

EXPLORATION OF A SPECIAL EDUCATOR'S CONTRIBUTIONS TO
CO-TEACHING IN RELATION TO CONTENT AND
PEDAGOGICAL CONTENT KNOWLEDGE

by

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A Dissertation Submitted in
Partial Fulfillment of the
Requirement for the Degree of

Doctor of Philosophy

in Urban Education

at

The University of Wisconsin-Milwaukee

May 2013

Abstract

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The University of Wisconsin-Milwaukee, 2013
Under the Supervision of Professor Judith Winn

This was an exploratory case-study of a high performing co-teaching team at the high school level. The team consisted of a special educator and a general educator in their third year of co-teaching biology. The focus of the study was on the contributions of the special education teacher; these contributions were considered in relationship to his content and pedagogical content knowledge. The study contributes to the dialogue about the extent of content knowledge needed by the special educator and about the roles that special education teachers play in co-teaching in content areas. The study took place over four months. Data sources were interviews with the teachers both individually and together; observations followed by debriefing interviews; artifacts such as pacing guide, curriculum materials, school magazine, and field notes. Ball's model of pedagogical content knowledge (2008) was used to examine the special education teacher's pedagogical content knowledge. The characteristics of this high performing team, and the way their relationship evolved, confirmed many of factors that have been identified as contributing to successful co-teaching. The special education teacher contributed both in both planning and in teaching biology; in addition to a supportive role, he also took a lead role in teaching; this role grew as his content knowledge increased. Over the years, the special education teacher used several strategies for gaining content knowledge,

strategies which were useful to him in supporting the students who were struggling. It was possible to get an overview of the special education teacher's pedagogical content knowledge using Ball's model; however, more was learned about his knowledge of content and pedagogy than of students.

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DEDICATION

To my parents, Uma Rani and Shyam Tandon, and my sister, Arti Tandon, whose love, unwavering support, and words of encouragement throughout the process inspired me to keep moving forward to complete this research and write my dissertation.

TABLE OF CONTENT

List of Tables and Figures	vii
Acknowledgement	viii
1. CHAPTER ONE: INTRODUCTION	1
Co-teaching and Content Knowledge.....	3
Pedagogical Content Knowledge	6
Purpose of the Study.....	7
Significance of the Study.....	8
Operational Definitions.....	10
2. CHAPTER TWO: LITERATURE REVIEW	14
Collaboration.....	14
Co-teaching	18
Characteristics of Co-teaching.....	19
Approaches to Co-teaching.....	20
Benefits of Co-teaching for Students.....	24
Benefits of Co-teaching for Teachers.....	29
Essentials of Co-teaching	31
Pedagogical Content Knowledge (PCK)	54
Different Models of PCK.....	56
Summary.....	63
3. CHAPTER: METHODOLOGY	64
Introduction.....	64
Characteristics of Qualitative Research.....	64
Case Study Methodology.....	67
Interpretative Framework.....	69

Site and Participant Selection.....	70
Selection Criteria.....	71
Selection Process.....	72
Description of the Site and the Participants.....	74
Data Sources.....	83
Data Analysis.....	90
Trustworthiness.....	97
Role of the Researcher.....	100
4. CHAPTER FOUR: FINDINGS AND RESULTS	103
Co-teaching Partnership.....	103
Evolution of their Co-teaching Partnership.....	106
Contributions of the special Education Teacher.....	113
Ball’s Conceptions of PCK.....	128
Summary.....	140
5. CHAPTER FIVE: DISCUSSION	142
What Did We Learn From Dan	142
Implications and Recommendations.....	155
Limitations of the Study.....	158
Summary.....	159
6. REFERENCES	160
7. APPENDICES	169
APPENDIX A: Tool for Measuring PCK	169
APPENDIX B: Interview Protocol	174
APPENDIX C: Consent Letters	184
8. CURRICULUM VITA	192

LIST OF TABLES AND FIGURES

Tables	Page
Table1. Overview of observation timeline.	85
Table.2 Dan's contributions in co-teaching biology.	113

Figure	
1.1 Coding category layers	94

ACKNOWLEDGEMENT

As it is said that “it takes a village to raise a child” likewise the completion of this dissertation was not only the hard work of the writer, but also the dedication of many other individuals. I would like to express my sincere gratitude to my dissertation committee, Dr. Judith Winn for your guidance and mentorship, along with Dr. Amy Otis Wilborn, Dr. Elizabeth Drame, Dr. Marleen Pugach, and Dr. Craig Berg for your continuous support and patience. This would not have been possible without the help of each of you as well as your trust in me.

My thanks go also to the principal, the co-teachers, and the students of the high school who allowed me to access to the school and the curricular materials; I needed to complete the study.

I am grateful to many colleagues who shared their experiences and insights, thus; giving me courage to challenge my own potential and rediscover myself in this process.

Furthermore, I would like to acknowledge my officemates for their friendship and for providing me perspective to look at my tough days in this wonderful learning experience.

CHAPTER 1

Introduction

Co-teaching occurs between two or more professionals who are actively involved in providing substantive instruction in a shared physical space to a diverse student population in inclusive settings. It is often compared to “professional marriage” (Friend & Cook, 2003) where two professionals—general and special education teachers—collaborate, trust, respect, and share responsibilities as in any other relationship. It embraces the philosophy that children with disabilities have a right to learn with their non-disabled peers regardless of their grade level achievement. Research has established various benefits of co-teaching for children with and without disabilities, both socially and academically (Keefe & Moore, 2004; Trent, 1998; Walther-Thomas, 1997). In addition, co-teaching provides opportunities for general and special educators to collaborate and learn from each other’s expertise (Austin, 2001; Walther-Thomas, 1997; Thousand, Villa, and Nevin, 2006).

Proponents of co-teaching believe and advocate that general and special education teachers must contribute mutually to make it effective. Even though co-teaching might blur the boundaries of traditional roles, it is evident in research that the roles constitute what general and special education teachers contribute to this instructional partnership; sometimes the roles are not clear enough to know what the special education teachers are expected to do. For example, in Keefe and Moore’s study (2004) of high school co-teachers, one of the general education teachers commented, “I do not even know why she [special education teacher] is here, quite frankly. She’s a nice person, the kids like her,

but I do not understand the point of having her in my classroom.” A special education teacher pointed out that, “I [special education teacher] focus a lot on my kids, but no one in the classroom knows who I am...every once in a while I might teach a lesson, but for the most part I just help the teacher with whatever is going on...” (p. 83). Often, children in the general education classroom view the special education teacher as an education assistant and/or glorified paraprofessional who is there only to support general education teachers.

Literature indicates that most special education teachers in inclusive settings adopt a supportive role in co-teaching rather than one of equal professional status, thus highlighting the limited contributions of special educators in the instructional partnership. Typically, a general education teacher would be a lead teacher and take responsibility for planning, curriculum development, and large group instruction; a special education teacher would share responsibility for curriculum modification and accommodations. S/he would contribute in collection and grading of assignments, providing individual help to students as and when required, manage classroom activities, take notes, ask questions, monitor student performance, modify curriculum, model behavior, and so on (Wallace, Anderson, Bartholomay, 2002; Mastropieri, Scruggs, Graetz, Norland, Gardizi & McDuffie, 2005; Rice & Zigmond, 2000; Keefe & Moore, 2004).

There are a few studies that indicate the equal and/or lead role of special education teachers in co-teaching. For example, in Wallace’s (2002) study, teams in two schools shared equal responsibilities and mutually split their instructional roles, so that both teachers took lead roles in providing substantive instruction. A general education teacher in a third school said, “What we usually do...one day I’ll teach the lesson, and the

special education teacher will move around, collect homework, and help out the kids...when he teaches, I do the opposite” (p. 370). Mutually dividing the instructional role and other activities of the classroom and taking equal responsibility for all students provides equal status to both general and special education teachers in co-teaching. There is scant literature that talks in detail about the contributions of special education teachers, in either a support role or a lead role, indicating what a special educator brings to the team. For example, there is little indication of questions they asked, examples they provided in a lesson, or activities they suggested in planning and/or teaching within the context of a specific content area.

Co-teaching and Content Knowledge

Even though much has been written about co-teaching and its benefits and about the factors that must be considered, co-teaching has not been successfully implemented at the high school level. Mastropieri and Scruggs (2001) enumerated the following implementation barriers for co-teaching at the secondary education level: curriculum demands, fast-paced instruction, high-stakes testing, less positive attitude of teachers, and limited content knowledge.

There is a notion that the general education teacher is a content knowledge expert and the special education teacher contributes pedagogical knowledge in a co-teaching partnership. In fact, special educators at the high school level often do not feel confident in taking a lead role in co-teaching because of their lack of content knowledge, which is especially challenging at the secondary education level (Mastropieri et al., 2005). This can result in restricted contributions of special education teachers in regular education

classrooms in day-to-day teaching; at times their contribution is limited to simply collecting homework assignments or waiting for students to ask for help. Lack of in-depth knowledge of content matter, which pushes special education teachers to adopt supportive roles in the general education curriculum, could be an underlying reason for the “backseat” role they play in co-teaching.

Within the last two decades, there has been an emphasis on the importance of content knowledge and teaching practice. Researchers believe a teacher must understand and know the content necessary to teach a concept (Shulman, 1986, 1987; Grossman, 1990; Ball, Hoover, & Phelps, 2008). This was further strengthened by the enactment of the No Child Left Behind (NCLB) Act passed in 2001, which focuses on the quality of teachers and teacher preparation programs. It demands that teachers in general education be experts in the core academic subjects they teach to children with and without disabilities, thus pushing for Highly Qualified Teachers (HQT) in the field. This mandate did not make clear what criteria special education teachers had to meet in order to be considered HQT. Requirements were made more explicit with the reauthorization of the Individuals with Disabilities Education Improvement Act in 2004, which aligned itself with NCLB in developing similar requirements for special education teachers and for general education teachers teaching the core academic subjects. According to NCLB, even special education teachers who are fully certified in special education do not meet the requirements unless they demonstrate expertise in the core academic subject(s) that they teach. The literature has established that the content knowledge of special educators does play a significant role in collaboration and in taking the lead role in teaching a

diverse student population in inclusive settings (Mastropieri et al., 2005; Keefe & Moore, 2004).

However, not all agree that special educators need content knowledge to teach in co-teaching settings. McKenzie (2009), in a position paper that focuses on the role of secondary special education teachers in providing instruction in core academic areas, agrees that it is not logical to have special education teachers in co-taught and collaborative classes meet the Highly Qualified Teacher (HQT) requirement. He argues that this would not only duplicate the expertise in the core content area, but would also require special educators to have two sets of knowledge—both pedagogy and core academic content—as compared to general educators who would possess only knowledge of content. The author suggests that for providing high-quality education in co-taught classes, there is a need to harmonize the content knowledge expertise of general educators with the pedagogical expertise of special educators. This contributes to the debate regarding the content knowledge expectations for special education teachers teaching in inclusive settings, especially at the high school level.

Often, content knowledge of special education teachers in co-teaching is studied in terms of its significance relative to special educators taking a lead role. However, it raises questions. What does this knowledge look like and how much knowledge is required to gain familiarity of the content? Does this necessitate adding more content knowledge courses in the teacher preparation programs? Is it possible that special educators can gain content knowledge through professional collaboration while co-teaching with the general education teachers?

We need to look at factors other than content knowledge to explain the “backseat” role of special educators. Perhaps it is a lack of subject-specific strategies or pedagogical content knowledge (PCK) that limits special education teachers from taking an active role in co-teaching partnership.

Pedagogical Content Knowledge

In 1986 Shulman introduced the term *pedagogical content knowledge* (PCK) and explained that PCK is the teacher’s understandings of how students comprehend specific subject matter. It involves the ways of representing and formulating the subject matter to make it comprehensible to others. It involves understanding how particular subject matter topics and issues are organized and represented in order for teaching to be effective and also, understanding the needs and struggles of the students. Like content knowledge, PCK also evolves with experiences and professional development of teachers; however, content knowledge is considered the core of PCK (Abell, 2008).

In general and special education there is a body of literature that talks about the significance of teachers’ content knowledge and its influence on teaching and co-teaching (e.g., Morocco & Aguilar, 2002; Masteropieri et al., 2005; Keefe & Moore, 2004). In general education, research has highlighted the role and components of PCK in teaching a concept within the context of a specific subject (e.g., Shulman, 1986; Grossman, 1990; Ball, Thames, & Phelps, 2008; Gess-Newsome & Lederman, 1999). Research on the role of PCK is still emerging in the special education arena.

Research highlights that most researchers situate their studies within the PCK framework developed by Shulman and that their findings could be grouped into four

important characteristics of PCK: “PCK includes discrete categories of knowledge that are applied synergistically to problem of practice; PCK is dynamic, not static; content (science subject matter) is central to PCK; and PCK involves the transformation of other types of knowledge” (Abell, 2009, p. 1407). Therefore, PCK has been studied both as individual constituting components and also, how these components are blended together to create a unique knowledge to teach a specific concept.

Deborah Ball and her colleagues (2008) conducted a study to identify mathematical [content] knowledge for teaching and further expanded Shulman’s PCK category into three sub domains: knowledge of content and students (KCS), knowledge of content and teaching (KCT) and Knowledge of content and curriculum (KCC). I decided to implement Ball’s PCK framework; of all the PCK models, it most explicitly highlights the intersection of knowledge of content with knowledge of students, teaching, and curriculum. By using this model, I want to explore the role of these knowledge bases on a special education teacher’s contribution in co-teaching. For example, whether knowing his or her students and the content would help him or her to identify an example which would motivate students to engage in learning that concept.

Purpose of the Study

This study explored the contributions of the special education teacher in a high performing co-teaching team at the high school level. These contributions of a special education teacher were studied in relation to his or her content knowledge (CK) and pedagogical content knowledge (PCK) within a core content area. The high performing co-teaching team in the study comprised a special education teacher and a general

education teacher. An exploratory case study was conducted using classroom observations, teacher interviews, and collection of artifacts such as lesson plans. The research questions that drove this investigation were:

- a) What contributions did the special education teacher make in co-teaching biology?
- b) How can we apply Ball's conceptions of PCK to the special educator in co-teaching?

Significance of the Study

Given the importance of the instructional partnership in co-teaching and the high curriculum demands at the secondary education level, it's important to investigate these questions. With the increase of students with disabilities in schools nationally, co-teaching as a collaborative teaching model has created a potential to enable two professionals, general and special education teachers, to co-actively provide meaningful education to children with and without disabilities in the general education curriculum. Special educators are no longer only consulters/supporters, but are also direct providers of instruction in core content areas; supporters of content knowledge for teachers believe that subject matter knowledge is a significant component of effective instructional practices. Ball et al. (2008) point out that those who are teaching subtraction to students in classrooms must be able to perform subtraction exercises themselves. They also must be able to identify process errors, provide rationale for their corrections, and demonstrate different means or modes to conduct those processes. All this is possible if a teacher is familiar with the content of a particular topic.

Moreover, with the enactment of No Child Left Behind (2001) and the Individuals with Disabilities Education Improvement Act (2004), the focus on teachers' content knowledge and its implication has forced momentum in both the camps of teacher preparation—general and special education. The focus of these legislative initiatives is on educational accountability, effective schools, evidence-based teaching, and inclusion of students with disabilities in regular classrooms (Greer & Meyen, 2009). They require teachers in general to be expert or highly qualified teachers (HQT) in the subject matter they teach to children with and without disabilities.

Even though much has been said about the dependence of effective co-teaching partnerships on the content knowledge of special education teachers and about highly qualified special educators (Mastropieri et al., 2005; Keefe and Moore, 2004; Rice, Drame, Owens, & Frattura, 2007), there is not much literature about special education teachers' contributions in terms of examples used or implemented a specific strategy in a co-teaching team within the framework of PCK and through what ways a special education teacher could gain content knowledge co-teaching with a general education teacher as a part of learning from each other's expertise.

The present study is valuable, not only because it builds and elaborates on the previous literature (Mastropieri et al., 2005; Keefe and Moore, 2004; Borko, Eisenhart, Brown, Underhill, Jones, & Agard, 1992; Morocco & Aguilar, 2002; Pugach & Winn, 2011) but also because it will contribute to the emerging research on content knowledge and pedagogical content knowledge in special education.

This study focused on the contributions made by a special education teacher in teaching a concept and making connections among concepts and processes in the core content area. The study using the Ball's PCK model explored examples of special educator's drawing on his or her PCK and whether it helped a special education teacher in taking the lead role or engaging actively in the classroom activities and helping students to understand specific subject matter. The results of this study will add to the knowledge base of co-teaching by exploring the instructional partnership role between a special and a general education teacher in a high-performing co-teaching team. This study will attempt to suggest ways to improve instruction in teacher education programs for preparing teachers to co-teach in inclusion settings and sets a platform for future research on co-teaching and PCK in the special education arena, which is scant.

Operational Definitions

Co-teaching is defined as two or more professionals working together to provide substantive instruction to a diverse group of students in an inclusive classroom (Friend & Cook, 2003; Villa et al., 2008; Salend, 2008). This pairing could be either between a general education teacher and a special education teacher, speech therapist, school psychologist. In this study, the co-teaching team consisted of a special educator collaborating with a general education teacher teaching high school biology in an inclusive classroom.

In this study, *high performing co-teaching team* referred to the team that met the following selection criteria: (a) included an experienced special education teacher and a general education teacher; (b) taught in a core content area such as math or science, (c)

facilitated growth in student learning in children with and without disabilities over a period of one academic year; (d) included teachers who did not possess a dual teaching certification license; (e) was considered an effective or a model co-teaching team by the principal; (f) included teachers who were equally involved in all or different aspects of teaching, and (g) carried out instruction in the general education curriculum with both teachers present.

Content knowledge is defined as the knowledge of a core content area or discipline such as math, science, or social studies in terms of its organizing principles, facts, theories, structures, and ground rules that help in understanding “what” and “why” of different processes and concepts in the field (Ball et al., 2008; Grossman, Wilson, and Shulman, 1989). This study considered the content knowledge familiarity of the special education teacher in biology.

Pedagogical content knowledge is defined by Shulman as “the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations—in a word, the most useful ways of representing and formulation the subject that make it comprehensible to others. Pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and background bring with them to the learning of those most frequently taught topics and lessons” (p. 9). Ball et al. (2008) furthered this definition by adding three components of PCK: knowledge of content and student (KCS), knowledge of content and teaching (KCT), and knowledge of content and curriculum (KCC). These components are explained in Chapter 2, Literature Review.

Pacing guide is a teacher's written schedule demonstrating the alignment of concepts, topics, and/or skills related to the pre-defined curriculum over a defined period of time. In this study, the biology pacing guide included inputs from both special and regular education teachers; it was initially developed by the regular education teacher.

Contribution is a term used by the researcher in this study. It refers to the special education teacher's specific teaching behavior including suggestions, additions, and changes to content or instruction that impact the way content is taught or made accessible to all students. These contributions included teaching strategies, examples, or demonstration used by the special education teacher while teaching a specific content. Some of the contributions in the study have been labeled as unique because these were different from those implemented by the regular education teacher.

Biology curriculum in this study is defined as the key concepts and related content that are organized around scientific principles, theories, and processes governing cell biology, biochemistry, genetics, and ecological systems. In this study, the biology curriculum was developed by teachers from the two high schools in the school district; these teachers identified the key concepts to be taught in accordance with the state and the district standards.

Co-teaching as a service-delivery option provides an equal opportunity for students with disabilities to access the regular education curriculum. Even though schools and classrooms nationwide are adopting the philosophy of co-teaching to create more inclusive learning environment, its success varies from elementary to middle to high school. Research highlights that knowledge of content, which is the most debated topic

within the field, plays a significant role in the contributions of special educators at the high school level (Mastropieri et al., 2005; Keefe & Moore, 2004; Rice & Zigmond, 2000). This study will investigate the contributions of a special education teacher in relation to his or her content knowledge and pedagogical content knowledge in the co-teaching partnership at the high school level.

CHAPTER 2

Literature Review

In order to situate co-teaching as a collaborative teaching model, I will first briefly explain collaboration followed by the defining characteristics of co-teaching. This will be followed by the components and approaches of co-teaching. The next section focuses on the benefits of co-teaching, which leads into a review of barriers in implementing co-teaching with emphasis on the teachers' content knowledge. The last section of the chapter describes pedagogical content knowledge (PCK) and its models.

Collaboration

Over time, special education has evolved. In the past, students with disabilities were completely isolated. From there they moved to specialized classrooms and then to segregated hallways or buildings away from the general education curriculum (Walther-Thomas, Korinek, McLaughlin, & Williams, 1999). Eventually the model changed to one that included children with disabilities in the general education classroom. Prior to the 1970s legislative enactments, there were more than eight million children with disabilities nationwide, most of whom did not have access to educational opportunities. Out of the small population of children with disabilities who could gain education, 70% were educated in separate buildings and classrooms segregated from non-disabled peers (Gordan, 2006). For years, practitioners, proponents, and researchers have made compelling arguments advocating for inclusion for people with disabilities in education (Dun, 1968; Lipsky & Gartner, 1997b; Walther-Thomas et al., 2000). These culminated in initiatives at various levels— individual, state, and national—resulting in children with

disabilities being included to a large extent in both schools and classroom communities as a result students with disabilities could gain access to the regular education curriculum.

The last few decades have seen a national increase in the diversity of the student population in schools and classrooms, and these diverse populations include students with disabilities (Mastropieri et al., 2005), which calls for collaboration among professionals. Most professionals believe that for effective inclusion, effective and continuing collaboration among stakeholders is essential (Friend & Cook, 1996; Korinek, Laycock McLaughlin & Walther-Thomas, 1995; Walther-Thomas et al., 2000). In the process of creating successful inclusive classrooms, collaboration between general and special education teachers is particularly important and has gained attention in the field (McLaughlin, 2002).

Collaboration has multiple meanings and definitions depending upon who is implementing it and how. According to Friend and Cook (2003), collaboration is a style or an approach voluntarily used by co-equals for interaction toward a common goal. Within this definition there are several critical components. First, for collaboration to be successful, it must be voluntary. Second, successful collaboration requires parity among participants. Participants in collaboration have an equal status and power in making decisions about any and all aspects of teaching. A third essential component is mutual goals; in order to design an appropriate education program for a heterogeneous student population, it is important that all participants share goals or have mutual input in developing them. A fourth component for effective collaboration is shared responsibility. Active involvement and division of labor among collaborators includes shared responsibility; however, it is not always necessary to have equal division of labor. Last,

shared accountability for outcomes is essential for successful collaboration. Irrespective of the nature of an outcome—positive or negative—participants must mutually shoulder responsibility for results and reflect on what worked, what did not work, and what must be changed.

According to Bauwens and Hourcade (1995), an effective collaboration is “an ongoing style of professional interaction in which people voluntarily engage in shared program planning, implementation, evaluation, and overall program accountability” (p. 6). This definition highlights that collaboration acts as a means for professionals to share and develop working relationships to accomplish common goals. The authors discuss two forms of professional collaboration: indirect and direct. In indirect collaboration, participants are involved only in the planning of an educational program; in direct collaboration, participants collaborate in planning as well as in the implementation of the program.

Pugach, Johnson, Drame, and Williamson (2012) defined collaboration in schools as “all members of a school staff are working together and supporting one another to provide the highest quality of education to all the students they serve” (p. 33). The authors note that collaboration in educational settings involves not only professionals but also parents and other community members who work together to provide meaningful education to all children. Similarly, Cook and Friend (2000) believe “collaboration has become an integral part of today’s schools” (p. 3). They highlighted that the boundaries between the traditionally held roles of both general and special education teachers have blurred since the enactment of the Individuals with Disabilities Act (IDEA) in 1990. In today’s schools, working alone with students is not sufficient to provide meaningful

education; teachers need knowledge and skills to work collaboratively. The authors stated that collaboration is not limited to special services, but is considered crucial and imperative as classrooms are becoming more diverse.

With schools becoming more inclusive, the term collaboration “has become something of an educational buzzword” (Friend & Cook, 2003). It involves a working relationship between and among different professionals such as speech language pathologists, social psychologists, general and special education teachers, or audiologists required to provide meaning learning experiences to students.

