky, 1997). Co-teachers are able to share and work together to accomplish desired goals (Dettmer, Thurston, & Dyke, 2005). Bandura (1986) uses the triadic reciprocity model of causality to explain how learning can occur through the use of models within social environments, such as co-teaching. Learning is a process whereby information about the structure of behavior and environmental events are transformed into symbols that serve as guide for future actions (Bandura, 1986). Learning occurs either inactively when people perform actions or vicariously when they observe models of behavior (Bandura, 1986, 1997; Schunk, 2008).

CONTRIBUTION OF THE STUDY

There are limited studies available that present information about co-teaching at the secondary level. This study begins to fill this gap in research as it specifically utilized a sample group of mathematics and special education co-teachers at the high school level. Most of the studies on co-teaching utilized a qualitative approach in collecting data. This is an attempt to contribute to the field by using a quantitative research design in studying teacher efficacy of high school mathematics co-teachers utilizing valid and reliable scales. Because of the special focus on teaching mathematics, this study also is unique as it discusses findings about the teacher efficacy of co-teachers as they teach high school level mathematics such as algebra and geometry. The following questions will be addressed.

1. Is there a significant difference in teacher efficacy of mathematics teachers among the varied lengths of collaborative planning time?

2. Is there a significant difference in teacher efficacy of special education co-teachers among the varied lengths of collaborative planning time?

3. Is there a significant difference in mathematics teaching efficacy of mathematics teachers among the varied lengths of collaborative planning time?

4. Is there a significant difference in mathematics teaching efficacy of special education co-teachers among the varied lengths of collaborative planning time?

METHODOLOGY

The study utilizes a quantitative research design with follow-up interviews. The quantitative data were collected from a sample of 77 secondary mathematics teachers and 15 special education teachers from a large, urban school district. At the time of the study, these teachers co-taught mathematics inclusion classes in 9th, 10th, or 11th grades. This was a sample of convenience derived from a pool of participants from specific school locations. Table 1 shows additional information about the participants in this study.

Table 1

Survey Participants' Teacher Demographic Information								
	General Education Teacher	Special Education Teacher	Gender		Educational Attainment			
			Male	Female	Bachelors	Masters	Masters+	Doctorate
n	77	15	25	67	24	30	34	4
%	84	16	27	73	26	33	37	4

There were two instruments utilized in this study. The first was *Teachers' Sense of Efficacy Scale* (TSES) by Tschannen-Moran & Hoy (2001) and the second was *Mathematics Teaching Efficacy Belief Instrument* (MTEBI) by Enochs, Smith, and Huinker (2000). Without a valid single instrument available that could measure the teacher efficacy of collaborating teachers involved in a particular setting of co-teaching secondary mathematics inclusion classes, both instruments were utilized to capture the participants' beliefs about the subject. The *Teachers' Sense of Efficacy Scale* (TSES) is also called the Ohio State Teacher Efficacy Scale (OSTES). Two researchers and eight graduate students, who were participants in the seminar on self-efficacy in teaching and learning at the College of Education in Ohio State University, created it. The Likert scale format from the Gibson and Dembo (1984) instrument and the expanded scale advocated by Bandura (1997) were referenced in the early stages of the creating the instrument. The TSES has three scales. They are efficacy in student engagement, efficacy in instructional strategies, and efficacy in classroom management (Tschannen-Moran & Hoy, 2001). The *Mathematics Teaching Efficacy Belief Instrument (*MTEBI) for pre-service teachers resulted from a small modification of the Science Teaching Efficacy Belief Instrument (STEBI-B). Essentially, the word "science" was replaced with "mathematics" with everything else remaining the same. This MTEBI instrument consists of 21 items with 13 items comprising the Personal Mathematics Teaching Efficacy (PMTE) subscale and eight items on the Mathematics Teaching Outcome Expectancy (MTOE) subscale. In this survey, participants choose one rating from a 5-point scale. The scales are labeled using the descriptors "strongly agree," "agree," "uncertain," "disagree," and "strongly disagree." Item analysis was conducted for the original 23-item scale and it was found that two items had item-total item correlations that were less than 0.30. These items were removed from the survey. Reliability analysis produced an alpha coefficient (Cronbach's alpha) of .88 for the PMTE subscale and .77