Thousand, Villa, and Nevin (2006b) explained that collaboration in regular education curriculum involves four different personnel support options and co-teaching is one of them. Co-teaching is an instructional partnership between two or more people in all aspects of teaching in a classroom. Together, professionals in the classroom decide who teaches each portion, when it will be taught, and what strategies will be implemented. Typically, co-teaching in inclusive settings involves a general education teacher and a special education teacher. Other professionals could be a part of this team or collaborate as needed to support a particular student in the general education curriculum. Focusing on collaboration in special education, Friend & Cook (2003) explained that co-teaching is a special form of teaming between a general and a special education teacher in providing direct and indirect services while teaching students—with and without disabilities—in a single classroom.

Co-teaching

The idea of co-teaching is not new in the education arena. The history of co-teaching goes back to the 1960s, when it was considered progressive education in U.S. schools. By the 1970s, it was used as a school reform model to provide instruction to a diverse student population. In the 1990s, co-teaching received much attention in the research and practice literature as one of the most frequently employed collaborative service delivery options in schools to teach students with diverse learning styles, including children with disabilities (Villa, Thousand, & Nevin, 2004; Zigmond, Kloo, Volonino, 2009). Co-teaching has been identified as the most widely used model of teacher collaboration in schools nationwide (Lipsky & Gartner, 1997b; Zigmond, 2001; Villa et al., 2004).

There are different definitions of co-teaching in the field. Friend and Cook (2003) situated co-teaching in student-centered teams and defined it as “two or more professionals delivering substantive instruction to a diverse, or blended, group of students in a single physical space” (p. 48). Villa and colleagues (2008) defined co-teaching as “two or more people sharing responsibility for teaching some or all of the students assigned to a classroom” (p. 3). The authors defined some of the characteristics necessary for the co-teaching process to be effective. These include shared responsibility for the co-teachers in all aspects of teaching, such as planning, delivering, and evaluating student progress. Co-teaching provides an opportunity for teachers to blend the best of their teaching strategies and expertise to ensure that all children—with and without disabilities—learn in a single classroom.

Likewise, Gately and Gately (2001) defined co-teaching as “the collaboration between general and special education teachers for all of the teaching responsibilities of all students assigned to a classroom” (p. 41). The authors describe that in co-taught class the co-teachers plan, teach, evaluate, and manage the classroom to enhance the learning environment for all students.

A distinct characteristic of co-teaching emerges from these definitions and distinguishes it from other forms of collaborative options such as consultative support or individualized support. In other forms of collaborative options professionals can work together without co-teaching, but co-teaching does not exist without collaboration.

Characteristics of Co-teaching

Friend and Cook (2003) further explained unique characteristics of co-teaching that separate it from other forms of collaborative teachings. First, co-teaching involves at least two professionals (for example, a general educator and a special education teacher or a general educator and a reading specialist) who share similar employment status and who are engaged in providing substantive instruction to all students. The authors further clarified this by pointing out that collaboration between a teacher and a paraprofessional or a class volunteer cannot be considered co-teaching; in school districts where paraprofessionals are actively involved in providing services, these are considered supported or assisted classrooms, not co-teaching.

Second, in co-teaching both professionals must be involved in all or different aspects of teaching. Simply having two adults in a classroom does not necessarily mean co-teaching. The authors stated that co-teaching is not having “an extra set of hands.” It

requires two minds working together in planning, teaching, and evaluating students. And, in doing so, both teachers—general and special education—and other professionals can integrate or modify instruction in a number of creative ways to enhance the learning environment and to make a concept or a teaching unit comprehensible while meeting the needs of children with disabilities.

Third, co-teaching provides a platform to teach a variety of students in a single diverse classroom. It allows teachers with distinct expertise to address the individual needs of children and helps to reduce the student-teacher ratio. The core component of co-teaching is the desegregation of the classroom to address the needs of students with and without disabilities. Last, one of the advantages of co-teaching is that co-teachers provide instruction in a single working space or classroom, thus distinguishing it from a pullout model. These defining characteristics of co-teaching demand that teachers work together and provide instruction implementing various approaches to co-teaching in a single physical space.

Approaches to Co-teaching

Different approaches to co-teaching between general and special education teachers can be observed in elementary school, middle school, and high school. Co-teaching can be implemented in a variety of ways in a general education curriculum depending upon the needs of the students and the arrangement that works for both teachers. However, the selected approach must consider the following: the ecology of the class, pedagogies used, specific content, teaching material, administrative support, expertise of the teachers, and workload (Friend & Cook, 2003; Snell & Janney, 2005;

Thousand, Villa, & Nevin, 2006b). Villa et al. (2004) highlighted that the selection of the approach may also depend on the length of experience teachers have had with co-teaching

In the literature, there are different names and categories used to describe various approaches to co-teaching (Friend & Cook, 2003; Walther-Thomas, 2000; Villa et al., 2004). Friend and Cook (2000; 2003) have described six approaches to co-teaching. These approaches are: parallel teaching, team teaching, station or center teaching, alternative teaching, one teach-one observe, and one teach-one drift or supportive teaching.

Parallel teaching is an approach in which both teachers—general and special education—are teaching at the same time. The classroom may be divided so that one teaches students in one half of the room while the second teaches those in the other half. They teach the same lesson at the same time (Friend & Cook, 2003; Villa et al., 2004; Walther-Thomas et al., 2000). This style is great for large classes because the students benefit from being in a smaller group; it increases the likelihood of student participation and sharing. This model could be effective in addressing topics with multiple dimensions where students could be strategically placed in two smaller groups and these groups can be brought together at the end. In parallel teaching, the special and general educator mutually plan the lesson and decide the sequence in which the content will be taught. The teachers are co-responsible for the learning outcomes and they share equal responsibilities. There are two advantages to parallel teaching. The first is that teachers share equal status and are mutually accountable for the outcomes. The second advantage is that dividing students into two groups lowers the student-teacher ratio; thus it allows

more time for individual attention as well as for hands-on activities (Friend & Cook, 2000, 2003; Villa et al., 2004).

Team teaching is one of the most common approaches used in the co-taught classroom. Teachers share the teaching responsibility and may act as a tag team. For example, they may deliver the lesson together. Either teacher can raise points or “jump-in” at any time. The teachers should bounce ideas off of each other and raise questions (Friend & Cook, 2000, 2003; Villa et al., 2004). Team teaching is very powerful when the entire class is participating in a particular inquiry project such as a thematic unit. In this model, general education teachers often take the lead role in the classroom and special education teachers ask questions and provide extra examples as needed. Even though teachers are equally active in providing instruction in the classroom, they co-plan the content to be taught and appropriate teaching strategies required and share responsibility for determining activities for the lesson.

Station teaching or *center teaching* is often used in elementary schools and may be used in middle and high school settings. Students work in stations or centers and the co-teachers take responsibility for teaching and explaining directions for their assigned stations (Friend & Cook, 2000, 2003; Walther-Thomas et al., 2000). Students benefit by working in groups. Children with special needs could be grouped in a separate station or mingled with other children at each station. In this model, both special and regular education teachers lead their respective stations in the classroom, address the needs of individual students, and assist as students work independently or work with a peer tutor or a paraeducator at a third station. This model is helpful in catering to specific demands of the students, targeting specific IEP goals, or minimizing distraction for students with

attention problems by not isolating them from general education classrooms. Both teachers are viewed with equal status and are engaged in any and all aspects of teaching (Friend & Cook, 2003).

One teach-one drift model or *supportive teaching* should be used occasionally but not exclusively because students begin to view the teachers as unequal in the classrooms. In this model, one teaches the lesson while the other drifts around the classroom and helps students who need extra attention. Teachers take turns teaching concepts based on their area of expertise, requirement of the teaching unit, or needs of students in the classroom (Friend & Cook, 2003). This approach may not be helpful for children with emotional/behavior disorders. There may be excessive distraction and they not able to connect with the teacher responsible for the other portion of the unit. This method initially requires more co-planning time to break down units to sub-units and to assign individual roles accordingly. However, the model provides an opportunity for both special and general education teachers to co-actively teach and share responsibilities.

Alternative teaching occurs when one teacher pulls out a small group of students who need extra help or who are advanced and in need more of a challenge. This approach is especially helpful for catching up students who have been absent. When pulling out special education students, it is best to include some non-special education students so that no one feels singled out. In this model, the lead teacher, who is often the general education teacher, is responsible for the instruction and planning of the unit. At the same time, the special education teacher helps struggling students to comprehend the concept using multiple pedagogical strategies determined by individual student demands. For

example, some student may need more visual, auditory, tactile, and/or kinesthetic support to successfully communicate certain skills, concepts, ideas, and different content.

One teach-one observe is similar to *complementary teaching* in that one teacher teaches the topic while the second observes students during the lesson and collects data regarding the teaching and the struggles of the students in the lesson. In this model, a general education teacher generally takes the responsibility of teaching the content in the classroom. At the same time, a special education teacher collection data about students' comprehension levels and identifies topics with which most students struggle (Friend & Cook, 2003; Villa et al., 2004). Teachers co-plan the topic and decide on the activities related to it. The lead teacher is accountable for the teaching-learning process in this model.

Co-teachers can implement more than one approach to teaching a topic depending upon the content and their comfort level with the various approaches. Friend and Cook (2003) suggest that co-teachers must periodically change and experiment with different approaches to keep the classroom interesting and fresh.

Benefits of Co-teaching for Students

A number of researchers have conducted studies about the social and academic benefits of co-teaching for students with and without disabilities in the general education classroom, Keefe and Moore (2004) emphasized that one of the positive outcomes of co-teaching for students with disabilities is that it eliminates the stigma of being in special education, which Walther-Thomas refers to as, "lost their labels." Children without disabilities benefit from this model by getting more individual attention and expert help

from both teachers—general and special education. In co-teaching, the instruction delivered by both teachers is natural and is less fragmented than in a pullout model (Friend & Cook, 2000; Walther-Thomas, 1997). Likewise, Trent (1998) conducted a case study of a general education teacher who co-taught U.S. history with two special education teachers in an inclusive setting at the high school level. The purpose of the study was to explain the difficulties faced by the general education teacher in this instructional partnership. The results of the study indicated that all students, both with and without disabilities, benefited from the smaller pupil-teacher ratio that provided increased individual attention. In addition, students in general benefited from the modified study guide prepared by the special education teacher because it helped them develop and improve organizational skills.

Most teachers interviewed in a study conducted by Austin (2001) believed that inclusive education was socially beneficial for all students. It provides an opportunity for general education students to become aware of diversity and promotes a tolerance for differences. It also provides an opportunity for peer modeling for students with special needs. It also provides an opportunity for students with disabilities to be in general education classrooms and mingle with their non-disabled peers.

Walther-Thomas (1997) investigated the benefits and the problems experienced by 23 school teams in implementing an inclusive education model over a period of three years. These teams included: one principal, one special education teacher or more, and one general education teacher or more. The principal or the assistant principal on the team was responsible for the special education students in that school and the general and special education teachers participating in the study co-taught.

Using semi-structured interviews and classroom observations, the author describes the following benefits of co-teaching for students with and without disabilities. Most teachers saw improvement in self-esteem and self-confidence among students with disabilities and most of the students were no longer labeled with the change of service delivery option. One teacher particularly reported that these children, “have greater faith in their abilities to succeed in school and they are feeling better about who they are” (p. 399). Teachers also observed change in the attitude of these children toward themselves and others; they were more motivated and objectively analyzed their strengths and weaknesses and were less defensive. Moreover, teachers pointed out students with disabilities not only behaved more appropriately in mainstream settings than in special education settings, but their social skills also improved as a result of spending time with non-disabled peers. The teachers reported that the social skills of many non-disabled peers improved and resulted in a reduction in fights, name callings, verbal disagreement, and cliques, and more cooperative learning and friendship circles in the co-taught classes. The author highlights that teachers noted that many low achieving general education students who did not qualify for special education services benefited from individual attention in co-caught classes and their performance improved when compared with that in traditional settings.

The results from the Schwab Learning (2003) study reinforced the findings of Walther-Thomas’s study. The study highlighted a decrease in referrals to intensive special education services, fewer disruptive problems, increased overall student achievement, and less paperwork. Similarly, in a review of 32 qualitative co-teaching studies Scruggs, Mastropieri, and Mcduffie (2007) indicated that most of the studies did provide evidence for the benefit of having two teachers in a classroom on both academic

and social skills of students with and without disabilities. Scruggs and colleagues also found that students with and without disabilities benefit in co-taught classes from extra attention and exposure to peer models for appropriate behavior. Results of a comprehensive six-year longitudinal study conducted by Blackorby, Chorost, Garza, and Guzman (2005) of 11,000 students nationwide highlighted those students with disabilities who had more access to general education curriculum were absent less and outperformed their peers in pullout settings when standards-based assessments were used indicating the benefits of co-teaching in an inclusive setting.

Finding from Hang and Rabren (2009) substantiate the benefits promoting co-teaching as an instructional approach for students with disabilities in general education classrooms. Participants for this study included 45 co-teachers from grades 1 through 10 and 58 students with disabilities. The authors found significant statistical differences in National Curve Equivalent scores of students with disabilities in math and reading in co-taught classes as compared to their previous year in non co-taught classes, indicating that co-teaching provides adequate support to children with disabilities for their achievement on standardized exams. Co-teaching had positive results on student behavior in the study, but there were more absence and discipline referrals during the co-teaching year.

Cook and Friends (1995) pointed out benefits of co-teaching for both students and teachers in general education curriculum. The authors highlighted that students in a co-taught class benefit from the reduced student-teacher ratio and increased engaged time with both professionals. They also emphasized that co-teaching reduces “wasteful interruptions” that occur when students with special needs must leave the classroom for their special education. In addition, co-taught classes eliminate the stigma that often is

associated with special education services and reduces the fragmentation associated with a pullout model that is distinct from that in the general education curriculum. On the other hand, Murawski and Swanson (2001) conducted a meta-analysis of quantitative studies on co-teaching for past 10 years. The authors reviewed 89 articles, but only six met their research criteria. These six quantitative research studies indicated positive social benefits for students with and without disabilities in a general education setting. Even though achievement in mathematics and reduction in referrals both received average effect size, it indicated positive benefits for using co-teaching as a service delivery option for students with disabilities. Moreover, the effect size for results in achievement in reading and language arts was overall largest highlighting academic gains of students with special needs in inclusive settings.

Lastly, Welch (2000) conducted a descriptive analysis of two schools implementing team teaching. The author uses the term “team teaching” for co-teaching. A total of 45 students, including just nine students with disabilities, and two special education teachers from two elementary schools participated in the study. The author reported positive academic gains by students with disabilities, but due to the small sample size, these results were statistically insignificant. An increase in the mean scores potentially indicated the positive impact of team teaching over a segregated model of imparting instruction to students with disabilities. Each teaching team showed a gain of at least 20% in student performance from the previous pre-team teaching measures. In school 1, reading fluency showed an impressive gain of 72% for five students with disabilities. In school 2, students with disabilities experienced a 60% gain in reading recognition.

It seems clear that co-teaching not only helps to eliminate ‘social stigma.’ It also provides equal educational opportunities that allow students with disabilities to grow and learn in inclusive settings, which would be impossible otherwise. Although there is not much literature to strongly claim its academic gains, empirical studies do indicate the social benefits of co-teaching for all students, both with and without disabilities.

Benefits of Co-teaching for Teachers

Co-teaching, in addition to providing access to students with disabilities in the general-education curriculum, provides opportunities for general and special education teachers, to collaborate and to learn from each other’s expertise.

Walther-Thomas (1997) discussed the following benefits of co-teaching for teachers. First, professional growth: Most teachers in 23 school-based teams reported that working closely with another professional provided an opportunity for professional growth through sharing and learning from each other’s ideas, pedagogies, and experiences in addition to exploring new ideas and content areas. Second, personal support: Many participants noted that teaching is considered as an isolated profession and that co-teaching reduces that isolation because two teachers work as a team and support each other. The author quotes one teacher comparing teaching alone to single parenthood: “You can do this alone, but it’s a lot more fun and rewarding if someone else is there with you...someone who cares about the students as much as you do. Someone who will appreciate it when students are absolutely wonderful—or absolutely awful!” (p.401). And finally, increased collaboration among faculty members: Most participants pointed out that their colleagues seemed to have a more positive attitude toward team work than

before, and other professionals and specialists were also motivated to collaborate. In a position paper, Thousand, Villa, and Nevin (2006b) pointed out that co-teaching provides an opportunity for both teachers to benefit from distinct and specialized professional knowledge the other brings to this partnership and that helps them develop different methods for catering to the needs of students with and without disabilities in inclusive settings.

Trent (1998), in analyzing the implementation of a collaborative teaching model in a high school, discussed that co-teaching as a collaborative teaching approach provides a platform for both teachers—general and special education—to optimally use their teaching capacities and expertise. For example, a general education teacher has an expertise in content area and curriculum and special education teachers bring knowledge of curriculum adaptations and modifications and organizational skills.

Findings of the data collected through a semi-structured interview of 12 co-teachers indicated that most of them had a positive co-teaching experience. General education teachers indicated that their classroom management skills, curriculum adaptations, and knowledge improved. Special education teachers noted that they gained content specific knowledge (Austin, 2001). Similarly, Scruggs et al. (2007) found that personally compatible co-teachers benefited from co-teaching in professional development because both teachers capitalized on the other's diverse and specialized knowledge.

In conclusion, collaboration not only improved professional competencies of both teachers, but also enhanced social relationships, diffused the stress that comes with

teaching, and changed teachers' attitude toward students. Both teachers could develop a positive attitude toward students' success as well as toward their own co-teaching experience (Evan-Stout, 1998; Villa et al., 1996). It should be noted that the literature highlights different components or essentials required to effectively implement co-teaching at various school levels.

Essentials of Co-teaching

Research not only points out “what it takes” to maintain a collaborative co-teaching partnership, but also indicates that ineffective implementation of these essentials/components/elements in the process of co-teaching could result in implementation barriers (Cook & Friend, 1995; Pugach, 1995; Trent, 1998; Walther-Thomas, 1997; Gately & Gately, 2001; Keefe, Moore & Duff, 2004, Wallace et al., 2002; Dieker, 2001, Weiss & Brigham, 2000; Rice & Zigmond, 2000; Austin, 2001; Wood, 1998; Mastropieri et al., 2005 Scruggs et al., 2007; Villa et al., 2004; Pugach & Winn, 2011). For this study, I discuss the following elements necessary for the implementation of successful co-teaching: planning time, communication, personal and professional compatibility, administration support, identification of roles, and content knowledge.

Planning Time

Planning time is one of the essentials for effective co-teaching. Walther-Thomas, Bryant, and Land (1996) identified a comprehensive three-level planning process required for successfully implementing co-teaching and creating a supportive environment. The three levels are: (a) district-level planning, (b) building-level planning, and (c) classroom-level planning. District-level planning can ensure that proper resources are allocated for new

program initiatives and can create collaboration among schools, assuring that the school implementing the co-teaching model has system-wide support. Building-level planning can provide critical administrative support for smooth functioning of the initiative. Planning also addresses professional development, manageable teaching load and schedule, small class size, and weekly scheduled planning time. Lastly, classroom planning is necessary for both teachers—general and special education—for mutual development of lesson plans and for reflecting, modifying, and evaluating their instructional efforts. Additionally, it allows teachers to discuss students’ specific needs and IEP requirements. Similarly, Tannock (2009) highlighted teachers’ need for mutual planning time and time to discuss students’ achievements and struggles, share teaching strategies, and develop assessment plans.

In a meta-analysis of research on co-teaching, Scruggs, Masteropieri, and McDuffie (2007) identified planning time as one of the “expressed needs of co-teachers” and found in most of the articles that both general and special education teachers expressed the need for scheduled common planning time for collaboration. Other research reported that teachers did not have sufficient planning time for working on various aspects of co-teaching. The authors also pointed out that some studies indicated inadequate support from the school in terms of the planning time needed to make collaboration work.

Similarly, Keefe and Moore (2004) conducted semi-structured interviews of three general education teachers, four special education teachers, and one head special education teacher at the secondary education level. They found that critical issues regarding co-teaching at the high school level revolved around three major themes—the

nature of collaboration, roles and responsibilities, and outcomes. Regarding the nature of collaboration, most participants indicated communication and planning as a logistical challenge in co-teaching. One general education teacher said, "...we were planning on the fly most of the time. We talked after school. A lot of times we talked at lunch." Another special education teacher said, "But all this is so hard, trying to do it in the time allowed, because even with our team meetings, we did not really have much time to work on curriculum" (p. 82). The study indicated that big class size and lack of scheduled planning time acted as disincentives to co-teaching at the high school level.

Explaining eight critical components and three stages of the co-teaching process, Gately and Gately (2001) highlighted the significance of instructional planning in co-teaching. The authors observed that, in the beginning stage, co-teachers often have distinct teaching styles. As they progress—to the second stage, the compromising stage, and then to the final stage, the collaborative stage—their planning and teaching reflect a blending of teaching ideas and strategies. The authors emphasized that common planning time is essential in order for teachers to become collaborative. Instructional planning is a complex and continuous process that involves "day to day, week to week, and unit to unit planning of coursework" (p. 44).

In the study conducted by Dieker (2001) identifying the characteristics of "effective" middle and high school co-taught teams teaching students with disabilities, planning time emerged as one of the important practices. Evaluation of nine co-teaching teams, including seven middle school teams and two high school teams, provided data for this study. The author used tools such as observations, interviews, field notes and teachers' planning forms over the period of 16 weeks. Among the themes that emerged

from the data was a commitment to planning time. Even though teams had some scheduled planning time, they felt it was not sufficient and they would have liked to have daily scheduled planning time. Responses to the question “How much time would you need for planning each day?” (p. 8) ranged from 15 minutes to an hour. Respondents stressed the need for consistency.

Providing an overview of unique issues present at the secondary education level—such as high stakes testing, higher standards, and more diverse student population and their impact on the collaboration between general and special education teachers—Dieker and Murawski (2003) emphasized the significance of common planning time in co-teaching. The authors indicated that even though most schools do provide planning periods, teachers rarely find common scheduled planning periods and this limits their ability to co-plan, talk about student needs, and decide on teaching and assessment strategies.

Magiera, Lawrence-Brown, Bloomquist, Foster, Figueroa, Glatz, Heppeler, and Rodriguez (2006) conducted an action study in one elementary school in New York State to provide a comprehensive analysis of the co-teaching model being followed by that school. The study included 20 participants: general and special education teachers, related service personnel, and administrators. An hour-long, semi-structured interview was used to collect the data. Four themes emerged from their analysis: preparing for co-teaching, the co-teaching relationship, co-teaching models, and co-planning. The majority of participants agreed that common scheduled planning time is essential for effective co-teaching because it allows general and special education teachers to discuss students’ needs and struggles and choose appropriate strategies. Some co-teachers who valued

common planning time became a part of the school's scheduling committee to make sure it was available for teachers.

Most of the teachers in this study stressed the importance of a scheduled, consistent, common planning time that would allow them to identify and select teaching strategies to address the needs of all students in the class, those with and without disabilities. They emphasized that it is difficult for co-teachers to achieve these goals if planning meetings are limited to before or after the school day or during the lunch period.

Communication

Another essential component for creating effective co-teaching partnerships is interactive and continuous communication between the special and regular education teachers. Providing guidelines for effective co-teaching practices, Cook and Friend (1995) emphasized the value and significance of communication strategies not only between regular and special education teachers, but also among different individuals in varying roles who would affect this instructional partnership. The authors recommend establishing channels of communication among teachers, specialists, parents, and students even before the implementation of co-teaching. This allows all parties to provide input and assures that all are aware of the new program as it develops. The authors believe, "people are more likely to accept and decide to participate in a new program or approach when they have been involved in its development at some level" (p.html). They caution against the use of one-way communication strategies that do not permit interaction.

Gately and Gately (2001) emphasize that co-teaching is a developmental process consisting of the following three stages—the beginning stage, the compromising stage, and the collaborating stage. At the beginning stage, co-teachers communicate carefully and less openly with each other. They begin the process of knowing each other, developing mutual trust, and learning to interpret verbal and nonverbal messages. At the compromising stage, communication between the teachers is more interactive. At the collaborative stage, both teachers acknowledge and respect different communication styles and often develop nonverbal clues or signals; their communication is fluid and open. These signals can be used to prompt one teacher to move on with the concept, indicate a need for more time and explanation, or indicate one teacher's need to leave the classroom in case of emergency (Murawski & Dieker, 2004). In analyzing the challenges of co-teaching in inclusive classrooms, Keefe and Moore (2004) conducted a semi-structured interview of eight general and special education teachers at the high school level and found that most teachers mentioned the significance of communication, especially at the initial stages of the co-teaching partnership. One special education teacher said, "If you're having some type of conflict, if something made you uncomfortable or you did not agree, you have to discuss it right away. You know it's like a marriage" (p. 82). The message is that open and non-judgmental interactive communication is essential to resolving conflict and misunderstanding between teachers.

In a case study, Trent (1998) describes a collaboration dilemma at the high school level. Both co-teachers had issues with the other's teaching style and initially did not communicate about it. This influenced their collaborative relationship. Supporting the importance of verbal and nonverbal communication for collaboration, Pugach, Johnson,

Drame, and Williamson (2012) indicated, “Communication is the foundation upon which effective collaboration is built. Good communication skills are a prerequisite for collaboration. If we cannot communicate effectively with our colleagues and others, a collaborative relationship is not possible” (p. 66).

The authors highlight that for co-teaching to be effective, both teachers—general and special education—need to have an open and fluid communication. Gately and Gately indicated that the openness and comfort level in communication builds with time and experience and passes through three stages.

Personal and professional compatibility.

Literature suggests that personal and professional compatibility between two teachers is essential for effective co-teaching. Positive chemistry and similar teaching styles help teachers to connect and develop instructional partnership. One of the themes that emerged in Keefe and Moore’s (2004) study addressed the compatibility of teachers and logistics of co-teaching. Both general and special education teachers stressed the importance of knowing their co-teacher before they were paired. One general education teacher said, “She came in new and they paired her with me. I had never met her before” (p. 81). In order to make the co-teaching relationship work, most teachers recommended allowing teachers input in the selection of a co-teaching partner. Another special education teacher said, “You know what? Teachers are funny critters, they’re very territorial. I couldn’t imagine me going in and, you know, playing by someone else’s rules. And that’s the thing I really had a problem with” (p. 81).

Similarly, personal and professional compatibility for co-teaching was observed as one of the themes in the findings of Rice and Zigmond (2000). The authors studied 17 secondary co-teachers in Pennsylvania and Australia. The focus of the study was to explore different models of co-teaching used by secondary school teachers and the nature of the role and responsibilities of co-teachers in inclusive settings. The study was conducted in 10 urban public schools in the United States and eight urban schools in Australia using a 90-minute semi-structured interview protocol. The study resulted in seven themes including “Teachers rate professional and personal compatibility highly in preferred co-teaching partners.” Several teachers indicated personal compatibility as “the most critical variable for co-teaching” and included the following traits that they would look for in a co-teaching partner—“tolerance and patience, sense of humor, flexibility and willingness to adapt, and excellent communication skills” (p. 194). In addition, most teachers explicitly described professional traits that they would either prefer or require as in order to make this relationship work. They include: (a) shared academic and behavioral expectations for students; (b) open and honest communication between teachers; (c) the avoidance of personalizing problems; (d) common knowledge and skills; and (e) self-confidence and a preference for taking risk. Most teachers understood there were challenges in adapting new roles and responsibilities and making co-teaching work and some teachers did not consider these challenges to be implementation barriers. One teacher called it “a professional marriage, which like a normal] marriage, you have to work at” (p. 194).

In a position paper, Cook and Friend (1995) discussed elements that are necessary to maintain a collaborative working relationship between co-teachers. The authors

advocate that teachers must share beliefs about co-teaching in order to make it work. “If partners for co-teaching do not agree on their beliefs about the ability of all children to learn, the rights of children to experience success in their classroom, regardless their ability, and their own role in student learning, they are likely to encounter difficulties when they share a classroom” (p. html). The authors pointed out that pet peeves were another issue that could influence compatibility of teachers in this instructional partnership. Co-teaching partners need to know each other’s likes and dislikes, routines, preferred classroom layout, and expectations. Not knowing them could interfere with a positive working relationship.

In a meta-analysis of research for co-teaching, Scruggs, Mastropieri, and McDuffie (2007) identified compatibility as one of the “expressed needs of co-teachers” and found that “teachers were generally very emphatic about the needs for co-teachers to be compatible” (p. 405). The authors cited examples from different studies highlighting the value of professional and personal compatibility required for effective co-teaching. The authors also pointed out that one of the reasons some teachers have a negative attitude toward co-teaching is that they fear being paired with someone they wouldn’t get along with personally and professionally. A successful personal and professional relationship between teachers was considered an essential component of effective co-teaching.

Highlighting the problem encountered by a general education teacher in collaboration at the high school level, Trent (1998) pointed out that the teachers had different organizational and operational styles and that this became “a source of unresolved conflict.” For example, the special education teacher was more liberal with

excusing students on passes and the general education teacher found this approach problematic. She said, “I’ve got 20 of ‘em in here...you’ve always got to remember that you’re with an X-level class in here and you’ve got to watch” (p. 508). Both teachers were uncomfortable addressing their issues and differences and this influenced not only their collaborative experience but also their co-teaching partnership.

Mastropieri et al. (2005) conducted four co-teaching case studies in science and social studies at the upper elementary, middle, and high school levels. The data sources for the study consisted of extensive classroom observation, field notes, interviews with teachers and students, and artifacts and documents. During the study the researchers worked closely with the teachers for time periods ranging from one semester to two years. The first case study describes two co-teaching teams at the upper elementary and middle school level. Both teams were teaching science; one at the fourth grade level and the other at the seventh grade level. The fourth grade teachers and one seventh grade teacher were veterans. One seventh grade teacher was a beginner. The authors found outstanding working relationships in these co-teaching teams. Teachers had fluid communication and seemed to enjoy each other’s company. They had positive chemistry and respected each other’s positions and opinions. The second case study describes one team teaching social studies at the middle school level. Both teachers had extensive teaching experience. The regular education teacher took the lead in most cases; the special education teacher played the supportive role, but at times assumed the lead role in multi-part activities and activities involving multiple steps. These teachers tried to make their relationship work, but as the year progressed tension became noticeable. They believed lack of planning time, differences in teaching styles, and distinct classroom

expectations resulted in confusion and frustration both between teachers and among students. The third case study focused on three co-teaching teams of tenth grade world history. These teachers had teaching experience ranging from three years to twenty years. In this co-teaching partnership, general education teachers were the content experts and special education teachers assumed the role of activities manager. Both teachers within teams seemed to accept this binary division of roles and had a positive relationship. The authors did not find any major conflicts that made a collaborative relationship difficult to implement. The last case study describes a single high school chemistry co-teaching team. Both teachers had several years of experience. In this team, the general education teacher was the content knowledge expert and the special education teacher took the supportive role; both were comfortable in these roles. During the second co-teaching year, the special education teacher assumed more lead roles. Both were comfortable with the personality and teaching style of the other and they spoke very highly of each other.

Administrative Support

Administrative support for co-teaching has been identified as a necessary component of successful teacher collaboration. According to Cook and Friend (1995), “nearly every study of teacher performance and satisfaction finds that administrative support is essential to teachers’ success...anecdotal and focus group information suggests what administrative actions are needed to support co-teaching” (p.html) The authors suggested that administrators can support co-teachers by promoting collaboration, by scheduling common planning time, by providing resources and incentives, by assisting teachers in framing their priorities, and by conducting professional development programs. Similarly, in a position paper, Walther-Thomas and his colleagues (1996)

discussed the planning issues that schools must to address in order to facilitate effective co-teaching. One way to approach these issues is through administrative support and leadership. The authors emphasize that “principals, as the instructional leaders of their school, play critical roles in facilitating collaborative efforts by instructional personnel. Support, understanding, and involvement by principals often serve as pivotal factors in the lasting success of new instructional innovations” (p. 258). Research suggests that principals not only help support co-teaching, but also assist teachers to navigate through the challenging stages. Walther-Thomas (1997) conducted a three-year study of eighteen elementary and seven middle schools that implemented co-teaching as an integral part of their service delivery options. The sample included 119 teachers and 24 administrators and the author collected data through the following methods: classroom observations, semi-structured interviews, school documents, and informal contacts. Administrative support emerged as one of the major themes that focused on persistent problems for participants. The author found that schools did much better when principals not only supported co-teaching but were actively involved in making it successful. Participants in the study indicated that principals shoulder multiple roles in supporting and promoting new special education services within a school. These roles were: advocate, promoter, team leader, and advisor. One teacher said about her principal, “Her enthusiasm and commitment kept us all going. Over and over again she kept telling us ‘We can make this happen!’ Her strong belief in inclusion and her obvious support for us kept us going” (p. 404).

Highlighting the roles and factors influencing co-teaching based on their study in the United States and in Australia, Rice and Zigmond (2000) discussed the significance

of administrative support for co-teaching. The authors indicate that most secondary teachers had a negative attitude toward inclusion and did not believe that either they or their students would benefit from in-class support provided by a special educator. In addition, the authors found in both countries that less experienced teachers and social studies teachers were more welcoming and “less territorial” than their more experienced colleagues. Schools in which principals or vice-principals valued co-teaching and demonstrated strong leadership were able to minimize these negative perceptions.

Scruggs et al. (2007) found administrative support to be one of the “expressed needs of co-teachers” and highlight several studies that documented the need for administrative support for making co-teaching partnership successful. The authors also pointed out that administrative support in co-teaching is not a stand-alone component; it is linked to other essentials in co-teaching such as planning time, training, and personal and professional compatibility.

The above studies suggest that strong leaders and administrative support provide co-teachers an environment that is conducive to implementing a co-teaching program. Co-teaching is not confined to two teachers in a classroom; it requires a support system to change conventional perceived roles make it successful.

Role Identity

Identification of roles is essential for effective co-teaching. Researchers and professionals in the field advocate clarity and equity in roles of co-teachers. Literature highlights that in most cases the special education teacher adopt the role of supporter,

assistant, behavior analyst, or manager, and seldom a lead teacher, especially at the high school level.

Cook and Friend (1995) suggested that both teachers—regular and special education—must understand their changed roles and comprehend the specification of their role responsibilities in order to make co-teaching a successful experience. Identifying factors and characteristics that enhance successful collaboration between co-teachers at the middle and high school level, Dieker (2001) developed a model that could be implemented by secondary level co-teachers. The study included data collected from seven middle school co-teaching teams and two high school co-teaching teams from seven different schools. The following tools were used to collect data: classroom observations, interviews of students and teachers, and teacher journals documenting planning time. In the discussion section the author indicated that the co-teaching teams emphasized the significance of “role definition” and clarity to avoid confusion. The author also observed that most of the special educators adopted the supportive role and were not active contributors in either planning or implementing the lesson.

The finding of the Tent’s (1998) study indicates a positive chemistry between a general education teacher and a special education teacher, but there was a clear divide between their roles. The general education teacher mentioned in these studies was the content expert. The special education teacher took care of curriculum adaptations and modifications and classroom organization. Her role included developing modified study guides and fill-in-the blank sheets. She also checked for supplies and graded students on bringing appropriate materials to class. The special education teacher believed that she brought skills different from the regular education teacher and that part of her mission

was to make information more accessible to all students in the class and advocate for students with disabilities. Despite of having clearly defined roles, the special education teacher always had concerns about her role and felt she was not using her specialized training optimally in this relationship. She said, “I do not feel I’m wasting time, but sometimes I do not feel I’m earning my money when they are doing a basic lecture” (p. 506).

Similarly, in the findings of four co-teaching case studies Mastropieri et al. (2005) pointed out that role division and interchangeability of co-teachers varied across teams and content areas. In most cases the general education teachers were the content experts and the special education teachers played a supportive role. Two teams co-teaching science in the upper elementary and middle schools had outstanding working relationships and took ownership of all students in the class. Co-teachers in the elementary school frequently exchanged roles. On the other hand, social studies co-teachers in the middle school had more pronounced division of roles and followed a lead and support model. Rarely the special education teacher took the lead role and provided instruction to the large group. The authors think one of the reasons for this was a distinct teaching style, which created conflict in their collaboration. The chemistry and world history co-teachers in the high school settings clearly followed the model in which the regular education teachers took the lead role and the special education teachers adopted the supportive role. The authors highlight the following reasons for such division of roles: academic content, high-stake testing, and co-teacher compatibility.

Welch (2000) conducted a descriptive analysis of team teaching in two classrooms at the elementary school level and found that teachers in the study preferred

the lead-support model of team teaching, where the general education teachers took the role of content knowledge expert and the special education teachers provided either technical or remedial support. The author was not clear as to why the teachers selected the lead-support model for large group instruction in both schools. According to the author, it could be “the result of general education teachers’ predisposition of planning for and teaching to an entire class” and “maintained the traditional professional roles” (p. 373).

In contrast, Morocco and Aguilar (2002) focused on interdisciplinary co-teaching relationships at the middle school level instead of the traditional co-teaching partnership between a special and a general education teacher. They found that special education teachers were engaged in all and the same instructional roles as were the content teachers, but they contributed differently on seven pre-determined roles: set up, motivate, instruct, monitor, manage, assist, and confer. The sample for the study included 11 teachers with limited teaching experience at sixth, seventh, and eighth grade levels. There were four interdisciplinary teams. The authors implemented the following methods to collect data for the study: observations and interviews. Special educators in Teams 1 and 3 engaged less in providing feedback and monitoring while the special education teacher in Team 2 was actively involved in providing feedback and monitoring students. Overall, special education teachers provided less substantive content knowledge than did their content-area colleagues and they were more involved in providing individualized instruction. One first-year language arts teacher was not comfortable in a co-teaching situation and left the school after her first year. The authors suggested the following essentials for successful

co-teaching partnerships: “collaborative school structures, equal status rules for teachers, a commitment to all students learning, and strong content knowledge” (p. 342).

In an ethnographic study, Naraiian (2010) highlighted the teaching experiences of a dually-certified special education teacher co-teaching with a general education teacher in first grade. Even after working as the lead teacher for several months when her general education co-teacher went on a maternity leave, she had to take a “back seat” supportive role when the other teacher returned. However, the temporally change in the roles provided an opportunity for the special education teacher to prove her ability to take the lead role and she felt empowered in the process.

Several studies in the meta-analysis of co-teaching studies conducted by Scruggs et al. (2007) indicated that “turf” could be a potential factor in determining the subordinate role of special education teachers in the co-teaching partnership. In most of the articles, special education teachers said they felt like an intruder and found it difficult to fit into the general education teacher’s classroom. In some articles, regular education teachers considered themselves the content specialist but valued the skills that special education teachers brought to the classroom. The studies highlighted the following contributions of special educators in the co-teaching partnership in inclusive settings: supporting the traditional role of general education teachers, modifying the curriculum, providing temporary assistance to students, modifying and modeling behaviors to students, checking for resources, developing classroom layouts, collecting assignments, and occasionally taking the lead role in providing substantive instruction.

Likewise, Rice and Zigmond (2000) identified the following roles of special education teachers in co-taught classrooms in the United States and in Australia. These roles were: (a) performing clerical duties—taking attendance, receiving and giving out passes, record-keeping on homework assignments, (b) assuming a helper role—identifying students who were struggling with the concept and redirecting students who were off task, (c) monitoring students in computer labs or students taking tests in a separate room, and (d) researching resource and supplemental materials for regular education teachers in the content areas. One special education teacher assumed her role was to model appropriate behavior in the class for special needs students. She said, “The first year I was a model for the students. Often, if [the subject teacher] is lecturing, I would do the notes on the overhead projector to model note-taking” (p, 195). The authors highlight that special education teachers in Pennsylvania were rarely observed as active contributors in a co-teaching partnership than their colleagues in Queensland, Australia. Although two teachers considered their co-teaching model as “an enmeshing of our abilities,” the authors considered “they were clearly not equal partners” (p. 195).

Weiss and Lloyd (2003) conducted a grounded theory qualitative research study to identify the roles and mediating factors that influence special educators at the secondary level in co-taught classrooms. The findings of the study highlight the following roles that special education teachers adopted, which to a large extent were influenced by their perception of co-teaching: “(a) providing support to students, (b) teaching the same content in separate classroom, (c) teaching a separate part of the content in the same classroom, and/or (d) teaching as a team” (p. 32). The authors also highlight that for co-teaching to be successful, expectation guidelines must be developed

at the administrative level as well as at the classroom level in addition to clear school district policy about co-teaching.

Voicing the experiences and struggles of co-teachers at the secondary school level, Keefe and Moore (2004) highlight that even though most teachers struggled with their roles within the context of the co-teaching partnership, the struggle varied from team to team. Several special education teachers felt there was no clear understanding or conversation between the teachers about who should do what. One special education teacher said, “But there was never any discussion about what my role or their role would be.” A general educator said, “...it’s just here, you’re working with so-and-so, and they do not have a clue what their job is, either party really” (p. 83). The authors pointed out that most special education teachers agreed to help individual students and design modifications. General education teachers took the lead role and shouldered responsibility for the curriculum, planning, and teaching to the large group. Some special education teachers felt their regular education colleagues treated them like an educational assistant; one special educator said, “...it can be as insulting as, ‘I need some coffee’” (p. 83).

It’s clear that one important reason for the supportive role of special education teachers in co-teaching settings is lack of content knowledge. Many special educators do not feel comfortable either taking the lead role or actively engaging in teaching activities in the classroom. However, in the Narian’s (2010) study the special education teacher did take a lead role and provided substantive instruction in the absence of the regular education teacher. She could take the lead role because of her strong content knowledge; even so, she was not supported by the regular education teacher, who considered herself

the content expert. A teacher must know and understand the content before she teaches; with the blurring of boundaries, special education teachers who are engaged in providing instruction need to have content knowledge familiarity.

Content Knowledge

Another essential for effective co-teaching is content knowledge. This essential is contested in the field. Some researchers believe that special education teachers in collaborative and co-taught classes bring knowledge of pedagogies and that general education teachers are content knowledge experts. These researchers believe there is no need to duplicate expertise, that collaboration can be effective because harmony exists between professionals (Mckenzie, 2009). Others believe and have established that content familiarity allows special education teachers to take the lead role in co-teaching partnerships (Mastropieri et al., 2005; Keefe & Moore, 2004).

The importance of content knowledge emerged as one of the themes under “roles of the teachers” in Keefe and Moore’s (2004) study. The authors highlight that “overall these teachers struggled with their roles within the content of co-teaching...there was great variability across the teams” (p. 83) and a major factor for the limited role of the special education teachers was their lack of familiarity with the core content. Because content knowledge is more challenging in high school than in elementary school, the authors believe that limits the role of special educators in high school co-teaching settings. One general education teacher said, “...was more of hindrance than a help in the room because it was another person who didn’t know her materials” (p. 84). A special education teacher said, “You have to know the curriculum. You have to know the subject

area. Because if you don't they don't trust you, you can't help them as much, it just doesn't work out" (p. 84). The author pointed out both special and general teachers suggested that special educators must be familiar with the content knowledge in order to be more comfortable teaching core content areas.

Likewise, knowledge of content materials emerged as a significant contributor to co-teaching success in Mastropieri and her colleague's (2005) study. The authors found that with simpler and more familiar content, such as in an ecosystem class, the special education teachers were actively engaged and shared classroom responsibilities. With subjects such chemistry or world history, where they had less expertise, special education teachers were more likely to adopt supportive roles. The general notion that special education teachers bring knowledge of pedagogies and that general education teachers bring knowledge of content in the co-teaching partnership did not hold true in this study. The authors believe it was content knowledge that determined who would take the lead role or whether to split the instructional role equally.

Similar results were observed in the meta-analysis of co-teaching conducted by Scruggs et al. (2007), who determined that most special education teachers took the subordinate role in the instructional partnership. Several studies pointed out that special educators in the co-teaching partnership assumed a backseat role and carried out duties other than found in the lead role. Some of the studies indicated that special educators adopting the supportive role is more common at the high school level than in elementary schools. Others believe it was a common observation at all grade levels. They believe content knowledge could be significantly associated with the subordinate role of the special education teachers.

Weiss and Lloyd (2003) explained that content knowledge was one of the essentials that influence the role of special educators. The authors studied six special education teachers in middle school and high school. The sources for data collection were: observations, interviews, and documents. The study found that special education teachers adopted four different roles in co-taught classes, though some of the models they implemented did not reflect co-teaching. These roles were: “a.) providing support to students, b.) teaching the same content, c.) teaching the same content in a separate class, and d.) teaching as a team.” The authors further indicated that the special educators at the high school adopted a supportive role because of less familiarity with content.

One of the six themes that emerged from Rice and Zigmond’s (2001) study was that “special education teachers must often prove themselves capable of making a unique and substantive contribution,” indicating the role of content knowledge in the co-teaching partnership. Even though special education teachers were known to have patience and devotion to students with disabilities, they did not have equal status in the co-teaching partnership. Special education teachers must constantly prove that they can teach and share equal responsibilities at the secondary school level. One special educator, acknowledging the importance of content knowledge, said, “It is difficult to teach what you are not trained to teach” (p.195).

Morocco et al. (2002) found that even though both content and special education teachers were actively involved in providing instruction, the role of special education teachers varied across the teams and core content areas. The authors provided a description of the role of special education teachers in three different teams that included at least one content teacher and at least one special education teacher. All the teachers,

whether general or special education, had no more than five years of teaching experience. In one such team, the authors pointed out the changing roles of one special education teacher at the eighth-grade level who was paired with three content area teachers. She and her math and geography partners took equal responsibilities in the classroom. Her role changed in partnership with the language arts teacher, where she adopted more of a support role. However, the authors quoted someone who observed two math activities conducted by the special education teacher: "Instruction was confusing and not always mathematically competent," thus raising the question of content knowledge expertise.

There is a scant literature on content knowledge and the contributions of special education teachers in terms of example, addressing in-class activities or teaching pedagogies either as a lead teacher or in a support role within the context of a particular content area. Most studies talk extensively about the importance of the special education teacher's content knowledge in collaborating with general educators, deciding roles and responsibilities, and developing professional compatibility. Morocco et al. (2002), highlighting the results of a third research question, provided an example of the contribution made by a special education teacher in a science lesson about plate tectonic and movement and the formation of Earth's crust. The special education teacher chimed in when she sensed confusion among the students. She provided a metaphor about a surfboard and said, "The lithosphere moving the continents is like the ocean moving a surfboard." (p. 341) With the active contribution of the special education teacher, the lesson became a "duo-lecture" where the general education teacher explained the concept and the special education teacher provided examples and answered questions.

In addition to lack of content knowledge, there could be another explanation for the “back seat” role of special educators. Perhaps it is a lack of knowledge of subject-specific pedagogies and multiple ways to present information to a diverse student population—pedagogical content knowledge (PCK)—that prevents special education teachers from taking an active role in co-teaching partnership.

Pedagogical Content Knowledge

Tracing the history of content and pedagogy in academia, Shulman (1986) says that there always has been a “sharp distinction” between the two, that a professional possess an expertise in either content or pedagogies and is not accountable for the other. He believes that this distinction is newly constructed, that a century ago the “Defining characteristics of pedagogical accomplishment was knowledge of content” (p. 7). Shulman and his colleagues (1986) introduced the term pedagogical content knowledge (PCK) while conceptualizing the significance of the professional knowledge base needed for effective teaching. Shuman used this phrase while giving the presidential address to the American Education Research Association. He explained that PCK is teachers’ understanding of how students comprehend the specific subject matter. PCK is concerned with the ways of representing and formulating subject matter that make it comprehensible to others. Shulman defined PCK as:

...the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations—in a word, the ways of representing and formulating the subject that makes it comprehensible to others. Since there are no single most powerful forms of representation, the teacher must have at hand a veritable armamentarium of alternative forms of

representation, some of which derive from research whereas others originate in the wisdom of practice (p. 9).

PCK includes a wide array of teaching strategies ranging from examples to analogies to demonstrations, which a teacher acquires as a result of the teaching experience and from research. Further expanding on Shulman's definition, Magnusson, Krajcik, and Borko (1999) defined PCK:

Pedagogical content knowledge is a teacher's understanding of how to help students understand specific subject matter. It includes knowledge of how particular subject matter topic, problem, and issues can be organized, represented, and adapted to the diverse interest and abilities of learners, and then presented for instruction...the defining feature of pedagogical content knowledge is its conceptualization as the results of a transformation of knowledge from other domain (p. 96).

Knowledge of content and of the needs and struggles of students are two other essentials of PCK that help a teacher choose an appropriate strategy for teaching a specific concept within a particular core content area.