for the MTOE subscale. The MTEBI has two scales – personal mathematics teaching efficacy (SE) and outcome expectancy (OE). The survey also included questions about the collaborative teaching practices of the teachers such as gender, years of teaching, educational level, co-teaching experiences, and mathematics teaching experiences. Data were collected using a commercial online tool and was analyzed using SPSS, a common statistical software package. Analysis of variance (ANOVA) was utilized to assist in the data analysis process.

Independent semi-structured interviews were conducted with members of three pairs of high school mathematics co-teachers who were selected using a purposeful sampling method. Table 2 shows some demographic information on the interview participants. Pseudonyms were used to maintain confidentiality. They were provided a set of guide questions ahead of time.

Table 2

Follow -Up Interview Teacher Demographic and Instructional Information				
Teacher	Certificate Area	Years of Teaching Inclusion Class	Years of Collaboration with Current Co-Teacher	Common Planning Time Provided
Team A				
Ms. Allen	Mathematics	9	3	No
Ms. Bennett	Special Education	7	3	No
Team B				
Ms. Carter	Mathematics	4	< 1	No
Mr. Dalton	Special Education	1.5	< 1	No
Team C				
Mr. Elbert	Mathematics	10	2	No
Mr. Ferguson	Special Education	2	2	No

The researcher had the flexibility to adjust the order of the questions and may not necessarily use exact wording during the interview (Merriam, 2009). The researcher used follow-up questions to clarify the meaning of shared statements between members of the same co-teaching team. This method was also used to determine the accuracy of the collected data. Permission to conduct the interviews at the school site was provided by each co-teaching team's principal. Interviews were audio recorded with the consent of each participating co-teacher. The purpose of the follow-up interviews was to gather information that can provide further explanations of significant results (Creswell, 2009). It was also intended to provide further exploration and clarification of unusual findings (Morse, 1991). The survey data were considered the primary source of data with the data from the interviews providing a supportive role in this study (Creswell, 2009).

RESULTS

Participants were asked to provide information about the amount of time they spend in collaboration with their co-teacher and the instructional practices that they perform while engaged in collaborative planning. The analyses of the responses of mathematics and special education co-teachers were treated separately.

Analysis of Variance (ANOVA) tests were used to analyze if significant differences in teacher efficacy and mathematics teaching efficacy of the mathematics and special education co-teachers exist among the varied weekly collaborative planning times. Results revealed that there is no significant difference in the average TSES subscale scores of the mathematics teachers across the varied collaborative planning times ($F(6,70) = 1.031$, $p > .05$). Similarly, there was no significant difference in Student Engagement ($F(6,70) = 1.307$, $p > .05$), Instructional Strategies ($F(6,70) = .883$, $p > .05$), and Classroom Management ($F(6,70) = .465$, $p > .05$) scores of mathematics teachers across the varied collaborative planning times. These were also true for special education teachers. The results from follow up interviews showed that the co-teachers' were committed to setting aside some time for collaborative planning. This tremendously minimizes the range of planning time differences to begin with. That is why significant difference in teacher efficacy across various collaborative planning times was not detected.

Results of the ANOVA showed that there was no significant difference in the MTEBI subscale scores of the mathematics teachers across the varied collaborative planning times ($F(6,70) = .417$, $p > .05$). Similarly, there were no significant differences in personal mathematics teaching efficacy ($F(6,70) = .937$, $p > .05$) and outcome expectancy ($F(6,70) = .250$, $p > .05$) scores of mathematics teachers across the varied collaborative planning times. There were no significant differences in the average MTEBI subscale scores of the special education teachers across the varied collaborative planning times ($F(5,9) = .993$, $p > .05$). Similarly, there were no significant differences in personal math teaching efficacy2 ($F(5,9) = 1.482$, $p > .05$) and outcome expectancy ($F(5,9) = .924$, $p > .05$) scores of mathematics teachers across the varied collaborative planning times.