Differentiating between pedagogical content knowledge and that of a content specialist such as a scientist, Cochran, King, and DeRuiter (1991) defined PCK:

Teachers differ from biologists, historians, writers, or educational researchers, not necessarily in the quality or quantity of their subject matter knowledge, but in how that knowledge is organized and used. For example, for experienced science teachers, knowledge of science is structured from a teaching perspective and is used as a basis for helping students to understand specific concepts. A scientist's knowledge, on the other hand, is structured from a research perspective and is

used as a basis for the construction of new knowledge in the field (p. 5).

The authors of this definition highlight the basic difference between the pedagogical content knowledge of a teacher and a scientist. Even though both are content knowledge experts to one degree or another, a teacher can transform that information in a way that is accessible by the students. A scientist would use that knowledge to construct new information in the field.

Shulman and colleagues' (1986) ideas about PCK captured widespread interest and much has been written since then. Articles, research reports, and book chapters have focused on PCK in variety of subject area such as math, science, higher education, and music. Ball and her colleagues (2008) conducted a survey of the literature and were surprise to find that almost one fourth of these articles were about science. Math was the next most discussed content area.

Models of Pedagogical Content Knowledge

There is no global PCK model; researchers have explained it differently in terms of components in the field. Shulman (1987) explained two dimensions of PCK: knowledge of student misconceptions and errors and knowledge of representation of subject matter. Based on Shulman's two-component model of PCK, several conceptualizations exist in the literature. For example, Grossman's model of PCK (1990) included knowledge of representations and strategies, student learning and conceptions, curriculum available for teaching, and purposes for teaching a particular subject. Building on Grossman's model, Magnusson, Krajcik, and Borko (1999) conceptualized PCK for science teaching as consisting of five categories. In this model, components included orientation toward science teaching, knowledge about science curriculum, knowledge

about students' understandings of specific science topics, knowledge about assessment in science, and knowledge about instructional strategies for teaching science. Ball and her colleagues (2008) further expanded on Shulman's model of PCK and included knowledge of content and students, knowledge of content and teaching, and knowledge of curriculum. Most of these models exist in regular education and focus on a specific content knowledge in areas such as math, science, or English. The development of them did not necessarily consider either students with disabilities or special education teachers. In this study, I used Ball's PCK model to comprehend the role of the special education teacher's pedagogical content knowledge in co-teaching biology in a high school setting. In this section, I have explained Shulman's model followed by Ball's model of PCK.

Shulman's Model.

Shulman's model of teachers' knowledge has three categories: (a) subject matter knowledge, which is further divided into syntactic knowledge and substantive knowledge; (b) pedagogical content knowledge, which is further divided into knowledge of comprehensible representation and knowledge of learners' difficulties; and (c) curricular knowledge, which is divided into lateral curriculum knowledge and vertical curriculum knowledge.

Subject matter knowledge.

Teachers' content knowledge is the knowledge a teacher possesses of the content of a subject. It refers to factual information, organizing principles, and central concepts. Shulman (1986) explains that knowledge of content should not only contain factual information; it must also embody the ground rules and organizing principles of the

content. Thus, a teacher must know the ‘why’ and ‘how’ of a concept in addition to ‘what.’ In addition to clearly defining and analyzing these concepts, an expert in the content area is able to explain the underlying connections and relationships among these concepts. Shulman divided content knowledge into the following three categories: substantive structures, syntactic structures, and teacher beliefs. Substantive structures are different modes in which the explanation of basic concepts and principles of the discipline are coordinated to incorporate its facts. Mostly, teachers acquire knowledge about the substantive structures of their discipline in undergraduate and graduate course work during which they get acquainted with various theories and principles related to that specific content area. Syntactic structures provide a means for establishing the reliability and validity of the information in the discipline. Academic subjects do not survive only on concepts and organizing frameworks; new knowledge is brought constantly into the field and members use the means provided by syntactic structures to guide further inquiry. Teacher beliefs are the ways teachers perceive the nature of the subject matter in relation to how they learn and how they will facilitate this information to their students. Teacher beliefs also embrace the experiences teachers have in content and methods courses.

Pedagogical content knowledge.

Shulman explained pedagogical content knowledge as knowledge of learner’s difficulty and knowledge of comprehensive representation. Knowledge of learner’s difficulty includes students’ understanding, experiences, conceptions, and misconceptions related to a particular topic. In order to develop new schemas or construct new information, teachers must have knowledge of students’ comprehension level as well as

their misconceptions about a topic. Teachers could provide meaningful situations in learning to modify and construct new schemas of information. Knowledge of comprehensive representation embodies different ways of presenting a concept to students in order to satisfy their diverse needs. A teacher could use analogies, illustrations, examples, explanations, and demonstrations to project information in such a way that it is easily comprehended. Pedagogical content knowledge is a set of special attributes that help a teacher transfer content knowledge using different teaching modalities to make it comprehensible. Pedagogical content knowledge is a special combination of content and pedagogy that is uniquely constructed by teachers; thus it is the "special" form of an educator's professional knowing and understanding. Pedagogical content knowledge also is known as *craft knowledge* (Berry, Loughran, & van Driel, 2008).

Curricular knowledge.

Curricular knowledge includes the full range of program design required to teach a particular subject as well as the instructional material available in those programs in accordance with age and grade levels. This embodies anything from motivational activities to course projects to learning activities of a topic in a specific subject within the broader framework of standards and purpose of teaching that subject. Shulman classifies this into two groups: lateral curriculum knowledge and vertical curriculum knowledge. Lateral curriculum knowledge informs a teacher what students have learned in previous grade levels and in other subjects. This helps a teacher to understand the comprehension level of students in relation to that specific subject and to decide on strategies for imparting new knowledge. Vertical curriculum knowledge, on the other hand, includes

the familiarity of topics and issues that students would be learning in future classes (Ball et al., 2008).

Ball and her colleagues (2008) further expanded Sulman's components of teacher knowledge base and created a modified model of PCK.

Ball's Model.

Ball and her colleagues (2008) investigated the nature of professional subject matter knowledge by analyzing mathematic classroom teaching and the content knowledge needed to teach math. In addition to developing the measures of teacher content knowledge, Ball expanded Shuman's PCK model and added two categories under Shuman's content knowledge category. Ball's PCK model contains three components: knowledge of content and students, knowledge of content and teaching, and knowledge of curriculum.

Knowledge of content and students.

Ball defined knowledge of content and students as "knowledge that combines knowing about students and knowing about mathematics [content]." Knowledge of content and students includes the needs, struggles, motivation, and interests of diverse groups and specific mathematical understanding that recognizes and identifies topics in any given concept that are either hard to comprehend or confusing. Ball provided the following indicators or components that constitute knowledge of content and students: "(a) when choosing an example teachers need to predict that students will find interesting and motivating, (b) when assigning a task, teachers need to anticipate what students will like to do with it and whether they will find it easy or hard, and (c) teachers must also

able to hear and interpret students' emerging and incomplete thinking as expressed in the ways that pupils use language" (p. 401). Ball provided examples to explain this component. In one, she talked about a subtraction problem, 307 minus 168, and explained that a teacher who could identify and anticipate the most likely student errors exhibits knowledge of content and students.

Knowledge of content and teaching.

Ball defined knowledge of content and teaching as "knowing about teaching and knowing of mathematics [content]." Knowledge of content and teaching embodies understanding student comprehension levels, sequencing a topic accordingly, and identifying and implementing multiple ways to represent the concept (such as providing examples, conducting activities, or narrating experiences). Ball included the following elements in this category: "(a) teacher sequence particular content for instruction, (b) they [teachers] choose examples to start with and which examples to use to take students deeper into the content, and (c) teachers evaluate the instructional advantage and disadvantage of representations used to teach a specific idea and identify what different methods and procedure afford instructionally" (p. 401). Explaining this component, Ball emphasizes that teachers must make instructional decisions regarding "when" and "how" to involve students in the lesson, where during the discussion they should pause and check for understanding or ask students probing question to ensure comprehension and engage them in critical thinking about the content. Ball explained a teacher must understand the rationale for implementing different strategies to teach a specific concept and how to effectively use them. The authors emphasized that teachers must understand how one teaching strategy is different from another and cautioned about limiting the

conceptual information to procedural aspects “in order to make the mathematical issues salient and usable by students” (p. 402).

Knowledge of curriculum.

The authors mention that they have provisionally placed Shuman’s third category, curriculum, within the PCK model, but they were “not sure whether this may be a part of our category of knowledge of content and teaching or whether it may run across the several categories or be a category in its own right” (p. 403). Assuming that the authors adopted Shulman’s definition and components for knowledge of curriculum in their model, I adopted Shulman’s definitions and two components of knowledge of curriculum in this study. This is Shulman’s definition of curriculum knowledge:

Represented by the full range of programs designed for the teaching of particular subjects and topics at a given level, the variety of instructional materials available in relation to those programs, and the set of characteristics that serve as both the indications and contraindications for the use of particular curriculum or program materials in particular circumstances (p. 391).

Curriculum knowledge constitutes knowledge of resources, teaching strategies, and instructional materials that a teacher could use while teaching a specific concept within the context of a particular core content area. This knowledge also includes understanding the pros and cons of those instructional materials and teaching pedagogies. As explained earlier, Shulman divided curriculum knowledge into two components: lateral curriculum knowledge and vertical curriculum knowledge. Lateral curriculum knowledge includes information and knowledge that students learn in other classes or core content areas such as science, English, or social studies. Vertical curriculum

knowledge includes information or knowledge in same content areas, which student either bring with them from the previous classes or would be learning in future classes.

Summary

Co-teaching is defined as an instructional relationship between two teachers in inclusive settings influenced by essential elements such as communication, planning time, role identity, and content knowledge. A few studies highlight the contributions of the special education teachers as equal in co-teaching. A few studies provide a detailed description of those contributions in co-teaching content-focused contexts. Nothing in the literature situates these contributions within the framework of pedagogical content knowledge and explains how this knowledge helped a special educator to identify and resolve an error committed by a student or to anticipate where and why in the lesson students might struggle. Additionally, it does not provide fine-grained analysis of these contributions within a specific content area such as social studies or science.

CHAPTER 3

Methods

This chapter describes the research design, which provides a blueprint, a logical plan, or a roadmap of the study in seeking and providing answers to at least four major questions: what research questions are under study, what data are considered relevant, what data sources are tapped into, and how the data are analyzed (Yin, 2009). Moreover, a research design helps a researcher to avoid unsuspected slippage and continue to be on track as moving along in the research process.

This is a case study identifying the contributions of a special education teacher in a high performing co-teaching team. This study also explores the contributions of a special education teacher co-teaching science at the high school level and the role of pedagogical content knowledge (PCK) in those contributions. Qualitative research is considered a social inquiry process used to understand a problem or an issue in its natural settings. Creswell (2007) defines qualitative research as an inquiry process that “begins with assumptions, a worldview, the possible use of a theoretical lens, and the study of research problems inquiring into the meaning individuals or groups ascribe to a social or human problem” (p. 37). According to this definition, qualitative research focuses on the richness and complexity of an issue or a problem within a social construct and often results in multilayered descriptions involving different perspectives.

Characteristics of Qualitative Research

A comprehensive definition of qualitative research by Denzin and Lincoln (2005) highlights some of the characteristics and empirical tools used in conducting this research:

Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible. These practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations, photographs, recording, and memos to the self. At this level, qualitative research involves an interpretive, naturalistic approach to the world. This means that qualitative researchers study in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meaning people bring to them. (p. 3).

Qualitative research is an inquiry process, which is conducted in a natural setting to understand the phenomenon by making sense of the information collected through multiple resources such field notes, interviews, document and memos.

Creswell (2007) further explains the following characteristics of qualitative research as a social inquiry process: (a) natural settings—in qualitative research, a researcher collects data in their natural settings and attempts to make sense of or interpret phenomena in terms of the meanings people bring to them, what Patton (2002) calls an "empathic neutrality" (p. 55); (b) researcher as key instrument—in qualitative research, the researcher is the fundamental data collection instrument who gathers the information, keeping in mind the dynamics of the setting(s) and the participant(s); (c) multiple sources of data—often, in qualitative research, multiple forms of data such as interviews, observations, or document analysis are collected to project a holistic picture of an issue or a problem rather than relying heavily on a single set of data; (d) inductive data analysis—typically, a qualitative researcher builds themes from the “bottom-up” by maneuvering through the data and going back and forth between the themes and the information

gathered to increasingly yield multiple levels of abstraction; (e) participants' meaning—in qualitative research, the phenomenon of interest is understood from the perspectives of the participants in the study and not from what the researcher brings to the research or what is drawn from the literature; (f) emergent design—in qualitative research, a researcher enters the field with an open mind and a road map to guide the way through the process, and not with a tightly prescribed research design as it often evolves during different phases of the process; (g) theoretical lens—typically, qualitative studies center on a social, political, or historical construct of the problem under inquiry; (h) interpretive inquiry—in qualitative research, researchers assign meaning to or interpret what they observe, hear, and infer, which is influenced by researcher's own experiences and prior understandings; qualitative research, in addition, provides a platform from which readers can make interpretations, thus projecting multiple views of an issue or problem under study; and (i) holistic account—in qualitative research, the researcher approaches a problem or an issue through multiple perspectives, develops a multidimensional picture, throws light on various factors involved in the situation, and crafts a holistic and a complex account of the problem under study.

Using a qualitative framework and the exploratory case study approach, this study addressed the contributions of the special educator in relation to knowledge of content (CK) and pedagogical content knowledge (PCK) including an attempt to identify his PCK using Ball's framework. It also explored a way to examine content knowledge. There were two related purposes within this study. The study examined the involvement of a special education teacher in multiple aspects of co-teaching at the secondary education level. Two research questions drove this inquiry: What contributions did the special

education teacher make in co-teaching biology? How can we apply Ball's conceptions of PCK to the special educator in co-teaching?

Case study Methodology

A case study approach was identified as the appropriate methodology. Stake (1995) defines case study as “the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances” (p. xi) It can be concluded from the definition that case studies typically examine the interplay of all and/or different factors in order to provide as complete and comprehensive an understanding of an event or situation as possible. This type of comprehensive understanding is arrived at through a process known “thick description.” The term, coined by Geertz (1973), means to provide a careful and extensive description of time, place, context, and or culture so that readers are able to understand the intricacy of the settings and participants and make judgments about the applicability of the research findings (Mertens, 2009).

The case study method provides an opportunity for the researcher to answer “how” and “why” questions about a contemporary set of events, where the investigator has little control. A case is defined as a “unit of analysis” that includes a detailed contextual analysis of an individual, an event, or a phenomenon within certain parameters that help in defining the research (Yin, 2009). Furthermore, Merriam (1998) explained that a case is a bounded phenomenon and defines it as “an intensive, holistic description and analysis of a single instance, phenomenon, or social unit” (p. 21). A case study occurs concurrently with a chosen phenomenon and is designed to bring out the details from the viewpoint of the participants by using multiple data sources such as interviews,

artifacts, observations, and/or documents. Creswell (2007) highlighted that the purpose of analysis of different data sources in case study is to conduct either a “holistic analysis of the entire case or an embedded analysis of a specific aspect of the case” (p. 75) and indicated that in case study the research plan evolves and emerges as a researcher enters the field and initiates the data collection. However, the focus remains on a problem or an issue under study. Typically, case research study design embraces five significant components: research question(s); boundaries of a case or its proposition; its unit(s) of analysis; multiple data sources; and a strategic scheme for data analysis and interpretation (Yin, 2009).

The rationale behind selecting the method for this study was that this helped to explore in-depth information about what a special education teacher brings to co-teaching in science, especially biology, by closely tracing the contribution made by him situated in the instructional partnership. The case study method provided me an opportunity to look at the connection between content knowledge and the contributions of a special education teacher co-teaching in a natural setting within a bounded context.

Case studies are generally grouped into two categories: (a) the single or multiple case study and (b) the intrinsic or instrumental case study. The intrinsic case study approach focuses on a unique phenomenon. The researcher must be able to define the uniqueness of this phenomenon that distinguishes it from all others; this may be based on a collection of features or the sequence of events. The instrumental case study is done to provide a general understanding of a phenomenon using a particular case. Studying an unusual case may help illustrate subtle matters overlooked in a typical case. Although much case study research focuses on a single case, often chosen because of its unique

characteristics, the multiple-case studies design allows the researcher to explore the phenomenon under study through the use of multiple cases (Stake, 1995).

This is a single case study of a special educator within a co-teaching team. The co-teaching team comprised a special education teacher and a general education teacher in a content area—science. The boundaries of this case were set in terms of selection criteria, time, and processes. This study used the instrumental case study approach to illustrate the co-teaching contributions of a special educator paired with a general education teacher in an inclusive setting at the high school level. This approach was instrumental in understanding the contributions of the special educator in day-to-day co-teaching and the rationale of those contributions. The results of this study could be used as a basis to conduct future research to understand the co-teaching phenomenon from different perspectives within in the similar contextual framework.

Interpretive Framework

An interpretive framework was used as the theoretical stance in terms of the study's methodology. Interpretive research assumes that reality is socially constructed and the researcher becomes the vehicle by which this reality is revealed (Walsham, 1995a). In an interpretive study the researchers make meaning or interpret what they see, hear, and understand, thus providing a deep insight into “the complex world of lived experience from the point of view of those who live it” (Schwandt, 1994, p. 118). This approach is consistent with the construction of the social world characterized by interaction between the researcher and the participants (Mingers, 2001). Interpretations of results in an interpretive approach are typically influenced by the researcher's own experiences, history, context, and orientations. Often, interpretive studies provide a

platform readers can use to make their own interpretations about the results within the context (Creswell, 2007).

This study uses an interpretive framework to describe the experiences of a special education teacher co-teaching in a content area, specifically science, with a general education teacher at the high school level. The descriptive insight emerged from experiences and contributions of a special education teacher and provided a window into the interactions between that teacher and the general education teacher as they planned, instructed, and assessed together. The researcher, through the shared experiences of a special education teacher, will try to understand these contributions in relation to CK and PCK of special education teachers in co-teaching.

Participant Selection

Given that the purpose of the research was to identify the contributions of a special education teacher in relation to content knowledge (CK) and pedagogical content knowledge (PCK)—looking at PCK using Ball’s model—at the secondary education level in the teaching of science, a purposeful sampling method was used to identify a single high performing co-teaching team consisting of a general and a special education teacher at the high school level. Patton explains that purposeful sampling is based on “the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned” (p. 169). As a researcher, I wanted to identify and understand the contributions of a special education teacher in a high-performing co-teaching team and his or her or her rationale for making those decisions. In addition to purposeful sampling, this study implemented a criterion-based sampling model to identify and select a co-teaching team consisting of a special

education teacher and a general education teacher. Criterion-based sampling method is explained as a method that involves selecting cases that meet some predetermined criterion of importance (Patton, 2002). This sampling method helped the researcher predetermine what constitutes a high performing co-teaching team. The high performing co-teaching team was the unit of study in this research project.

Selection Criteria

Selecting a case or a unit of the study is described by Stake (1995) as one of the most critical steps in conducting a case study. Yin (2009) suggests two criteria in selecting a case: (a) choose a case that best illuminates the issue at hand, and (b) consider the access factors involved with the particular case chosen. This study incorporated Yin's first criterion, choose a case that best illuminates the issue at hand, and used the following selection criteria in identifying a high-performing co-teaching team: (a) co-teaching team—the team comprised experienced special and general education teachers, (b) content area dyads—co-teachers were teaching in a core content area such as math or science, (c) student achievement—co-teachers facilitated growth in student learning in children with and without disabilities over a period of one academic year, (d) single certification—both special and general education teachers did not poses a dual teaching certification license, (e) principal's nomination—a co-teaching team was considered an effective or model team by the principal, and (f) general education curriculum—both teachers were involved in all or different aspects of teaching and ensured that instruction was carried out in the general education curriculum with both teachers present.

Selection Process

A two-tiered strategy was used in order to identify the co-teaching teams in this study. The first tier of the process was an initial identification of a team through a referral by university faculty who were familiar with area high schools in which co-teaching occurred. Faculty nominated four or five co-teaching teams in four different high schools, both urban and suburban. Before contacting the faculty for nominations, I completed all Instructional Review Board (IRB) Requirements. Because the study did not focus on collecting student data in the schools, it was exempted from the comprehensive review process and was approved. The second tier of the selection process was to seek a principal's nomination of a co-teaching team from the suggested schools.

The selection process included the following three pre-determined phases. Phase one—solicit the nomination from the principal and then contact and inform both teachers the purpose of the study and the expectations. Phase two—ask to do an informal observation of interested teachers and decide whether the setting was appropriate for the study. If the setting was not appropriate, contact another principal and continue the process until a team was selected. Phase three—meet with teachers who agreed to participate and explain the study and the expectations in detail.

On meeting with the first principal early in December 2011, I presented the details of the study and the selection criteria. The principal recommended a co-teaching team in that school that met the selection criteria. After getting the recommendation, I emailed the special education teacher on December 10 about my research project and asked him whether he and his regular education co-teacher would be interested in participating in my dissertation research project. I received a quick positive response indicating their

interest in the study and suggesting a few meeting options. Even though the principal acted as a “gatekeeper” (Glesne, 2006) in gaining access to the co-teaching team, the decision to participate in the study entirely depended upon the team’s interest in the study. After several emails back and forth, I met with both teachers, general and special education, and informed them about the purpose of my study and expectations for interviews and observations. Additionally, I got their approval to conduct an informal observation in order to help determine whether the setting met the criteria for the study. In December 2011, after conducting an informal classroom observation and interacting with both teachers, I decided to conduct my study in that first high school. Once the school was selected and both teachers agreed to participate, I worked on the schedule of visits with input from both teachers. I shared this schedule with the principal and maintained contact with the principal via email throughout data collection.

I then embarked upon rapport-building strategies in my study. First, I began to develop trust by ensuring teachers that information provided would be used only for research purposes and would be confidential. Second, I conducted interviews in a comfortable environment where teachers would feel relaxed and willing to talk on different aspects. Third, I fostered reciprocity by letting both teachers know that their information would not only help me in completing my research, but that it would also allow me to make suggestions to improve instruction in teacher preparation programs. Marshall and Rossman (2006) pointed out the significance of reciprocity relationships, allowing the researcher to collect valuable information. They believe it is essential for the researcher to understand that “When people adjust their priorities and routine to help the researcher, or even just tolerate the researcher’s presence, they are giving of themselves.

The researcher is indebted and should be sensitive to this” (p. 81). Last, I was appropriate in speech and behavior by monitoring my behavior so that both teachers became accustomed to my presence while planning and teaching a lesson (Glesne, 2006).

Description of the research site—Green Valley High School

Green Valley High School is located in a suburb of a large metropolitan city in the Midwest with a population of 70,718 (U.S. Census Bureau, 2010). This suburb appeared in the *Money Magazine* "100 Best Places Live" in the nation and was recognized for the second consecutive year on Forbes.com's "Best Schools for your Housing Bucks" list (School's Annual Report, 2010-11). Green Valley High School is a part of the BigWay school district, which has two high schools, two middle schools, six elementary schools, and one special education county cooperative. It serves approximately 7, 000 resident and non-resident students. Green Valley High School is a four year public secondary school with approximately 1300 students enrolled in grades 9-12. In the school, 11% of students participate in the free lunch program. The student population is 83% white; 7% Asian; 6% African American; 2% Hispanic; and 1% other (school website). This school is a large rectangular two-story brick building with back and front yards, spacious classrooms, wide hallways, a roomy library, a large nature center, a cafeteria, commodious music rooms, and a theater. The hallways around the school displayed photos of achievements in scholastic and non-scholastic areas. Most of the classrooms in Green Valley High School have notebook computers for students and SmartBoards with Internet connection (field notes). There are 86 teachers in this school and the teacher-pupil ratio is 1:15. This high school is considered to have strong community support and an engaged parent-teacher association. The high school offers

extensive curriculum in art; business management and technology; English; foreign languages such as French, German, Latin, and Spanish; family and consumer education; applied technology and engineering; mathematics; music; physical education; science; and social studies. In addition, there are many advanced placement classes in subjects such as biology, calculus, and United States history. Green Valley High School provides ample opportunities for co-curricular activities such as athletics, music, clubs, drama, honor groups, and publications. Beginning in the 2011-12 academic year, Green Valley High School moved to a four-block Schedule, where each block is 97 minutes. Along with this, the school's traditional academic year was divided into four terms—terms one and two were considered one full academic year and terms three and four another. Initially, biology was a yearlong course; now it is half a year. This study was conducted in terms three and four, which started in January of 2012 and ended in June, 2012.

Co-teaching was initiated in the Green Valley High School approximately six years ago. Previously the school had self-contained classes with support for students with disabilities. Although the school still has a few self-contained classes with modified curriculum and limited access to regular education curriculum for students with severe cognitive disabilities, most of the students with disabilities are in inclusive settings. After shifting to the inclusive model, the school developed a policy limiting students with disabilities to no more than one-third of a class population.

In co-teaching, Green Valley High School follows three different approaches. In the first approach, a special education teacher collaborates with two or three regular education teachers in planning and implementing lessons. In this model, a special education teacher is in two or three different classes during the same teaching block. In

the second approach, a special education teacher collaborates with a regular education teacher to make sure that the needs of the students with disabilities are met through various support systems, but is not paired up for planning or implementing lessons. In the third approach, a special educator and a general education teacher co-plan and co-teach and are responsible for all students in the class. Both teachers are in the class for the full teaching block and engage in all and/or different aspects of the teaching-learning process. The co-teaching team selected for the study used this approach. The team consists of a general and special education teacher who co-taught science, specifically biology.

Description of the Classroom

The biology class selected for the study in the Green Valley high school had 27 students from grades 9–12, including three students with disabilities and three at-risk students. Some were taking the biology class for the first time; for others, this was their last class. Two freshmen, considered “average students” because their grades were not as high as their test scores, were encouraged to take a more challenging class. This diverse student population had varying levels of content knowledge. Typically, science classes in the school were capped at twenty-eight students because of lab space. The classroom was divided into two main sections. In one area, desks and chairs were strategically arranged so that teachers could have access to most students. The lab area had seven big lab tables and a number of stools. It also had a center table (island) and closets that contained specimens, tools, and equipment for conducting experiments. The classroom also had an greenhouse extension. It was equipped with a large whiteboard in addition to a Smartboard with an Internet connection. The teachers shared a big table in the sitting area of the class just in front of the whiteboard and across from the entrance. This table had a

computer and a sink on either side. In addition to large windows in the class, which provided a good source of natural light, the class had an adequate light and air system.

Description of Participants

The co-teaching team selected for this study consists of a general and a special education teacher, Kristine and Dan, who teach science at the high school level in an inclusive setting. During the 2011-12 school year, they taught biology to 9th- through 12th-grade students in the first teaching block every morning from 7:50-9:27. Kristine and Dan were co-teaching together for the third time.

Dan Steinbeck: Special Education Teacher

Dan is in the 31-34 age range, with a Master's degree in Special Education. This is Dan's third year as a special education teacher in Green Valley High School. So far, he has co-taught American history, economics, world history, and biology. His education experience includes volunteer work at a middle school when he was in college, two years as an English teacher in the Peace Corps, and four and a half years as a special education teacher in a public school. He has a total of nine years of teaching experience. Although Dan's parents were both teachers, he had been planning on law school after college. He earned a bachelor's degree in psychology and sociology with a concentration in African studies. Being inquisitive by nature, Dan considered himself a "nerd" and actively engaged in academic and non-academic pursuits. He was inspired by an aunt's stories about the Peace Corps and decided to volunteer. Dan was placed in a city called Shai Shai outside of Cape Town where he taught English to 8th- 9th-, and 10th-grade students. In addition, he taught English to adults who came straight from work to night school. For him, "that was trial by fire because I was never in front of the whole class by myself

before and we had three months of teacher training,” but it was not all about teaching. He learned how to speak Portuguese and he learned about the culture and about health and safety issues. This teaching experience as a whole acted as a turning point in his career. When Dan came home from the Peace Corps, he decided to pursue teaching. Dan’s motivation for joining a teacher preparation program, particularly special education, is his brother, who has Attention Deficit Hyperactive Disorder (ADHD). Having experienced how much individualized attention and support at school and at home helped his brother, he wanted to follow the same path to teach and help students with disabilities. He pursued the post-baccalaureate certification program in special education at the middle and high school level. For two years while earning his certification, Dan was a permit teacher in an urban public school. He became the math teacher leader in his school and headed the math department. After getting his teaching license, he pursued a Master’s degree in Special Education and continued teaching in the urban public school for the next two and a half years. In Green Valley High School, Dan replaced the special education teacher who left. She had been co-teaching economics and Principles of American Democracy, so Dan co-taught those classes. Primarily, Dan’s position focused on post-secondary transition of students with emotional behavior disorder. In all, Dan co-taught four school subjects. His favorite was American History because his dad had taught social studies and he grew up with social studies and discussions about government. His teaching beliefs and philosophy revolve around access to the best and meaningful education in an inclusive learning environment for every child. He is a strong supporter of inclusive education and co-teaching. Dan believed the pullout model does more harm than good, and he considered co-teaching the best teaching model for serving students with district

learning styles under the same roof. His ability to connect with students and understand why and where they are struggling may stem from his college days when he volunteered at the middle school or maybe his high school years when he did community service at his mother's school. Dan is good at engaging students in active learning. For this, he implements various teaching strategies that are not only motivating but that also result in meaningful learning. Dan is a team player, and he acknowledges the benefits of co-teaching for himself and his students in inclusive settings. During six years of co-teaching, Dan has had a variety of co-teaching experiences. At the urban public school, he was co-teaching with four regular education teachers and was sometimes expected to be in four different places at one time. To him, this felt more like simply being another adult in the classroom than an instructional partner. He played a supporting role in co-teaching and felt this was not successful. He believes the lack of success co-teaching at the urban public school was the result of large numbers of students with special education needs and limited number of special education teachers. On the other hand, in his current co-teaching position, he was paired with two regular education teachers and he was actively involved in planning, teaching, and assessment in those classes. Dan considers his primary role in the co-teaching partnership to be one of involving all students with and without disabilities in the teaching-learning process and seeing that the individual learning needs of students with disabilities are met.

Kristine Smith: General Education Teacher

This is Kristine's ninth year teaching at Green Valley, but her tenth year as general educator teaching science. In her first year, she taught part time in two high schools, one of which was Green Valley. Kristine is in 30-33 age range with a Master's

degree in Natural Resources with the focus on the Environmental Education. She has taught ecology, experimental lab science, low level science class, and biology. Kristine, like Dan, has a vast array of experience in education; although she is a regular education teacher, she worked with students with Emotional Behavior Disorder (EBD) and those who were at risk, taught in a self-contained class, and is now teaching in a full inclusion situation. Initially, Kristine never thought she would become a high school teacher; she planned to become a doctor and even got through two years of medical school. Her experiences in medical school made her ponder whether this was what she wanted to do and she decided to engage in lab research. It was then she remembered that her high school teachers had suggested she become a science teacher. This did not happen until after she got a job at the YMCA at the end of her sophomore year in college where she loved working with 10, 11, 12-year-olds. This was a turning point in her career. She thought the best way of talking about science and working with high school students was to become a science teacher. Her other motivation was to prove that “girls can do science” even though it is a male-dominated field. A final motivation was to break the misconception many kids have that science is boring. Kristine earned a Bachelor of Science degree with a major in zoology and got her teaching certification in biology and broad field science. After teaching for one year, she went back to school to get her Master’s degree in natural resources with the focus on the environmental education. She loves teaching biology and ecology. Kristine has a positive attitude about her students and believes in that all students can learn if you equip them with right set of skills and she wants to do the best she can for students every day. Her teaching beliefs and philosophy revolve around providing students the skills and especially science information they need

in order to be successful and productive adults. Kristine is a team player—she perceives the benefits for herself and her students working with another educator and other professionals. Over the years, she has had varying co-teaching experiences working with special educators, but considers her co-teaching partnership with Dan the most effective because they have similar teaching philosophies and because they encourage each other to be flexible and fluid and implement new teaching strategies. Her attitude toward Dan is positive because he brought innovative ideas about teaching a concept. She has been co-teaching biology with Dan for the last two years, although she had no direct co-teaching training in her teacher preparation program. In that program she had only one class that talked about special education, inclusion, and co-teaching. The section below provides an overview of the biology curriculum and the pacing guide used by Dan and Kristine in their co-taught biology class.

Biology Curriculum

Four science teachers representing the science departments of two high schools in the BigWay school district met to frame the biology curriculum. Kristine was one of the four teachers. The science curriculum committee decided on a new book series titled “Holt McDougal Biology” by Stephen Nowicki for the 2011-12 academic year and selected the content to be covered by implementing specific teaching activities, student projects and assignments, and lab work. They even decided on common assessment strategies. However, individual biology teachers in both schools could add or change smaller inbuilt activities to meet the needs of their students in the program; overall the teachers followed the same curriculum. The focus of the biology curriculum was to make students familiar with and help them understand many aspects of life from the micro

(including genetics, biochemistry, and cells) to the macro (including ecology, evolution, and human implementation of scientific processes and lab skills). The biology curriculum was developed taking into consideration the student learning outcomes mandated by state science standards school district requirements. It was broken down into 10 units and each unit was further divided into smaller topics depending upon the complexity and difficulty level of the content. Specific numbers of days were allotted by the science curriculum committee to complete each unit. The following were the 10 units: introduction to biology, ecology, cells, genetics, evolution, classification and diversity, plants, animals-invertebrates, animals-vertebrates, and humans. Example activities for the biology curriculum were: science projects, rap assignments, presentations, webquest activities, topic notes and summaries, hands-on activities, lab work, quizzes, and review sessions.

Pacing Guide

In addition to the above curriculum, Dan and Kristine used the pacing guide to co-teach biology. The pacing guide, mentioned in Chapter One, was a teacher's written schedule demonstrating the alignment of concepts, topics, and/or skills related to the pre-defined biology curriculum over a defined period of time. In this study, the pacing guide was initiated by Kristine and included inputs from both teachers. The pacing guide was a Word Doc file in a table format divided into four columns. The "day/date" column included a specific date of their curriculum timeline. The "schedule" column included a snapshot of the content to be covered and a list of teaching and other activities. The "homework" column included a list of things they wanted students to do outside the class. The "teacher notes" column included reminders such as copy notes, distribute curriculum maps, and send parent letters. Both, Dan and Kristine, followed pacing guide

co-teaching biology, but were flexible about making changes if needed. A comprehensive description of Dan and Kristine's co-teaching partnership and how it evolved over the years will be discussed in chapter four.

Data sources

Several methods were employed to generate data for the study. Data collection was done through classroom observations and debriefings, teacher interviews, document analysis, and field notes and memos. Data collection was spread over a period of four months in the spring of 2012, from February to May. I received written permission from both teachers and the parents of the students in the biology class. In requesting the permission, I explained the purpose of my study and the relevance of videotaping the lesson.

Observations

One of the sources of data collection for this study was observations. Observations help a researcher to position himself in the situation where the phenomenon is taking place by describing the activities, settings, and people. Marshall and Rossman (2006) described observation as, "a fundamental and highly important method in all qualitative inquiry" (p. 99) because it helps to unfold complex "interactions in natural social settings" (p. 99). There are two forms of observation in qualitative research: participatory observation and non-participatory observation. Participatory observation helps the researcher understand the contextual meaning of the event or events through participating and observing as a subject in the research. Non-participatory observation is a mode of gaining information about the event or events without being a part of it (Glesne, 2006). I conducted 14 observations. For four months, I visited the school once a

week, from the first week of February until the end of May, 2012. Each observation was 92 minutes, the duration of teaching blocks in Green Valley High School. Table 1 provides an overview of the observation time-line.

As a researcher, I played the role of non-participatory observer or onlooker (Patton, 2002), focusing on the team's co-teaching biology. I looked for a number of things including: the various subject-specific pedagogies both teachers employed in teaching a particular concept; the involvement of both teachers in all or different aspects of student engagement in the lesson; teachers identifying and responding to common student errors or misconceptions; and the amount of time spent on specific activities and interactions between students and between teachers and students. I videotaped classes using a mini-DVD camcorder and took field notes during and after each observation. For example, I wrote notes to myself if I had question regarding the classroom activity or wanted more information. Every observation was followed by a brief debriefing session with the special education teacher, 14 in all. These sessions were conducted either on the same day as the observation or when convenient for the special education teacher depending upon his schedule. The purpose of the debriefings was to make sure that I captured the information correctly and to clarify the purpose and procedure of some of the activities and/or strategies implemented for teaching a specific concept. These debriefings helped me to comprehend the ongoing teaching-learning process in that biology class. I asked questions based on those observations to gather more information or to clarify doubts. For example, I asked what worked or did not work in the lesson, how the pedagogies were selected, how both teachers decided on the teaching role, and what could have been done differently and why. Most importantly, the focus of the debriefings

was on the contributions of the special education teacher to the team and how those differ from the contributions of the general education teacher in terms of pedagogies or assessment.

Observation#	Date	Day's topic
1	2/1/12	Scientific Method
2	2/8/12	Review and quiz
3	2/22/12	Cell Theory and types of cell
4	2/29/12	Photosynthesis and respiration
5	3/7/12	Structure of DNA and replication process
6	3/14/12	Hybrid cross
7	3/28/12	Adaptations and natural selection
Exam	4/4/12	
Spring break		
8	4/18/12	Bacteria
9	4/25/12	Review and quiz
10	5/2/12	Flower parts and reproduction in plants
11	5/9/12	Virtual dissection and notes on arthropods and insects

12	5/15/12	Vertebrates
13	5/22/12	Outdoor activity and notes on mammals
14	5/29/12	Bones and muscles and notes on circulatory system

Table 1: Overview of observation timeline.

Interviews

In addition to the observations and debriefings, in-depth semi-structured interviews were conducted of both special and general education teachers. These interviews were approximately an hour long. The interviews were conducted at Green Valley High School, the research site and a location convenient to the participants. Creswell (2007) explains that interviews are generally used to obtain information from one person or a group about particular situations, problems, or topics. Often, two types of interviews are used in qualitative research: structured and semi-structured. Structured interviews make use of a predetermined interview guide and do not allow free conversation or provide an opportunity for further clarification either by asking more questions or providing clues. Semi-structured interviews are used to collect in-depth information about an issue or a phenomenon while also providing an opportunity to probe further with more questions or provide clues.

For this study, I conducted a total of six interviews: three individual interviews of the special education teacher, one individual interview of the general education teacher, and two team interviews. Every two to three classroom observations were followed by either an individual interview or a team interview. The first team interview did not

happen until the tenth observation, as I wanted to understand various teaching pedagogies and activities implemented by the special education teacher from the participant-observer continuum (Glesne and Peshkin, 1992), before adding the regular education teacher's perspective. These interviews were arranged over a period of four months, from February to May of 2012. All the interviews were audio taped. A semi-structured interview protocol was used with interviews lasting approximately 45 minutes to an hour. Semi-structured interviews were used to gather information about the educational background and teaching history of both teachers with a focus on the special education teacher. Specific purposes of these six interviews are described below.

These interviews helped me with the in-depth analysis of the participant's world, where planning, teaching, and assessment took place during the time of the research study (Patton, 2002). When required, I provided predefined probes to get more information. The first interview of the special education teacher was conducted on February 22, 2012, and that of the general education teacher was conducted on April 4, 2012. One purpose of these interviews was to collect demographic information about the teachers such as educational background, teaching and co-teaching experience, and beliefs and perception about inclusion (see Appendix B). Another purpose of the interview was to establish rapport with the teachers, so that they were comfortable in sharing information. Spradley (1979) explained that a researcher must establish rapport with an interviewee in the first interview by asking questions that demand experiential details that are easy to answer. He refers to these as "grand tour" questions. The second interview with the special education teacher was conducted on March 14, two weeks from the first interview. The second interview protocol included two main sections: co-teaching and pedagogical content knowledge. The co-teaching section was further

divided into three sub-sections: generic, school, and biology class. Similarly, the PCK section was further broken down to sub-sections: generic, knowledge of content and teaching, and knowledge of content and students (see Appendix B) The third individual interview was conducted with the special education teacher on May 29, 2012, after the two team interviews. The focus of this interview was on science curriculum, different pedagogies both teachers implemented in teaching science-biology and their significance, and things they kept in mind while deciding these strategies (see Appendix B).

Although my focus was on the special education teacher in this study, co-teaching was an important component and the teaching they did together was significant. The first team interview was conducted on May 2, 2012, and the purpose of the first team interview protocol was twofold (see Appendix B). In the first part of the interview, both teachers discussed how they decide on the physical layout of the class in terms of the seating arrangement or displayed material, things they keep in mind developing classroom expectations, how they make decisions about the time framework for classroom activities, and the importance of following protocol for incompletes. In the second part of the interview, both teachers shared information regarding things they consider when developing the pacing guide, deciding teaching strategies for a topic, or implementing alternative assessment. The second team interview was conducted on May 22, 2012. The second team interview focused on the teachers' professional development, co-teaching orientation, strength and areas of expertise in the teaching of science, and indicators of student learning (see Appendix B).

Documents analysis

The third data collection strategy included the collection of course documents whenever they were available. Course artifacts included a copy of the school annual report and school magazine, a copy of the pacing guide, the syllabus, curriculum materials, and handouts. The pacing guide provided the researcher with information about the participants' intentions to use teaching strategies and other aspects of their lesson plans in their practice.

Field notes and Memos

Patton (2002) emphasizes that there is no set protocol for the mechanics and procedure of note taking because this depends heavily on the organization of fieldwork and individual work habits. However, he points out the significance of note taking in qualitative research by saying "aside from getting along in the setting, the fundamental work of the observer is taking the field notes.....field notes contain the description of what has been observed" (p. 302). I wrote notes even before going out to the research site on loose paper, sometimes on a notepad, and later in a Word document file on my computer. The notes contained my thoughts, questions, or phrases as they occurred, for later use in developing interview protocols, questions for debriefing, things to consider while developing the contextual description, and for pulling out major ideas in the data analysis process. They were also used to support data collected via semi-structured interviews and the document analysis to help me as a researcher to expand upon the information collected (Bogdan & Bilken, 1992). The majority of field notes recorded for this study were observational notes (Schatzman & Strauss, 1973) such as a rich

description of the setting, events happening before, during, and after class, and direct quotes or observer's comments.

Memos are considered a written communication between the researcher and his or her data, focusing a specific issue and finding an appropriate solution as a researcher maneuvers his or her way through thinking and learning as research unfolds and draws meaning from the voluminous data. Schatzman and Strauss (1973) categorized memos in the following groups: observational memos, methodological memos, theoretical memos, and analytical memos. Analytical memos were used in the study on specific topics to reflect on the idea, the connection between ideas, or as a place holder in the process of analyzing, interpreting, and developing meaningful inferences from the data.

Data Analysis

Hatch (2002) expressed that “analysis means organizing and interrogating data in ways that allow researchers to see patterns, identify themes, discover relationships, and develop explanations, make interpretations, mount critiques, or generate theories” (p.148). Data analysis is implemented as a systematic search for meanings from the information gathered from the site and the participants, so that it can be communicated to the audience in terms of what has been gained in the research process. One of the distinct features of the case study approach is that data collection and analysis occur simultaneously (Creswell, 2007). The analytic process helps the researcher to immerse himself in the data and demands comprehensive understanding and awareness of all the subtle aspects. It assists the researcher to “identify salient themes, reoccurring ideas or

language, and pattern of belief that link people and settings together is the most intellectually challenging phase of data analysis” (Marshall and Rossman, 2010, p. 214).

This definition explains the process of analyzing the data—identifying ideas/themes/beliefs and strategically making multi-dimensional connections between them to convey the meaning. It is challenging. The data collected for this study came from six interviews, 14 observations, 14 debriefings, artifacts, field notes, and memos. During the data collection process I sifted through the data to make sure I gathered information in relationship to my research questions, but the actual transcription of data started after my last observation on May 29. I generated electronic copies for my classroom observations, interviews, debriefings, and field notes. It took me approximately two and a half months to create text files from the audio and video files. Initially, I did word-for-word transcription of my video observations (a total of 21.5 hours) but eventually changed to a running summary format with a specific timeline that would help me locate a video clip for future reference or for use as a quotation. I did six of 14 observations as word-for-word transcription and remaining eight observations as a running summary, approximately a 60/40 split. To help with the accuracy of transcribed data, I watched each video observation twice and left a “yellow blank space” if any word or phrase was not intelligible. In case of interviews and debriefings, I transcribed audio files verbatim. As with the video tapes, I listened to the audio files twice and left the same yellow blank space if a word or phrase was not clear. After going over the audio and video files several times, no yellow blank space was left unfilled.

After the transcripts were created, I moved into the next step of the data analysis process, organizing and coding of the data. Explaining the significance of codes and the

coding process in the analysis of data, Miles and Huberman (1994) said, “Whether codes are pre-specific or developed along the way, clear operational definitions are indispensable, so they can be applied consistently by a single researcher over time and multiple researchers will be thinking about the same phenomena as they code (p.63).”

Operational definitions are considered not only imperative for the coding process, but also for the researcher(s) to be consistent in developing codes within the similar context over time. In explaining the data analysis steps below, I revisited the operational definitions earlier defined in Chapter 1, so that I was clear in identifying and generating meaning and/or ideas from the data. I divided the steps of the data analysis process in accordance with the research questions.

First research question—*What contributions did the special education teacher make in co-teaching biology?* I went over the entire data a number of times to immerse myself and to get a good sense of it. I read and re-read the transcripts and I looked for the contributions made by the special education teacher in this instructional partnership either when the regular teacher was teaching or when he took the lead role. I defined the contributions as specific behaviors that included suggestions, additions, or changes to content or instruction that impact the way that content is taught or made the content accessible to all students or students with disabilities. I used colored post-it flags to mark the contributions on the hard copy and highlighted contributions with colors on the electronic copy. I went over the color-coded contributions several times to be sure I had identified the contributions made by Dan and not by the regular education teacher. After highlighting the contributions, I pulled this information from three sources of data—direct observations, interviews, and debriefings and field notes—and then generated a

separate document listing all the contributions at one place and created a table. I next organized his contribution into two groups—those related to planning and those related to implementation [i.e., teaching]. Next, I re-organized the implementation contributions into the following three types of teaching: (a) whole group teaching, (b) small-group teaching, and (c) as a supportive role. I decided to group the implementation contributions into three teaching types because I wanted to identify what Dan brought to the team when the general education teacher was teaching or when he took the lead role in this instructional partnership. I then developed a 2x3 table to group Dan’s individual contribution in two categories—planning and implementation with its three types of teaching. For example, in the small group teaching implementation contribution, he conducted a guided review session and helped students to make note cards on the topic “scientific method.” The table data became the graphic organizer that displays the layers of the coding categories used in the study (Figure 1).

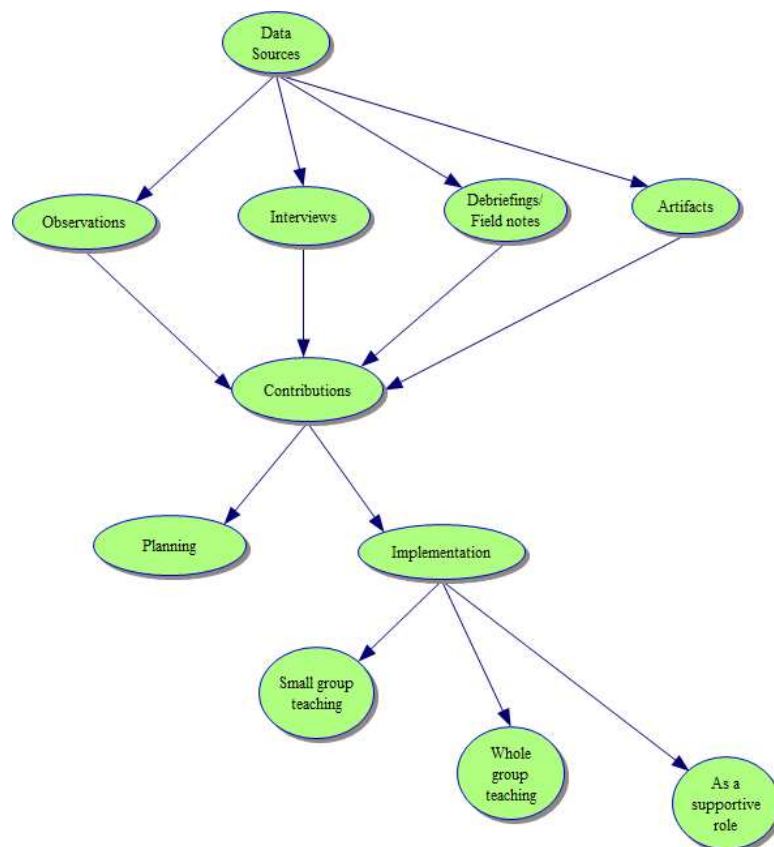


Figure 1: Coding category layers

After consolidating the contributions into three types of teaching, I looked for similarities and clustered them into categories. For example, in the implementation section, one of the categories I created was “examples.” Under that I grouped all day-to-day examples or examples from other content areas that Dan used in the whole group setting, in the small group, or as a supportive role. In this process, the information from the debriefings, field notes, and memos helped me in sorting out Dan’s contributions and creating major categories from the data.