Descriptive statistics indicated that participating co-teachers planned between 30 to 60 minutes per week. An item on the survey provided the participants the opportunity to indicate if they are given a scheduled planning time within a week. A defined scheduled co-planning time is necessary as a time frame that is built into the school's master schedule where both co-teachers are provided a common planning time to collaborate and plan their lessons for the shared class or classes.

Table 3

Analysis of Data on Scheduled Collaborative Planning Time for Co-Teachers					
Collaborative planning time provided	*n*	%	Performs instructional practices with co-teacher	n_s	%
Yes	37	40 %	No	6	16 %
			Yes	31	84 %
No	55	60 %	No	22	40 %
			Yes	33	60 %
Total *n*	92		Total Yes	64	70%

The results found in Table 3 indicate that fewer than 50% of the participants were provided a scheduled collaborative planning time during the week. Participants were asked to select instructional practices which they perform during their collaborative planning time. The results showed that of the participants who indicated that they were given a weekly collaborative planning time about 83.78% indicated some of the activities that they perform during this scheduled time. Approximately 16.22% did not respond to this question. On the other hand, of those who indicated that they were not provided the scheduled weekly collaborative planning time about 60% indicated that they collaborate with their co-teacher and that they perform instructional practices related to co-teaching. Approximately 70% of the participants indicated that they perform instructional practices with their collaborating teacher regardless of whether they were provided with a scheduled planning time or not. This showed that most of the participating co-teachers set aside some time to plan together even if a collaborative planning was not built into the school's master schedule. Results from the interviews showed evidence that supports this finding. Participants shared some of the creative strategies they used to be able to plan lessons with their co-teachers. Ms. Bennett, who was the special education teacher, shared:

> Unfortunately, we do not have the same planning. But because we have such a great relationship whenever she's on planning she'll come by and see me or whenever I have planning I'll go by and see her. And we discuss a couple of students at a time. Because we work so well together there have been times… she has called me at home to discuss some strategies we could possibly implement for some students or for the entire class. So we don't necessarily have a common planning time but we do make sure that we do get some time to discuss (Interview 1, 2/7/11).

This was consistent with Ms. Allen's testimony that they "get together in the hallway or discuss [lessons] on the phone" (Allen, personal communication, February 16, 2011). Similarly, Ms. Carter shared that they "plan after school, in between classes, via email. By in between classes [she] meant advisement [or homeroom time] as giving them a little bit more room for talking about things and getting things done before class" (Carter, personal communication, February 10, 2011). This was also supported by the testimony of Mr. Dalton, who was her special education co-teacher. He shared that "he would go in during advisement to look at the Powerpoints for the day" (Dalton, personal communication, February 23, 2011). Mr. Elbert, who was the mathematics co-teacher, shared that they "sometimes meet before class [or] sometimes after class" (Elbert, personal communication,

February 14, 2011). While co-teachers in each team stated that they were willing to meet with their co-teachers for planning, it did not alleviate the challenges in not having a scheduled collaborative planning time. Mr. Dalton shared that "he had to choose between doing [his IEP] paperwork or co-teach" (Dalton, personal communication, February 23, 2011). Even with challenges such as this, the participants were willing to find the time to co-plan with their collaborating teacher. Ms. Carter further explained that they "usually plan about once, maybe twice a week" (Carter, personal communication, February 10, 2011). Ms. Allen confirmed that "planning time is definitely important" (Allen, personal communication, February 16, 2011).