Second research question— *How can we apply Ball’s conceptions of PCK to the special educator in co-teaching?* I next looked for examples of Dan drawing on or using

his pedagogical content knowledge in making decisions in planning and teaching. I followed a twofold strategy. First, I looked at all the observation data and identified the six teaching episodes I observed where Dan took the lead teaching role. Out of these I selected two teaching episodes based on the richness of the content and the specialized science content knowledge teachers need.

In the first teaching episode, Dan explained the di-hybrid cross. The process involves passing down traits from heterozygous parents to their offspring and identifying possible genotypes and phenotypes considering a given example. It is a complex genetic visual representation. Dan not only helped students to understand and complete a Punnett Square related to the example, but also provided them a strategy referred as “FOIL,” a mathematically distributive property, to successfully do the distribution. In order to teach this concept Dan needed to have knowledge about Mendelian genetics and its visual representation.

In the second teaching episode Dan talked about vertebrates. He drew and explained a three-chambered heart and a double-looped circulatory system in amphibians using a frog as an example. He explained how this system was different from that in the fish, which has a single-loop circulatory system. To make students understand the concept, he used a variety of representation strategies such as diagrams, pictures, and a short animation. I adapted Ball et al. (2008) PCK categories—knowledge of content and teaching, knowledge of content and students, and knowledge of content and curriculum—as it clearly demonstrates the interplay of content knowledge with other knowledge such as student, teaching, and curriculum.

The biology class I observed had a diverse population including students from freshmen to senior year, at-risk students, and students with and without disabilities. Anticipating that Dan's selection of strategies, examples, and/or activities that would be influenced by the struggles of students with disabilities (such as difficulties with attention, abstract reasoning and/or perception and processing issues), I decided to incorporate this aspect of student knowledge under Ball's knowledge of content and students category. In addition, I developed examples within each category of teacher behavior related to science that I might see that would indicate Dan's use of PCK. I hoped to use these examples as a guide to help me to identify and select instances and examples from the teaching episodes for the different categories.

Using this example guide, I would look for instances where Dan either anticipated or watched for errors committed by students in completing a scientific process or when they were most likely to be confused in comprehending a complex concept. I planned to add these examples to indicate Dan's knowledge of content and students. Likewise, I would look for occasions where Dan provided an example or a real-life experience that would act as a motivator to start a day's topic or asked an application question to analyze the comprehension level of the students. I then would add these examples under knowledge of content and teaching category. Furthermore, I would look for instances where Dan provided examples from other content areas, such as math or English and /or integrated technology, and used other available resources in teaching a specific concept; these I would put under knowledge of curriculum.

After creating the guided examples, I looked for Dan's teaching instances and/or examples in the selected teaching episodes as well as in the debriefing data where Dan

provided the rationale for selecting a specific activity or teaching strategy while planning a particular lesson. For this process, I created several rules. First, when examples or instances could belong in multiple categories, I looked for their primary focus. Second, I selected only those questions Dan asked to check for analytical reasoning or the comprehension level of the students. Having identified the examples, I added them in a 3x4 table (see Appendix A). The vertical axis describes Ball's categories. The horizontal columns are: Ball's descriptors, my guide, examples from the teaching episodes, and their selection rationale. After consolidating examples and instances pulled from the selected teaching episodes, I summarized Dan's examples within each category of PCK and looked at how each knowledge source played the role either in identifying or implementing different pedagogies in teaching biology.

Trustworthiness

The process of establishing the validity and reliability in qualitative research is contested. Some writers use quantitative equivalents in qualitative research to establish validation and acceptance in the quantitative research arena. Others talk about validity in terms of trustworthiness (Creswell, 2007). There are different definitions, explanations, strategies, and/or procedures for establishing trustworthiness in qualitative research in accordance with the research strategy. Lincoln and Guba (1985) provided an array of alternative terms to establish trustworthiness of a study, such as "credibility," "transferability," internal validity," external validity," and "reliability" (p. 300) and provided specific parameters to implement them. The following eight are frequently used by qualitative researchers as validation strategies and they could be used in different combinations depending upon the nature of the study (Creswell, 2007).

Prolonged engagement and persistent observation in the field means that a researcher stays on the site for sufficient time to become familiar with the research site, its participants, and its culture and to clarify doubts and miscommunications, if any.

Triangulation is a process by which a researcher establishes the trustworthiness and credibility of the study through the use of multiple sources, methods, investigators, or theories. There are four basic types of triangulation: (a) triangulation of multiple data sources; (b) method triangulation; (c) analyst triangulation; and (d) theory/perspective triangulation.

Peer review or debriefing is a process of establishing an external validity of the research. It allows a peer to look at the transcripts of the data, go over the emerging themes or ideas, and then read the final results with an eye other than the researcher.

Negative case analysis is also called deviant case analysis. It is a process through which a researcher confirms the new data collected in the field with one already collected.

Clarifying researcher bias means a researcher, up front, talks about his or her biases in terms of past experiences or orientation that might have influenced the shaping of the study.

Member check is a process by which a researcher engages the participants of a study to judge the accuracy and validity of the research. This is also called as informants' feedback or respondents' validity.

Thick description refers to detailed account of the study that provides a comprehensive picture or detailed description of the phenomenon and conveys a complete story to the audience within a contextual framework.

External audits involves an external consultant that examines the process of the research as well as its findings. The reason to have an outsider examine the project is to establish its accuracy. There are several ways to determine reliability in qualitative research: quality of video or audio taping, field notes, blind coding, software programs, external check, and inter-rater reliability.

In order to establish trustworthiness and credibility of the study, I implemented the following strategies: a) Member check—In order to ensure trustworthiness of the data, member checking was used throughout the study to reduce subjectivity and researcher bias. I had participants review transcripts of the interviews, observations, and debriefings and ensure the accuracy of the transcription. I emailed the transcripts and asked the participants to provide feedback and suggestions and to point out inaccuracies, if any. Furthermore, after each observation, I talked with the special education teacher to make sure I had not misinterpreted any information. I asked questions about specific teaching lessons. Why did they perform this activity? Did it go as planned? Whose idea was it? This also provided an opportunity for the special education teacher to add further information regarding the classroom activities, b) Field notes—I stored detailed notes of the interviews and observations containing information of the participants, events, date, observer's comments, and time. The logs substantiate the time spent on interviews and observations, c) Memos—In addition to the field notes, memos helped me to reflect upon the data to understand and to make decisions as I moved along in the study, d) Prolonged

field engagement—I conducted six interviews and fourteen observations at the site over the period of four months from February through May, 2012. These provided me enough time to know about the setting and the phenomenon, and e) Triangulation—In this study, triangulation was achieved through the use of multiple data sources such as interviews, observations, debriefings, and field notes. The data of the study comprised 14 observations, 14 debriefings, six interviews, and field notes and memos. Extrapolating data through multiple sources helped me to analyze data from different perspective and to check and establish validity.

The Role and Position of the Researcher

In this study I embraced two different roles to meet the expectations of the research process: researcher as the primary instrument and non-participant observer. As a researcher, I recognize that I am the primary instrument in my study (Creswell, 2007; Merriam, 1988). Data was to be collected, organized, and evaluated through my efforts, rather than with a tool such as a questionnaire or machine. As the primary instrument, I had the opportunity to continuously respond to the context as I gathered meaningful information. Recognizing that human instruments are fallible and that mistakes and biases occur is crucial to this process. Merriam (1988) stated that a researcher “must have an enormous tolerance for ambiguity, must be a good communicator, and must be highly sensitive to the context, to the data, and to personal bias” (p. 52).

Throughout the research process I recognized my role as a non-participant observer. I did not know the teachers prior to the research and had to quickly build trust and rapport so they were comfortable having me observe their co-teaching. As a non-

participant researcher I closely observed the activities in order to comprehend the co-teaching phenomenon. I believe that it is imperative that my biases and my personal position in the research is revealed up front (Patton, 2002), so that the reader can interpret the results as credible, trustworthy, and honest in the context in which the study is situated.

In qualitative research, the researcher could adopt a variety of member roles in the research setting. For example, the researcher could be a member of the group being studied (an insider) or a complete stranger (an outsider) (Adler & Adler, 1994). In the literature there are different definitions for insider-researchers and outsider-researchers. Generally insider-researchers are those who decide to study a group to which they belong and it is otherwise for outsider-researchers (Breen, 2007).

I considered myself an insider-outsider in the study. I position myself as an insider in the field of education and teacher preparation programs. I worked as a teacher at the high school level and as a teacher educator, preparing regular education teachers. Furthermore, the co-teaching team selected for the study was in science, a content area with which I am familiar. I believed that familiarity in science would help me to comprehend the rationale the co-teachers used for deciding on and using pedagogies for teaching specific concepts. I position myself as an outsider as I am not a product of the American school system, although I did traditional student teaching in the elementary and high school level during my doctoral program.

With a background in secondary science education and as a strong supporter of inclusive education, I began to notice during my traditional student teaching that special educators co-teaching in inclusive settings typically adopted a supportive role; at times

they were invisible in the instructional partnership. This experience raised many questions about co-teaching and the role of a special education teacher and that made me curious to explore further. The more I immersed myself in my work, the stronger I felt the need to prepare and equip special education teachers to meet the expectations of co-teaching in inclusionary settings and be at par with their general education peers. This does not mean that a special education teacher must provide instruction to a large group all the time in co-teaching, but he or she must be contribute in planning and in teaching within a specific content area such as math or science. My work as a doctoral student in the urban education program and as a co-researcher on various projects provided me with knowledge and skills to pursue my research. I strongly advocate for the rights of children with exceptionalities and my passion about educating myself and others finding ways to improve teacher preparation programs has been a motivator in this direction.

CHAPTER 4

Results

The focus of this case-study was to identify the contributions of a special education teacher in a high-performing secondary co-teaching team and to explore the nature of his content knowledge (CK) and pedagogical content knowledge (PCK) in those contributions. In this study, data were gathered through multiple sources such as interviews, direct observations, and artifacts and field notes. The data analysis process involved identifying Dan's contributions and their corresponding rationale in three types of teaching: in small-group teaching, in whole-group teaching, and in the supportive role. For the second question, I used Ball's model of PCK as a framework to look for evidence for Dan's PCK and how that helped him make these contributions. This chapter is organized in sections to provide an overview of their co-teaching partnership and how it developed, a description of contributions made by Dan both in planning and in implementation, a description of two teaching episodes, and lastly, the results of application of Ball's model of PCK.

Co-teaching partnership

Kristin and Dan had known each other for approximately 17 years and were friends before they were co-teaching partners. They went to college together and volunteered together at the YMCA in their college sophomore year. Both acknowledged that their prior personal relationship was one of the contributing factors to their exemplary co-teaching partnership; they knew they had similar teaching philosophies and could be comfortable teaching together. After the third time co-teaching opportunity in

two years, they agreed that they would not opt for a substitute teacher if one or the other went on leave. Dan said:

Kristine and I are lucky because we had that personal relationship already and with other teachers you build it up over time. You do not want to step on another person's toes and you do not want to offend them. So far it has been really good... We have been friends for a long time, so if I say I do not think we should be doing something this way she won't get mad. If I say I am not really sure about this content and ask her to go over it with me I do not have to feel embarrassed because we have that relationship and I know she is going to support me (Interview 1SE, 2/22/12).

Dan believes knowing Kristine before they began co-teaching helped them both in developing professional competency and the mutual trust that is required for an effective co-teaching partnership.

They strongly believe that a school's administration must understand which two teachers could be an effective pair based on similarities in their teaching philosophies and styles. Kristin acknowledged that teaching for a long time could result in fixed routines and a rigid teaching style, but accepting a fresh perspective can result in changes that are beneficial for students. She felt this is an important component of an effective co-teaching relationship. Both felt that being flexible and valuing the other's input helped them become more cohesive. Kristine said:

He [Dan] opens my eyes to be flexible and recognize that if the kids did not get something, we can't move on. It is better to take this activity out or re-teach and

then move on. I like to go according to my schedule (that's how I am as a mom, too); sticking to a schedule is comforting to me. So he helps me to be little more flexible about what the kids need in the moment. Just because kids did not need help with this topic during the past eight years doesn't mean this group doesn't need help. Dan also helps me welcome new ideas (Interview 1GE, 4/4/12).

Kristine had been teaching biology for 10 years, but she welcomed and valued a fresh perspective and flexibility that Dan brought to their co-teaching partnership.

Both Dan and Kristine said they never perceived students as "his or hers." They thought of them all as "our students." In their co-taught classes students could learn from two teachers or choose the one they wanted to work with. Kristin stated, "I know there are kids who like Dan better and am pretty sure there are kids who like me better and that is ok. Hopefully all of them will connect with one of us" (Interview 1 GE, 2/22/12). Dan explained a number of ways that he and Kristine supported and affirmed their co-teaching partnership. "We never had a serious disagreement. There were times when I said, 'Why do not we do it this way?' and she [Kristine] was not sure something would work for one reason or another. We talked through it came to some sort of agreement" (Interview 2 SE, 3/14/12). Kristine echoed Dan on this and said that they believed the ultimate goal of co-teaching was to help students succeed and understand the concept and be knowledgeable about it; if Dan could do something better, she did not mind and vice versa.

Both Dan and Kristine bring enthusiasm and organization in their co-teaching partnership and enjoy teaching together. Dan said:

The biggest thing is we both enjoy teaching; we have a good time and our students see that, too. They have two teachers who enjoy being in class and enjoy the

content. We enjoy working with each other; we enjoy working with the kids, so I think we both bring in enthusiasm (Interview 2 SE, 3/14/12).

Dan and Kristine had similar teaching philosophies and enjoyed and teaching together, which students seemed to notice and appreciate.

Kristine considers herself to be a very organized person and she has more experience teaching the course; for her it is comforting to follow the set plan. Dan believes she has a strong grasp of content knowledge and is a phenomenal teacher. Kristine believes Dan brings flexibility, fresh ideas, and the ability to connect with students into this co-teaching relationship. Dan considers he brings a very good understanding of pedagogies and knowledge of accommodations and modifications needed to work with students in an inclusive setting. Dan said, "I think we both bring a set of skills to the class and we complement each other very well" (Interview 2 SE, 3/14/12). He acknowledges that co-teaching is a skill that develops over time and experience.

Evolution of the Co-teaching Partnership

I have divided Dan and Kristine's co-teaching history into three phases. Phase one highlights their planning process before co-teaching for the first time. Phase two explains their teaching roles and the challenges they encountered their first time co-teaching. Lastly, phase three indicates the growth in their teaching partnership in terms of either dividing their instructional role or grading of assignments in half and most importantly increased involvement of Dan in co-teaching.

Phase One

Dan and Kristine's co-teaching partnership started a year before this study was conducted, when they decided they wanted to co-teach and approached the administration about it. The administration considered their proposal and made sure that proper resources were allocated to make this partnership work. In Green Valley High School, teachers are not forced to co-teach until and unless they value and support co-teaching because it is believed that forced pairing is unsuccessful.

Kristine said that the other high school in their school district had an unsuccessful co-teaching experience because they paired teachers who were not supportive of co-teaching. She said:

This school is wonderful about supporting co-teaching. Across town Bay View central tried it and it did not go well because people did not believe in it. I think they tried it because we are doing it, but did not go well. I do not know their specifics, but they are back to self-contained(Interview 1 GE, 2/22/12).

Forced co-teaching sometimes results in effective co-teaching pairs, but teachers must be professionally and personally compatible in order to form a high-functioning co-teaching team.

Green Valley High School provides paid summer preparation time to teachers who wish to co-teach. They allocate approximately seven to ten hours, depending upon whether teachers have co-taught before. Dan and Kristine met in summer and looked at their incoming group of students in general and then at students with IEPs and identified

their strengths, challenges, and needs. They discussed whether they would be requiring any strategic seating arrangement or modification and accommodations in their teaching pedagogies. In addition, they planned the content they were going to teach and what teaching strategies they would implement in accordance with the biology curriculum laid down by the school district. They did the ground work and got ready to teach together for the first time.

Phase Two

The first year Dan and Kristine co-taught, Kristine took a lead role most of the time and Dan adopted a supportive role because he was not comfortable with the content. They estimated a 5:1 split in their teaching roles. However, Dan was observant about the students' struggles and any misconceptions that surfaced during the lesson and he kept a teaching journal in which he maintained running notes of what went well and what needed to be changed and why. Dan also wrote down any questions he had about the content, thinking that if something was not clear to him students might have similar questions. They went through his notes together in review sessions and in future lesson planning or made notes in the pacing guide about changes for future classes. During the first co-teaching year, Dan and Kristine met multiple times a week and debriefed about whether things had gone as planned and if not, why. Dan got clarification on the content when they met, and he improved his understanding of the concepts he was planning to teach. He further improved the second time they co-taught and he took the lead role more often as he became comfortable with the content; things really improved the third time they co-taught.

Phase Three

Dan and Kristine were co-teaching for the third time when this study was conducted in the spring of 2012. Dan described how they basically split the teaching instructions 50/50; if they had notes for a specific concept divided into six sections, then Kristine would take three and Dan would take the next three. According to both Dan and Kristine, there were no fixed criteria about how they made this split. It all came down to selecting their favorite topics in the current biology curriculum and recognizing their comfort level with the material. Dan thinks Kristine had more favorite topics than he did because she has been teaching biology for a long time. He felt more comfortable taking the lead role the third time they were co-teaching; one of the reasons for that could be his increased content knowledge. Dan indicated this during an interview and said, “Special education teachers who have the content knowledge are able to participate in the discussions...if you do not understand what is being taught, you cannot contribute to that co-teaching partnership” (Interview 2 SE, 3/14/12).

Dan was forced to take the lead when Kristine went on a two-month maternity leave and Dan had a sub who was not familiar with their curriculum. Taking the lead role made him more confident with the content material. In this co-teaching partnership, both Dan and Kristine felt comfortable jumping in and adding explanations, examples, or comments when other was taking the lead instructional role, providing comprehensive information from a different perspective or further breaking the concept into sub-concepts for students to comprehend. Kristine told:

I am not afraid I will offend him; I will be like, ‘Dude you are off today, can I explain this,’ or he jumps in says, ‘What she is trying to say is...’ when he sees confusion on their faces, or ‘They are not understanding your example, can I give another example?’ I will totally be OK with this because the ultimate goal is to help students succeed (Interview 1 GE, 4/14/12).

Both teachers felt comfortable interjecting and adding information or further expanding the concept when the other was teaching, anything to help students understand and clear up misconceptions.

Dan and Kristine split grading 50/50 so that neither was overwhelmed with the workload. They did not approve of splitting an assignment in half for grading but rather divided the number of assignments equally. Kristine pointed out it is hard to maintain consistency in grading when you split an assignment into half, and it is confusing for the students, too. Dan mentioned:

I grade one assignment and she grades one assignment and we really go back and forth. We both are flexible; if she says she’s really swamped, can I do this, I would definitely say yes. If I am out for IEPs for two days, then she would cover the material” (Interview 2 SE, 3/14/12).

As with teaching and grading, Dan and Kristine both felt comfortable communicating with parents of children with and without disabilities. Sometimes parents prefer to communicate with one or the other of them because of prior interactions, but both Dan and Kristine made sure that they informed or included each other on the email.

In this instructional relationship, Kristine was responsible for making sure they covered the content to be taught. Dan focused on what was to be modified to meet the needs of students with and without disabilities. Kristine ran all the labs and Dan ran all the review sessions. They had an even split between the required activities for smooth functioning of the teaching-learning process in an inclusive setting. To them, co-teaching is a teaching setup where two teachers work together on a similar objective to meet the needs of the students and it can be done using one or another of the various co-teaching models. Both valued the benefits of co-teaching in inclusive settings. To Dan, the benefits of co-teaching are many. He said:

I think there are lots of benefits. The class becomes more adaptive to the students instead of requiring students to adapt to a teacher's style. Teachers are more adaptable to the learning style of the students because you have more flexibility in how to deliver the instruction. You have an extra set of eyes in the classroom, so it is easy to make observations about what students are getting and what they are struggling with. Students like it because some like to work with one teacher more than the other; they usually find someone they are comfortable going to. It mixes things up instead of having the same person up front every day (Interview 2 SE, 3/14/12).

Dan acknowledged the benefits the co-teaching for students in that it addresses the needs of students with and without disabilities in an inclusive setting. Moreover, it provides a platform on which teachers can collaborate and learn from each other.

In addition to biology, Dan was co-teaching American History and Principles of American Democracy with two other regular education teachers during the 2011-2012

academic year. He believes that the nature of the content area and the pedagogy implemented to teach a specific content play a significant role in deciding the co-teaching model, which could change from one topic to another or from one activity to another. He considered biology to be a notes-based subject in nature as compared to either American History or Principles of American Democracy, which are discussion-focused subjects. Dan explained that they decided on a co-teaching model based upon day's activity (Interview 2SE, 3/14/12). For example, when they provided topic notes to the students in one big group, they used either the one teach, one observe model or the team teaching model, where one took the lead role and the other interjected at any time (Friend & Cook, 2003). While conducting review sessions, they often divided students into small groups and implemented the alternative co-teaching model, because it worked best for this activity. Dan emphasized that selection of the co-teaching model is activity driven. He said:

It completely depends on what we are doing because every day is different, and we do so many different types of activities. It depends on what we are doing on that particular day. I do not think you can go and say that alright, today we are going to do big group or small group and now, what are we teaching? That doesn't make any sense. It is what we are teaching kind of decides how we will do that (Interview 2 SE, 3/14/12)

Selection of a co-teaching model not only depends on the content to be taught, but also the ecology of the class; it changes from activity to activity and is different from one day to another. The following section describes Dan's contributions in co-teaching with Kristine, the general education teacher, in biology.

Contributions of the Special Education Teacher

In this co-teaching partnership, Dan and Kristine co-planned and co-taught the biology class and contributed according to their respective strengths. Table 2 highlights Dan's contributions in two categories, planning and implementation. These are explained later in the section.

Contribution to planning	Contribution to implementation [classroom teaching]
Assessment <ul style="list-style-type: none"> • Pre-test assessment • Modified tests 	Giving examples <ul style="list-style-type: none"> • Daily examples • Examples from other content areas
Activities <ul style="list-style-type: none"> • Adding an activity • Modifying an activity • Eliminating an activity 	Providing mnemonics <ul style="list-style-type: none"> • Using the first letter of a word(s) • Adding a letter before a word to develop a mnemonic
Materials <ul style="list-style-type: none"> • Modifying handouts • Modifying assignments 	Asking questions <ul style="list-style-type: none"> • Retrieving information • Applying information • Synthesizing information
Seating arrangements	Conducting review sessions <ul style="list-style-type: none"> • Quizzes • Guided reviews • Note cards

Table 2: Dan's contributions in co-teaching biology.

Planning

I have divided planning into two sections. In section A, I describe the planning process that Dan and Kristine implement in their co-taught biology class. In section B, I describe Dan's specific co-planning contributions.

Section A—Planning Process

I have divided Dan and Kristine's planning process into the following three subsections: planning before the academic year, planning a unit, and spontaneous planning or planning during teaching.

Planning before the academic year.

As mentioned earlier, Green Valley High School co-teachers are paid for summer planning according to their co-teaching experience. Each pair of teachers gets 7-10 hours of paid time to co-plan for their class. Dan and Kristine met in the summer of 2012 to plan for their co-taught biology class. Because they were planning for the second time, they did not spend much time on content; for the first few days, they refreshed themselves and glanced over the topics and activities they wanted to do. They took advantage of the previous year's pacing guide that contained lesson plans and notes developed in accordance with the curriculum laid out by the school district. Their main focus for this class was the newly implemented "block schedule" that required them to revamp the curriculum by either adding or taking out a few activities. Dan said, "We were going to a block schedule so we thought, what can come out? Maybe the photo journal project..." (Team Interview 1, 5/2/12). Another focus was the incoming students; Dan and Kristine spent time getting to know their students and their specific

needs, if any. Dan added, “We spent our time talking about the kids—who will need our help, what kind of help will they need, and how will we do that?” (Team Interview 1, 5/2/12).

Planning a unit.

In addition to changing the pacing guide over the summer, Dan and Kristine reviewed each unit teaching plan as they moved along in their planning. In doing so, they reaffirmed their teaching pedagogies, planned activities, and identified their roles. Who will do what in that specific unit? Often both teachers sat down before the start of each unit, went over the curriculum map in the pacing guide, and identified concepts that might be hard for students to comprehend so they could think of alternative explanations or examples to make the concept comprehensible (Team Interview 1, 5/2/12).

At the start of their school year, they had all students fill out an information sheet listing their interests, likes and dislikes, and strengths. This was in addition to the information they had gathered about the students, those with and without disabilities, through the district database. In addition to summer planning, Kristine emailed Dan the unit teaching plans at the beginning of each unit and inquired whether he thought they should change anything or switch things around. Dan would respond, suggesting either sequential changes or the addition of an activity. Kristine said, “I usually spearhead the planning and he [Dan] says ‘What about this? [or] what about this?’” (Interview 1 GE, 4/4/12). Additionally, Dan commented:

Our communication is pretty good. We have the pacing guide for the entire unit, we know exactly what we are doing on each day, and we know who is doing what.

It is not set in stone. Kristine was going to give today's notes and I was doing tomorrow's notes, but then something came up and we switched. It worked out fine that way. We are very clear on who is doing what and we are very flexible; both of us are fine with things changing (Interview 2 SE, 3/14/12).

Typically, as a co-teaching team they had good communication and an explicitly laid-out teaching plan, but Dan and Kristine were also flexible to accommodate changes in the teaching plan as needed.

Spontaneous planning.

During my classroom observations, I saw Dan and Kristine making spontaneous changes while teaching a concept. For example in the past Dan and Kristine used three different examples to teach a di-hybrid cross. This year, after going through one of the three examples, both teachers felt students understood the concept. They did a quick check (i.e., thumbs up from students) and decided not to use two more examples but instead gave the students some time to work individually on the next example (Interview 2 SE, 3/14/12). Dan explained. If they had continued as planned in their pacing guide, they would have wasted time and students would not have been interested in the lesson. In the interview, Dan explained that planning is a continuous process; teachers must have a plan for immediate activities or teaching, and must constantly look for what went well or did not go well so they can make changes on the spot (Interview 2 SE, 3/14/12).

Section B—Contributions in Planning

In addition to curriculum planning, Dan contributed in co-taught biology class in three important areas: assessment, activities, and materials. This section is a partial response to

the first research question: *What contributions did the special education teacher make in co-teaching biology?*

Assessment.

Dan's contributions in assessment are twofold. One, he introduced a pre-test assessment that all students take a couple of days before the test. The pre-test assessment contained 10 or 12 questions from different sections of a unit. Results of this activity helped both teachers identify students who needed extra help and who might be struggling with the content. This assessment it provided feedback to teachers about specific content that should be reviewed either in a small group or in the whole group. Dan said, "I will take a look at what questions most of them get wrong usually it is pretty clear. If twelve people got question 7 wrong, obviously we should review that content." (Team Interview 1, 5/2/12). Second, Dan modified tests to make them less confusing for all students, especially for students with disabilities who have either short-term memory issues or reading issues. He changed their vocabulary, increased their font size, and limiting the options in multiple-choice questions. Dan commented, "Sometimes we reword question. For example, *All of the following is true 'except'* questions, which are always hard." Regarding the format of a test, he suggested breaking down one large five-point question into five short answer questions worth 1 point each (Team Interview 1 & 2, 5/2/12; 5/22/12).

Activities.

In the current co-teaching role, Dan contributed by adding, modifying, and removing activities from the curriculum. Drawing from his previous co-teaching

experiences, Dan introduced a jelly bean activity and the nature center scavenger hunt activity. In the jelly bean simulation activity, the students acted as predators and hunted for prey (jelly beans) and documented observations at the end of each hunting round. Dan and Kristine, through this activity, wanted their students to understand the law of natural selection and its process (Observation & Debriefing 7, 3/28/12). Another example of Dan's contribution was a nature center activity. For this, students were given an activity sheet that asked them to look for organisms and then use their knowledge to classify them. Students were excited and curious to see insects, amphibians, and other organisms in their natural habitat. This application activity helped them to synthesize and compare the characteristics of different classifications (Team interview 2, 5/22/12; Observation & Debriefing 12, 5/15/12). Dan's input on distinctive activities and pedagogies resulted in changes in the curriculum. For example, in one lab students burned different types of food and documented their results. Dan felt it was a confusing lab, and he believed it only addressed the standards tangentially and did not focus on either a particular skill or the scientific processes. He discussed it with the general education teacher and they decided to remove it from their pre-determined science curriculum (Team Interview 1, 5/2/12).

Materials.

Before Dan started co-teaching with Kristine, she had been in the habit of distributing handouts that included class notes so students could focus more on listening. These went to students with IEPs, at-risk students, and sometimes to all students. In fact, she observed some students were not listening attentively in class. Dan observed the same in his first year of co-teaching with Kristine and modified the format of the handouts. He strategically added blanks to the handouts, blanks that students could fill in as they

listened to a presentation. This middle-of-the road approach meant that students were not overwhelmed by having to write complete notes, but they were responsible for filling in the missing information. Dan explained the importance of handouts by saying, “If we know the concept is particularly hard or has lots of diagrams, we give handout notes to everyone in the class so that students focus more on listening and less on writing...” (Interview 2SE, 3/14/12). Dan and Kristine note positive outcomes of this change as students seemed more focused and involved in the lesson. In addition to modifying handouts, Dan also provided input in modifying assignments in accordance with the needs of the students or as per their IEP requirements. He said, “I modify tests or I modify assignments, whatever is needed for the students” (Interview 1 SE, 2/22/12). When the Green Valley High School adopted a 92-minutes block schedule, Dan suggested either eliminating a portion of a home assignment or reducing the number of problems students were asked to complete at home. This was meant to give all students sufficient time to comprehend a concept. He said:

They did not have enough time for it to be meaningful and were rushing through the problems to finish. We saw that it was becoming a negative. Reducing the number of problems meant students had more time to focus and made the exercise more valuable (Team Interview 2, 5/22/12).

Having time to reflect on the class lesson and apply new knowledge to the problem helps in learning, and that is the most valuable part to the process. Rushing through content and trying to cover as much as possible does more harm than good.

Seating plans.

Dan prepared seating plans for the biology class in order to meet the needs of all students, those with and without disabilities, and to make sure that no student was isolated in class. This was something Kristine did not do and Dan was responsible for developing strategic seating arrangements for the entire academic year. In the beginning of the year, students filled out a personal information sheet that included seating preferences. Dan used this information in addition to IEPs and other information in the school database to create strategic seating plans using software. The seating plan changed two or three times during the class. Dan was careful to meet the needs of students with disabilities and other student who indicated seating preferences. Dan assigned aisle seats to students who were likely to need help during a lesson so a teacher could approach easily without disturbing other students in that row. Dan supplied an example from the previous year. "A student from last term could hear with his right ear but not with his left ear. He needed to sit on the left side of the room so his good ear was facing the activity." He added, "As students work together in pairs or in small groups we get a much better sense of who should or shouldn't be sitting next to each other" (Team Interview 1& Debriefing 10, 5/2/12). Dan was not only actively involved in preparing the seating plans for the classroom, but was equally engaged in planning the biology curriculum. The following section explains Dan's engagement in different aspects of teaching.

Implementation

I have divided implementation into two sections. In section A, I briefly describe one of Dan and Kristine's typical lessons. In section B, I describe Dan's contributions to implementation [i.e., teaching].

Section A—Sample Lesson (Observation 11, 5/9/12)

The lesson “Virtual Dissection” included simulation activity, notes, and a review session on arthropods. For this lesson, Kristine took the lead role in running the activity and Dan took the lead role in providing notes and conducting a quick review session. At the beginning of the biology period, both teachers greeted students and Kristine instructed them to take out their curriculum notes. Both teachers distributed the activity sheet, and Kristine explained the process of virtual dissection on the Smart Board. The steps included: (a) logging on to the website provided on the activity sheet, (b) clicking and dragging to label a dissected earthworm and then self-checking their work, and (c) showing the completed activity to her or to Dan. She told them to complete the questions on the activity sheet and suggested using the notes and the dissection manual for this activity.

After explaining the process and making sure students understood the expectations of the day's activity, she instructed them to get the laptops and check to see whether they were charged and working. This was an individual activity, but students had the option to work either in the seating area or on the lab tables. Students had approximately 45 minutes to complete this activity. Both Dan and Kristine moved around

in the room to make sure students were on the right website and that they understood the process of virtual dissection.

After completing the virtual dissection, students got their activity sheets stamped by either Kristine or Dan, filed them in their binders, and went back to their seats. Then Dan reviewed the notes on arthropods on the Smart Board. He explained the meaning of the word arthropod by breaking it down into two words, “arthro” meaning “joined” and “pods” meaning “legs.” Going through the PowerPoint slides, he explained the characteristics of arthropods: a segmented body, an open circulatory system, an exoskeleton, etc. Dan showed pictures on the Smart Board to illustrate each characteristic and provided the following example to explain the exoskeleton. He said that a person who accidentally steps on an insect or a spider might hear a crunch because arthropods have an exoskeleton made up of chitin. He asked the student to write the word “outside” next to the exoskeleton to help them remember. He also drew a picture of a segmented insect on the whiteboard and labeled it. Lastly, Dan conducted a quick activity to reinforce the concept; he showed pictures of arthropods, asked students to identify which class of arthropods they belonged to, and then discussed each class and its characteristics, habitat, life cycle, and distinctive adaptation. He also drew a picture of a grasshopper on the whiteboard to explain the body structure. Both teachers moved around in the class to provide support, if need, as students drew the diagram.

Section B—Implementation Contributions

This section describes contributions Dan made in implementation [i.e., teaching]. I have grouped his contributions into five sub-sections: giving examples, providing

mnemonics, asking questions, running review sessions, and conducting pre-test assessment. This section also addresses response to my first research question, What contributions did the special education teacher make in co-teaching biology?

Giving examples.

Often in teaching, Dan provided examples from daily life to explain a concept or introduce a topic. For example, in whole-group teaching Dan introduced a day's topic by asking the following question: "What scientific theory have you heard of before?" Students looked at each other and were quick to respond, "Big Bang Theory" (a television comedy). He announced the day's topic by saying, "So today we will study about a theory, not the big bang theory, but cell theory" (Observation 3, 2/22/12). In a small-group teaching setting Dan showed a diagram of an atom and explained two types of bonds, covalent and ionic. He explained the best way to remember covalent bonds was to remember that two atoms are cooperating by sharing electrons. He emphasized the "co" syllable on both words. Then he said that one way to remember ionic bonds is to think of "I" being selfish. He explained that atoms do this bonding activity to become full or stable.

Dan used another example to reinforce the rationale for the bonding activity. He said, "After eating Thanksgiving dinner, when you are sitting in the recliner, you are content and stable and happy. It's the same with atoms. When they have a full outside ring of electron, they are stable and happy" (Observation 2, 2/8/12).

In addition to providing examples from daily experience, Dan also added examples from another content area. For example, in a who whole-group teaching Dan

explained the passing down of alleles in heterozygous parents using the mathematics distributive property.

Dan: Alright. We will not gonna have box that we will have two freckles or two wrinkles. For each one of these areas, we will have two alleles and one gonna be freckle trait that has passed down and one gonna be wrinkle traits that has passed down. To figure this out, we will gonna do little math alright. ...does FOIL sound familiar...what does FOIL stands for?

Student: First, Out, In, Last.

Dan: Ok. First, Out, In, and Last. So here we go. I see big smiles at the back. A lot of math fans out there. Good! (Observation 6, 3/14/12)

Dan demonstrated a connection between two content areas—math and science—by using a distributive property example in a science-related problem.

Providing mnemonics.

I observed Dan using mnemonics to help students comprehend and remember a complex concept. He used mnemonics as a strategy in all the three contextual settings—the whole-group setting, the small-group setting, and as a supportive contribution when the regular education teacher was teaching. He created mnemonics using the letters of each word. For example, in small-group teaching Dan was explaining the concept of classification, which includes three domains, six kingdoms, and eight taxa. To remember the names of the eight taxa (kingdom, phylum, class, order, family, genus, and species), he suggested remembering “King Philip Came Over for Good Spaghetti” (Observation 9, 4/25/12). He used the first letter of each taxa to create this mnemonic. In another

example, when Kristine was teaching the reproductive parts of a flower in the whole-group setting Dan interjected and said, “To remember the male parts look for ‘men’ in stamen, or put ‘m’ in front of anther to make ‘manther.’ Filament has the word ‘men’ in it. These would be three male parts of a flower (Observation 10, 5/2/12). Both these mnemonics that Dan provided to students not only helped students to remember information but to retrieve as well.

Asking questions.

Dan asked questions while giving notes or conducting an activity. He used a wide array of questions that required students to retrieve, apply or synthesize information. Sometimes he asked questions when the regular education teacher was teaching: (a) to clarify the content and (b) to break down a concept into parts. For example, Kristine drew the diagram of a flower after explaining the general and reproductive parts and asked students to draw the same diagram. Dan asked, “What are the different parts as we go from outside in?” There was no response. Dan brought back the flower that he had shown earlier and said, “Sepal are the outermost. What is next?” Students responded, “Petals” (Observation 10, 5/2/12).

In another example, Dan worked with a small group of students on the beak adaptation assignment. In this assignment, students were asked to match beaks of the birds listed with the closest possible tool in the next section and write down what kind of food each beak is used for. Dan asked the following questions to help students complete the assignment: Dan: “What about vultures? Where do we see vultures a lot?” Students: “On dead animals.” Dan: “Yah! On dead animals. What type of food it going to be?”

Students: “Fleshy animals.” Dan: “Ok, and the tool you need?” Students: “A meat knife.” Dan: “A meat knife, very good. How about a humming bird? You see the beak long and pointy so we have to think of humming birds.” A student: “Nectar.” Dan: “Exactly, and what kind of tool? It is like a soda straw sucking nectar out of the flower. So write straw” (Observation 7, 3/28/12). To make sure students were understanding the content being taught or to help them complete an assignment, Dan would ask analytical and/or developing question. He also encouraged students to ask questions.

Conducting review sessions.

In this co-teaching partnership, Dan conducted all the review sessions in both whole-group and small-group settings. Whole-group review sessions were usually quizzes. Quiz questions appeared on PowerPoint slides and were displayed on the Smart board. Dan would read a question and allow time for students to work in groups at the lab tables to come up with an answer. The groups were pre-determined and were numbered from one to seven. Students were given an option to select an interesting science-related group name such as Excellent Enzymes or Food Catalyst. The following is an example of the whole-group review session quiz on the topic of the scientific method: Dan: “Ok, your first question is a 10-point question (reads it from the smart board); “Name and describe each step of the scientific method.” [Dan moved around in the room to make sure that each group was working on the question and explained what was expected of them. Question # 1 was displayed all the time in the class when students were working on finding the answer.] Dan: “We are not looking at speed, we are looking at the product and let me know when you are done.” [Dan and Kristine made sure that all the teams were working on the topic and answered their questions, if any.] Dan: “30 seconds.” Dan:

“Five...four...three...two...one...zero. Pull them up and hold up your boards.” Dan: “Step number one is what?” Students: “Problem.” Dan: “Problem. Which is the question to be studied and step two?” Student: “Hypothesis.” [Kristine was keeping score on the whiteboard] (Observation 2, 2/8/12).

Review sessions in small-group teaching consisted of either making note cards or doing guided reviews. Often these review sessions followed a quiz in the whole-group teaching a day prior to the test and after the pre-test assessment. For example, in the small-group teaching, Dan conducted a review session that included making notes cards on the topic of viruses Using the Frayer’s model (Observation 9, 4/25/12). This model contains a four-square format that includes the following four sections with the name of the topic in the middle—definition, characteristics, examples, and non-examples (Debriefing 2, 2/8/12). He asked questions and added more information to student responses, if required, to frame a summary on the topic. He drew diagrams to go along with the information. After that he moved to the next topic, bacteria, and changed the last square of the model from non-examples to positives and negatives.

Conducting pre-test assessment.

As with review sessions, Dan conducted all pre-test assessments in the co-taught biology class. This was one of the activities that did not happen before Dan started co-teaching with Kristine. Dan created this assessment to learn where students were struggling and then geared his review session towards it. Pre-test assessment was a quick activity that contained 10-12 multiple-choice, true-false, and short-answer questions. This activity focused on both the needs of students with disabilities and on the class as a

whole. Both teachers were happy with the results of this activity and the difference it made in terms of better test scores. Instead of assigning grades, Dan gave colored stars to indicate performance in the pre-test assessment. Star colors varied from one test to another, preventing students from stigmatizing peers. For example, a day before the test, Dan or Kristine would announce that they were doing a review for tomorrow's test. If they had a green star on their pre-assessment, they would be staying with Kristine. If they had a purple star, they would be going with Dan for the small-group review session (Debriefing 2, 2/8/12).

Dan not only provided support and advocated for children with disabilities in this inclusive biology class; he also took the lead role and taught students with and without disabilities as a class. His contributions included giving examples, providing mnemonics asking questions, and conducting review sessions and pre-assessment tests. In addition, jumped in whenever he sensed that students were confused or needed another example. Dan believed his understanding about students, content, and curricula helped him in this process.

The following section is a response to my second research question: *How can we apply conceptions of PCK to the special educator in co-teaching?* In this section I summarized the examples Dan used in teaching and teaching instances, which indicate that his pedagogical content knowledge is in accordance with Ball's categories. I have added one indicator under Ball's knowledge of content and student category and another indicator under Ball's knowledge of content and teaching category that specifically focused on Dan's knowledge of special education, such as understanding the struggles of students with disabilities and knowing about accommodations and modifications. In

addition to drawing examples and teaching instances from two teaching episodes where Dan took the lead role in the biology class and provided substantive content knowledge, I also looked at the debriefing data of these two teaching episodes. I have divided the following material into two parts. Section A provides a brief account of what occurred in the two teaching episodes that I selected. In section B, I highlight examples and teaching instances which Dan drew from his PCK using Ball's measures in a co-teaching setting at the high school level.

Section A

I selected two teaching episodes out of six teaching observations for this section. Even though both Dan and Kristine followed the pacing guide to plan and teach biology, it appears that Dan could not have approached the topics as he did without adequate content knowledge.

First Teaching Episode: Di-hybrid Cross (Observation 6, 3/14/12)

Dan introduced the topic by asking about the mono-hybrid cross, about which students had learned the previous day. He was trying to connect the day's topic with what they had already covered. He asked how many traits there were in a mono-hybrid cross and then asked, "What does di-hybrid cross tell you?" One of the students responded that mono-hybrid cross involves one trait and that di-hybrid means two. Dan acknowledged the response by saying, "Yes, two. So, a di-hybrid cross is going to be a cross of two traits." He provided the definition by reading from the SmartBoard and further explaining it. Dan said, "Let's do an example of a di-hybrid cross" and asked the students to give him two traits. Students said, "wrinkles," and he asked, "What would be the dominant

trait, wrinkles or no wrinkles?" Students wanted wrinkles to be the dominant trait for this cross. Dan asked students whether they were talking about humans, plants, or pets and gave an example. He said Kristine's dog "Spunky" had wrinkles all over his face. On the board Dan wrote big "W" representing "wrinkles" and small "w" representing "no wrinkles" and then asked for one more trait. Students responded "Freckles." He asked them to guess whether this was a dominant or recessive trait and got the answer "dominant." Dan wrote a big "F" to represent freckles and small "f" to indicate no freckles. After determining both traits, Dan asked the students to write the traits for both parents on a sheet of paper. While they were doing this, he moved around the class to see whether anyone needed help. Dan wrote the traits of both heterozygous parents on the Whiteboard and told students the next step was to make a "Punnett Square" to illustrate which traits would be passed down by these two parents. He made a 4x4 square and with the help of the students wrote what goes on the top of the square, and what traits go on the side of the square. Dan explained that next step would be to fill in the boxes with potential traits that pass down to off spring. He said one of the easiest ways to do this is to use "FOIL" (a math distributive property) and he explained the students how to do it. Dan involved students in filling the boxes in the square with possible combinations of traits or alleles. Once the square was completed, Dan asked them to find the genotypes and phenotypes from it. Engaging students in the process, Dan explained the method of finding potential genotypes and their percentages and then moved on to the phenotypes. He asked the students "How do you feel about that?" and most indicated that they understood it. Students seem to comprehend this multi-layered process of finding the

genetic and physical traits. Dan did a more examples with them in order to reinforce the process and to clear any misconceptions.

Second Teaching Episode: Vertebrates (Observation 12, 5/15/12)

When Dan taught vertebrates he first distributed the printed notes on the topic. These notes contained blank spaces students were expected to fill in while listening to the discussion. He started by discussing the following characteristics of vertebrates and provided examples and pictures: dorsal nerve cord, bilateral symmetry, coelomate, endoskeleton, closed circulatory system, complex brains, and efficient respiratory system. He named the various classes of vertebrates—fish, amphibians, birds, reptiles, and mammals. He told students they would begin by studying fish and amphibians and started by naming the primary characteristics of fish—gills, a two-chambered heart with a single-loop circulatory system, ectotherms (cold blooded), and external fertilization. He explained the process of spawning and milting. He drew a picture of a fish on the Whiteboard and labeled gills and the two-chambered heart showing a single-loop circulatory system. He explained the difference between oxygen rich blood and oxygen poor blood. He then talked about three different orders of fish, Agatha—jawless less fish, Chondrichthyes—cartilage fish, and Osterchthyes—bony fish, and showed some preserved specimens.

Moving on to the second class of vertebrates, amphibians, Dan defined the word *amphibia*, which means double life. Amphibians live on land and in water and in that way they live a double life. He explained the following characteristics of amphibians—their skin does not hold water well, they have four legs without claws, they rely on water

for reproduction, they have external fertilization, they are ectotherms, and they have a three-chambered heart with a double loop. Dan drew the picture of a frog showing a three-chambered heart and a double-loop circulatory system that forms a figure 8. Dan said amphibians do not have gills; they have lungs used for adding oxygen into the blood. Dan also showed them an animation of the double life of a frog from tadpole (in water) to adult (on land). Kristine threw a soft toy to Dan to show the metamorphoses from tadpole to an adult frog and Dan passed that the stuffed frog around the class. Dan made a T-chart comparing the difference between a tadpole and an adult frog. He showed more pictures of amphibians on the smart board. After that Kristine distributed worksheets.

Section B

In this section, I identified examples from the above two teaching episodes providing evidence of Dan's use of pedagogical content knowledge within the framework of Ball's PCK model. I did this for each category of PCK in Ball's model: knowledge of content and students, knowledge of content and teaching, and knowledge of curriculum.

Knowledge of Content and Students

In this category, Ball has four indicators that demonstrate a teacher's understanding about content and also about his or her students. These indicators are: "(a) teachers must anticipate what students are likely to think and what they will find confusing, (b) when choosing an example, teachers need to predict what students will find interesting and motivating, (c) when assigning a task, teachers need to anticipate what students are likely to do with it and whether they will find it easy or hard, and (d) teachers must also be able to hear and interpret students' emerging and incomplete

thinking as expressed in the ways that pupils use language” (p. 401). In this category, I added the following indicator: understanding the characteristics of students with disabilities and how they might intersect with the content (such as difficulties with attention or processing issues).