DISCUSSION

Co-teachers of secondary mathematics inclusion classes may be able to address the needs of all students by implementing these effective strategies while delivering rigorous instruction of a highly technical subject. A national study conducted by Maccini and Gagnon (2000) reported that special education teachers use more instructional strategies than general education teachers when it comes to teaching computational and problem solving tasks. Their familiarity with the mathematics topic significantly contributed to the number of instructional practices they provided. The strategy implementation rate of general education teachers are affected by the number of methods courses they took on teaching students with learning disabilities. While these differences in the background knowledge and preparation that special and general education teachers possess may cause some arguments about who is best equipped to teach the students, the main focus should be the promotion of a collaborative partnership between co-teachers to ensure that they can provide all students in their class the opportunity to master the standards (Maccini & Gagnon, 2000). Special education teachers take a variety of roles in varied content areas at the high school level; lowest levels of lead teaching were observed in high school mathematics classrooms (Zigmond & Matta, 2004). They are challenged to possess some level of specialized content background especially when co-teaching courses such as science and mathematics. Studies have shown that teacher efficacy influences the amount of effort and duration that a teacher is willing to invest in addressing challenges in teaching inclusion classes (Almog & Shecktman, 2007).

Comprehensive planning that focuses on content, assessment, and specific issues like classroom management can lead to a successful co-teaching partnership (Hang & Rabren, 2008). Scheduled planning time, agreement on shared duties, goals, and academic tasks, and open communication between these co-teachers also enable them to develop lessons that better address student needs (Hines, 2008). While there are benefits in scheduling collaborative planning times between the general education and special education co-teachers (Villa et al., 2008), in reality this may not always be the priority, especially at the high school level.

The findings show that the effect of scheduled collaborative planning time on mathematics teaching efficacy is not enough to cause a difference in teacher efficacy between the mathematics and special education co-teachers when the amount of scheduled collaborative planning time per week was considered. The data from the interviews and survey support this finding. Having scheduled planning times may not be a major concern for co-teachers such that it impacts their teacher efficacy. The reason for this may be that co-teachers find time to plan together regardless of whether they have a scheduled planning

time built into the master schedule or not. They set aside time to collaborate with one another outside of their regular teaching periods. Some of the creative ways to find time to plan include meeting during advisory period, before school starts, or after the dismissal bell rings. Others may briefly visit their co-teacher's room during their own planning time to present ideas about an upcoming lesson. Still some co-teachers who are comfortable with each other may plan lessons together via email or by calling each other on their cell phones at times that fall outside of the regular workday. Mastropieri, Scruggs, Graetz, Norland, Gardizi, and McDuffie (2005) stated that a lack of scheduled co-planning time is not a barrier for actually co-planning with co-teachers as they set aside time to collaborate outside of their regular teaching periods. The findings of this study support this as 70% of the mathematics and special education co-teachers scheduled meeting times outside of the scheduled planning times, or lack thereof.

IMPLICATIONS FOR SCHOOL PRACTICE

Most schools have adopted an inclusion model for providing support to their students with disabilities in general education classes. This approach to educating general and special education students in inclusion classes presents benefits as well as challenges. One challenge is additional demand for collaborating teachers of these inclusion classes to collaborate together in order to provide rich educational experiences that meet the needs of all students. The results of this study present some implications for supporting co-teachers of high school mathematics inclusion classes.

It should be noted that while co-teachers may find creative ways to craft some time to plan together as a result of their dedication to teaching, the research shows that teachers consider the scheduling of collaborative planning time as necessary to a successful co-teaching partnership (Mastropieri, Scruggs, Graetz, Norland, Gardizi, & McDuffie, 2005). Administrators should schedule collaborative planning times so that teachers are able to design lessons, learn from each other through their collaborative work, and determine strategies for teaching mathematical concepts to a diverse group of students. Friend (2008) recommended scheduling weekly planning time. This supports the finding that collaborative planning times for participating co-teachers were held between 30 to 60 minutes per week. All social support can improve teacher efficacy (Huang & Liu, 2007). There is an opportunity for district leaders and professional developers to look at providing adequate support to co-teachers so that they are provided information about research based practices that lead to effective co-planning and co-teaching.

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