First indicator—*Teachers must anticipate what students are likely to think and what they will find confusing.* The first indicator of this category includes examples where Dan anticipated while teaching that student could get confused in the lesson. For example, in the first teaching episode, di-hybrid cross, Dan anticipated that students would get confused in writing down traits for heterozygous parents. He asked students to give him two traits to create heterozygous parents. On getting two traits, wrinkles and freckles, Dan asked what the dad would look like in this particular example. One student responded, “It would be big “F” and little “f.” This was a partial response, so Dan asked about the other trait. When there was no response, Dan realized that students were confused. He explained that these parents were heterozygous, having both dominant and recessive traits. Therefore, the dad would be “WwFf.” To make sure students understood, he asked what the mom would be like. The students’ response was the same, which was what Dan expected to hear. In another example, Dan anticipated that the students would either commit error or would find it hard to create a chart with a specific number of boxes to represent visually the potential traits passed down from heterozygous parents. Dan knew students had done monohybrid cross in their previous biology class, which involves a similar process with one trait, but he wanted to make sure that students understand how many boxes go into making a perfect square that is the chart for a di-hybrid cross. On asking, “How many boxes do you think I need to have in my chart?” Dan got different

student responses ranging from 4 to 8 to 16. He explained that since they have two sets of traits, it would be 4×4 for a total of 16 boxes in the chart (Observation 6, 3/14/12). He told them this was the trickiest part and that once they figured out the correct number of boxes in the chart they should have no problem moving on to the next step in the process.

In the second teaching episode, vertebrates, Dan wanted to be sure students understood the function of lungs in the circulatory system in amphibians and that they would not be confused with gills in fish. He asked, “What is the blood picking up in the lungs?” The students were not sure, so Dan got no response. Dan said, “Oxygen” (Observation 12) Pointing to the diagram on the whiteboard, he explained that oxygen-poor blood from the heart enters the lungs and picks up oxygen before it is pumped out into the body. He then showed the path of blood in the diagram. All three above examples indicate that Dan knew where in the lesson students would become confused or where they would struggle, so he checked with them and went over the content again to clarify the material and clear up any confusion.

Second indicator—*When choosing an example, teachers need to predict what students will find interesting and motivating.* The second indicator for this category includes examples that Dan anticipated students would find interesting and would, as a result, engage them. He believed examples from daily experience, TV shows, or personal experiences motivate students.

For example, in the second teaching episode, while explaining three different orders of fish and their characteristics, Dan provided an example about his work stocking medicine in Walgreens when he was in college. One of the medicines was

“chondrichthyes.” Dan knew it had fish cartilage in it. “Chondri” means “cartilage and “chthyes” means ‘fish.’ This medicine is used for arthritis (Observation 12, 5/15/12). In the second example Dan not only reinforced that “chondrichthyes” means a cartilage fish, but also explained to students that they could use this information to read and understand medicine labels if they know how to break down the name of medicines into root words.

Third and fourth indicators—*When assigning a task, teachers need to anticipate what students are likely to do with it and whether they will find it easy or hard. Teachers must also be able to hear and interpret students’ emerging and incomplete thinking as expressed in the ways that pupils use language.* The third and the fourth indicators of this category include examples of Dan identifying the emerging knowledge of students and analyzing whether the activity used was doable by the students. For example, in the first teaching episode, after completing the Punnett square with all possible combination of traits that could be passed down by heterozygous parents, Dan wanted to know whether students could identify possible genotypes and phenotypes and their percentages from the chart. He did a few with the whole group and then asked the students to complete the rest on their own. He gave them 10 minutes to do this activity. He and Kristine moved around in the class to answer questions. After letting them work on it for 10-15 minutes, Dan completed the rest of the boxes on the chart with the help of the students. He clarified why some responses were incorrect (Observation & Debriefing 6, 3/14/12).

In another example, in teaching episode one, Dan explained the differences between arthropods, which have exoskeletons, and vertebrates, which have endoskeletons. Dan asked, “What do we think this skeleton is made?” One of the students said, “bone” and Dan further inquired, “What else?” Students looked at each other and

then one student said in a low voice, “Is it cartilage?” Dan wrote that answer on the smart board and explained that the exoskeleton in arthropods is made of a substance called “chitin,” whereas vertebrate skeletons are made up of bones and cartilages. Moving further in the same lesson, while explaining external fertilization in fish, Dan inquired whether fish lay a lot of eggs or small number of eggs. A student said, “A lot of eggs.” Dan acknowledged the correct answer and explained the reason why fish lay a lot of eggs.

Dan wanted to know whether students knew another adaptation in fish in addition to laying a huge number of eggs. When there was no response, Dan provided a clue: outside covering or coating. Students picked up on the clue and said, “scales and fins” (Observation 12, 5/15/12). In both teaching episodes I found Dan always went a step further in clarifying and visualizing the concept. For example, in teaching episode one, Dan broke down the process of the di-hybrid cross into five specific steps and suggested the students follow those steps for every single problem they did for practice. One of the steps was to draw the Punnett squares and visually represent all possible genotypes and phenotypes before calculating their percentages. This way, he helped students to lay out everything and then move to the next step in the process of calculating the percentages of either the genetic makeup or the physical traits in a given example.

In another example, in teaching episode two, he broke down long difficult names of different orders of fish and provided a way to remember them. For example, he broke the name “osteichthyes” into “ostei,” which sounds like “osteoporosis” and involves bone and “chthyes,” which means “fish.” So “osteichthyes” as a category includes “bone fish” (Observation 12, 5/15/12). In these examples, Dan focused on the needs and struggles of

students with and without disabilities. Dan identified teaching strategies that would help students to clarify their doubts or confusions, and they would find those strategies interesting. He considered the difficulty level of the task so that it is neither too easy nor hard for them. Dan used probing questions as a means to check whether the students comprehended the content of the lesson.

Knowledge of Content and Teaching

In this category, Ball (2008) has three indicators that reflect teachers' understanding of the content materials and identifying and implementing appropriate teaching strategies in teaching the content. These are: "(a) teachers sequence particular content for instruction, (b) they choose which example to start with and which example to use to take students deeper into the content, and (c) teachers evaluate the instructional advantages and disadvantages of representation used to teach a specific idea and identify which methods and procedures afford instructionally" (p. 401). In addition to Ball's indicators, I added the following indicator: While teaching, spontaneously changes the teaching strategy and/or implements specific modifications and accommodations considering the challenges and struggles of students with disabilities.

First indicator—*Teachers sequence particular content for instruction*. The first indicator of this category includes examples of Dan sequencing the content for his two lessons that I observed. This data come from the debriefings. In the first teaching episode, Dan broke down the notes for this unit by gene expression. He started with DNA replication then moved to monohybrid cross, since it involves passing down of one trait by the parents to the di-hybrid cross, which involve heterozygous parents and passing

down of two traits to the off springs. Dan planned to do a several examples for practice as a whole group and individually to reinforce the concept and follow this with a worksheet activity to assist a small group of students who needed extra help.

In teaching episode two, Dan broke down the notes for the unit by class. He started with fish, which have a two- chambered heart, moved to amphibians, which have a three-chambered heart, and finished with birds and mammals, which have a four-chambered heart. It basically tracked the evolution or progression over time and highlighted development of adaptations by each class that allowed them to survive further away from the water. Dan used the following modes of representation of content: pictures, diagrams, specimens, animation, soft toys, examples, and personal experiences considering the diverse student population.

Second indicator—*They choose which example to start with and which example to use to take students deeper into the content.* Dan conducted an activity to take students deeper in the content. For example, in the second teaching episode, while explaining double-loop circulatory system in amphibians, Dan asked the students to identify “What is not efficient with this type of circulatory system?” (Observation 12, 5/15/12). He asked the students to look at the diagram and then turn around and talk to their neighbors and come up with ideas why it is so. Students identified several possible answers to the question. Dan led an open discussion why there answers were correct or incorrect. After a few responses, one student said, “Because there is mixing of blood.” Dan repeated the response and explained that because oxygen-rich blood from the lungs and oxygen-poor blood from the body go to the heart first, there is mixing of blood. This activity took the content to the next level and provided an opportunity for students to think about

similarities and differences between the two circulatory system and also about the inefficiencies of the circulatory system in amphibians.

Third indicator—*Teachers evaluate the instructional advantages and disadvantages of representation used to teach a specific idea and identify what methods and procedures afford instructionally.* Dan implemented numerous ways of representation of the content in these two teaching episodes. For example, in teaching episode two, Dan explaining characteristics of fish as a vertebrate and its three types; he drew the diagram of a fish and illustrated a single-loop circulatory system, showed pictures of three types of fish on the smartboard, and also showed preserved specimens. Thus, he provided multiple opportunities for students to interact with the content and to comprehend the information.

Dan's biology class had high-performing students with disabilities, so I did not observe any particular modifications and accommodations in these two teaching episodes. Dan drew these examples and teaching instances from his knowledge of content and teaching. He sequenced the lesson in such a way that the information was accessible to most of the students. He identified and implemented various ways of content representation. Furthermore, Dan gave his personal example and conducted an activity to scaffold students to think critically and take them deep in the content.

Knowledge of Curriculum

The third category of Ball's model is knowledge of curriculum. Ball et al. in their study used Shulman's definition and his classification for this category. These are: lateral curriculum knowledge and vertical curriculum knowledge. It was clear in both teaching

episodes that Dan understood and was familiar with the biology curriculum. Dan strategically crafted activities and examples or showed pictures and specimens in the lesson. He considered what the students know about the content and also, what they would be learning if they chose to take AP biology in the next academic year. In addition, Dan's biology class was diverse in terms of comprehension levels: a few students were taking biology for the first time while for others this was their last required biology class. He focused on important scientific facts that he wanted his students to take away from this biology class.

The first indicator of this category includes examples of Dan using strategies from other core content areas. For example, in teaching episode one, Dan used a mathematic distributive property, “FOIL,” which the students have used in math class to help them determine distribution of alleles. Students who loved math were excited to know that they could use “FOIL” in science, too (Observation 6, 3/14/12).

The second indicator of this category shows Dan drawing examples and connectors from the previous topics in the curriculum. For example, throughout the teaching of episode two, vertebrates, Dan compared the characteristics students learned in their previous class about invertebrates to highlight similarities and differences of two subphylum of the kingdom Animalia (Animals). Dan drew these examples from his knowledge of the curriculum within the content area and across the content areas, which helped students to connect and expand on the information that they already had.

To conclude, Dan’s engagement in this co-teaching partnership grew over the years and so did his contributions. His role changed from supporter in the first year of co-

teaching to that of lead teacher in the third year. He strongly emphasized during the interviews and debriefings that he did not have the science background, and he gained content knowledge while co-teaching with Kristine. It has been a major contribution to his becoming comfortable and equally splitting the instructional role. He believed his knowledge of the content matter and knowledge of his students has helped him identify and choose teaching strategies, understand where in the lesson students might struggle, and what was required to clarify misconceptions and errors. He considered these three knowledge components have helped him make information more accessible to students. He appreciated the value of science and wanted his students to use scientific processes in their lives outside the four walls of the classroom to solve different issues that they would encounter.

CHAPTER 5

Discussion

This was a descriptive case study of the special educator in a high-performing co-teaching team at the secondary school level. The co-teaching team comprised two veteran teachers who co-taught biology for three years: Kristine, a general education teacher and Dan, a special education teacher. The data were collected from February to May 2012, using the following data sources: observations, interviews, debriefings, and artifacts. The focus of this study was to explore the contributions of the special education teacher in a high-performing team. The study looked at the special educator's contributions in relation to his content knowledge (CK) and pedagogical content knowledge (PCK). The findings indicate that the special education teacher made contributions not only in planning curriculum for his co-taught biology class, but also contributed in teaching biology at the high school level. His contributions changed over time with the change in his content knowledge. Using Ball's model of PCK, the study did find evidence of the special educator's pedagogical content knowledge. This chapter is organized in the following sequence: what can be learned from Dan, implications and recommendations, and lastly, the limitations of the study.

What Can be Learned From Dan?

In this study we learned several things from Dan and these are addressed in the following sections: essentials of an effective co-teaching team, contributions of the special education teacher, significance of content knowledge, strategies for learning content knowledge, and Dan's PCK.

Essentials of an Effective Co-teaching Team

The co-teaching team selected for the study met the required essentials, which were consistent with the literature. Research indicates that for a co-teaching team to be successful the following essentials or components are required: planning time, personal and professional compatibility, communication, administrative support, mutual trust and respect, shared responsibilities, identity of roles, and content knowledge (Cook & Friend, 1995; Walther-Thomas, 1997; Keefe, Moore & Duff, 2004; Wallace et al., 2002; Weiss & Brigham, 2000; Rice & Zigmond, 2000; Austin, 2001; Mastropieri et al., 2005; Scruggs et al., 2007; Villa et al., 2004).

Both Dan and Kristine were veteran teachers and had at least nine years of teaching experience. They had been friends for 17 years before they began to co-teach. Having known each other for so long provided them a comfort level that could otherwise take a while to develop between two educators. Dan believed their personal relationship helped them build their strong professional compatibility because they were not threatened or worried about stepping on each other's toes. Their strong personal and professional compatibility helped them develop effective co-teaching and it reaffirms the literature (e.g., Keefe & Moore, 2004; Rice & Zigmond, 2000; Cook & Friend, 1995; Scruggs et al., 2007; Trent, 1998; Mastropieri et al., 2005). Dan and Kristine believed that good communication helped them talk about the issues that arose and they worked as a team to resolve them more quickly. Their partnership grew stronger over time. Similar to what is noted in the literature, they believe that open and consistent communication between teachers is essential to resolving conflicts and for developing strong

relationships (e.g., Cook & Friend, 1995; Gately & Gately, 2001; Murawski & Dieker, 2004; Keefe and Moore, 2004; Trent, 1998; Pugach et al., 2012).

In this co-teaching partnership, Dan and Kristine mutually learned from each other. Kristine said she had learned a lot about special education concepts and processes such as modifications and accommodations, behavior management, and differentiated teaching and assessment while co-teaching with Dan. Dan said that when he started co-teaching biology with Kristine he did not have knowledge of content; his content knowledge increased over time while working with Kristine. Learning from each other's expertise is indicated in the literature (e.g., Walther-Thomas, 1997; Trent, 1998; Austin, 2001).

An important element that Dan and Kristine talked about in the interviews, something that helped them in developing a stronger partnership, was administrative support. In the Green Valley High School, all teachers who were co-teaching took advantage of paid summer time to plan for their next co-taught year, get to know their students, talk about content, and discuss required modifications and accommodations. Their teaching schedule was developed in a way that allowed them common planning time to meet and discuss their lessons and their students. The importance of administrative support is emphasized in research for successful co-teaching partnerships (Cook and Friend, 1995; Walther-Thomas, 1996; Walther-Thomas, 1997; Rice and Zigmond, 2000; Scruggs et al., 2007; Pugach & Winn, 2011). Dan and Kristine's relationship developed over three years and helped them to know each other's teaching style better.

Development of their relationship.

Dan and Kristine eventually became a high-performing co-teaching team; their relationship grew over time, and it took them almost three years to be at the point where they seamlessly contributed to teaching biology. The evolution of Dan and Kristine's partnership was consistent with Gately and Gately's (2001) contention that co-teaching is a developmental process, and co-teachers do maneuver their way through three stages of co-teaching before they start to experience a stronger instructional relationship. Dan and Kristine did go through different stages before they developed a stronger instructional partnership. The first time Dan and Kristine co-taught, Dan was trying to understand Kristine's teaching style, his role, and the expectations both teachers had. Because Dan did not have a strong science background he adopted a supportive role in the first year of his co-teaching. Dan contributed more the second time they co-taught because he was more comfortable with the content. I observed Dan and Kristine during their third co-teaching experience. By this time they basically had an equal split in the instructional role. For example, if there were six topic notes in a unit, Dan would take three and Kristine would take the next three.

Contributions of the Special Education Teacher

Often special education teachers in co-teaching relationships contribute in terms of providing support to all students in the class, monitoring student performance, handling behavioral issues, helping with accommodations and modifications, collecting and grading assignments, providing individualized assistance, providing instruction in co-teaching, and taking care of other managerial activities (Mastropieri et al., 2005; Friend,

2008; Wallace et al., 2002; Scruggs et al., 2007). A few studies describe an equal role and equal contributions of a special education teacher in co-teaching settings (Morocco & Aguilar, 2002; Wallace et al., 2002; Mastropieri et al., 2005). However, missing is research that provides a fine-grained analysis of what special educators' contributions to content teaching look like. The literature does not provide specific descriptions of these contributions in terms of suggesting and implementing a particular teaching strategy or modifying a specific topic in a curriculum within a particular content area such as biology or math.

In this study, Dan and Kristine's instructional relationship grew over time from first-year co-teaching to third-year co-teaching and so did Dan's contributions in teaching biology. Dan had multiple roles in this instructional partnership such as a lead teacher, as a supportive role when Kristine was teaching, and also in small-group teaching. He made active contributions not only in these three roles, but also in planning the biology curriculum. His teaching contributions could be divided into two categories. First, some of his contributions were his own. These strategies and activities did not happen at all in that biology class before Dan started to co-teach with Kristine. Other contributions were different than those used by Kristine, the general education teacher. For example, Dan introduced the "pre-test" before the assessment in the biology class. With the help of this test, both teachers could identify the content with which students were struggling and any concept that needed to be reviewed again with the whole class or to provide a guided review to a few students in a small-group setting. Both Dan and Kristine saw improvement in the test scores of all students as the result of this pre-assessment. Dan conducted all review sessions in the biology class, both in whole-group teaching and in

small-group teaching as guided review sessions. Some of his other contributions included preparing seating plans and modifying handouts, assignments and/or tests. Second, in addition to the unique contributions, Dan worked with Kristine in planning and teaching biology. Dan and Kristine made a 50/50 split in their instructional roles, and Dan took an equal lead role in their instructional partnership. Dan also suggested either adding or modifying activities in the biology curriculum. For example, he suggested a simulated activity, “Jelly Bean Hunting,” while planning to teach the concept of natural selection in the population. Dan wanted to provide his students with a hands-on experience to help them comprehend how the law of natural selection proposed by Darwin works in the natural environment.

Significance of Content Knowledge

For effective instructional partnerships and for special education teachers to take the lead roles in inclusive settings, special education teachers need content knowledge familiarity (e.g., Mastropieri et al., 2005, Morocco et al., 2002; Keefe & Moore, 2004; Zigmond & Matta, 2004; Rice et al., 2007; Scruggs et al., 2007). This study confirms that. Content knowledge is important in allowing special educators to take the lead role in co-teaching settings. Dan exemplifies it. In this study his content knowledge was not measured directly but rather indicated through self-report and inferences from his teaching moves.

The data from these classroom observations and interviews indicate that Dan possessed more than common knowledge in science (e.g., in the two teaching episodes, di-hybrid cross and vertebrates, Dan could not have approached the topics as he did

without adequate content knowledge) and that helped him make important contributions. He was confident with the content, and this helped him select appropriate examples while teaching. These not only helped students comprehend the concept, but also connected science with daily experiences and with other content areas to aid comprehension. Highlighting the significance of content knowledge, Dan said, “I do not care how good your knowledge is about teaching strategies. You have to know the content or you risk trying to make content fit the teaching strategies. You have to use teaching strategies that fit the content (Interview 2 SE, 3/14/12). Knowing the content helps a teacher identify and select appropriate strategies for teaching a specific topic, and according to Dan, it is not the other way around.

In response to an interview question about whether he could have made his contributions without the content knowledge, he said:

While I could have done it without any content knowledge, it would have been difficult and far less useful. I would have had to rely far more on my co-teacher for everything, making me more of an assistant in the classroom as opposed to a fully contributing teacher. I'm not saying I wouldn't have been helpful; I could have worked on behavior skills, study strategies, organization, etc. But for anything requiring content knowledge, I would have been far less helpful (Debriefing 14, 5/29/12).

Content knowledge familiarity helped Dan take a lead role in the co-teaching partnership; without content knowledge he would have been a supportive teacher only.

In this study, Dan showed us how a special education teacher can gain content knowledge while co-teaching rather than through professional development or taking extra content courses. Dan's involvement in teaching biology changed over the years. He said that with the growth in content knowledge, his role changed from that of a supporter to that of a lead teacher. Even with that change, Dan played multiple roles in this co-teaching partnership and made a wide range of contributions. He pointed out during an interview that the following strategies deepened his content knowledge and made him comfortable taking the lead role: (a) he kept a journal in which he maintained running notes of all the things they did in teaching a concept and also reflected upon them as to what went well and what did not go well; (b) he had regular debriefing meetings with Kristine to talk about the content and about how to add new pedagogies or try to do things differently; and (c) he closely observed students who struggled with the content and made sure those issues were addressed in the review session or in the next lesson.

The quality and quantity of Dan's contributions changed over time as his content knowledge changed. For example, during an interview Dan said that in the first year of co-teaching he observed Kristine teach and learned the content and made a few contributions. By their third co-teaching year he not only suggested but also implemented activities. Without content knowledge familiarity, Dan could not have made contributions in a lead role. Even a supportive role would have been less effective, for example conducting review sessions, helping students to make note cards, or organizing pre-tests.

Dan's biology class consisted of a diverse student population including students in grades 9-12, at-risk students, and students with disabilities. He helped students with and without disabilities with their independent work and with completing classroom

activities. In addition, Dan would interject when Kristine was teaching and he observed that students were struggling with a specific concept, and he provided an extra example or further detail about the concept. Ironically, it was easy for Dan to connect with students and to anticipate their struggles and needs in a specific topic because he was not much of a content expert. Acknowledging Dan's contributions, Kristine said, "It is easier for you to think about strategies because you are closer to what they are learning" (Team Interview 1, 5/2/12). She pointed out during an interview that she valued Dan's input both in planning and teaching of biology. Initially Dan did not have content knowledge expertise but he gained that over time and his own experience helped him to identify students who were struggling with the content or having confusion. This helped him identify the hard concepts where students struggled and those topics that required more practice and reinforcement. During an interview Dan said:

She [Kristine] has the biology background a lot of stuff might not be confusing for her but a lot of the nomenclature is confusing. So I will be more than happy to ask questions and would jump in and ask for that clarification because if I do not get it chances are kids did not get it too, so we can go over it some more (Interview 3 SE, 5/29/12).

Dan interjected when Kristine was teaching with questions and asked for clarification because he thought if he did not get it, chances are kids did not get it either.

Dan's Pedagogical Content Knowledge

In this study, I used Ball's model to identify Dan's pedagogical content knowledge and to explore how PCK informed his contributions. I looked at Dan's PCK using the following components.

Knowledge of content and students (KCS).

Dan's understanding of his students and his familiarity with the content helped him anticipate and identify where in the lesson students would struggle or would get confused and what examples and/or activities' students would find interesting or hard. It also helped him recognize the evolving knowledge of students, which Ball defines as different indicators of KCS. Dan often asked a wide array of questions while teaching a lesson to make sure that students were grasping information and had no misconceptions. These questions ranged from simple recall to complex analysis. For example, if Dan was not sure that students comprehended the concept, he would ask questions or do a simple "thumbs-up" activity to check. He also asked questions when Kristine was teaching if he felt the concept needed to be further broken down or repeated or if it required an extra example.

Dan knew what activities and examples would interest students related to the topic. His examples were often from daily and personal experiences and he added a little fun in the activities. This made science interesting and helped students learn complex concepts or review the information to clear doubts and misconception. For example, Dan organized a review session before school for all students, including students with disabilities, and called it a "Punnett Party." During the Punnett Party the students ate

donuts and practiced making Punnett squares, which are a visual representation of “Mendelian Inheritance.” Dan believed that adding “donut party” to a review session made it interesting while allowing students to synthesize the information learned in the class.

Ball and her colleagues, in their PCK model, did not focus on the specific needs of students with disabilities. I infer from the observation and debriefing data that Dan’s primary focus for some of the pedagogies he used was more on the students than on the content. One such pedagogy he used was mnemonics. He believed that mnemonics would help all students, but specifically students with disabilities, to remember information or a concept. This came from his experiential learning and also from his previous experiences with students in co-teaching settings. For example, in the whole-group setting, when Kristine was teaching the reproductive parts of a flower, Dan said, “To remember the male parts, look for ‘men’ or ‘man’ in the words. For example, sta+men, stamen. Or put ‘M’ in front of anther to remember ‘manther.’ Filament has the word ‘men’ in it, reminding students that these are three male parts of a flower.” Different types of reconstructive or transformational mnemonics can be used to address memory issues of students with disabilities (Scruggs, Mastropieri, Berkeley, & Marshak, 2010). Dan also modified tests, assignments, and handouts to meet the needs of the students with disabilities and to engage them in the lesson. Dan also took into the consideration the needs of the students in general to develop the seating plans for the biology, which changed two to three times in a semester.

Knowledge of content and teaching.

Dan strategically organized the content, chose examples to introduce the topic, decided on activities that could take students deeper into the content, and selected various representations. This indicates an intersection of Dan's content knowledge and his knowledge of content specific pedagogies required to make that content accessible to a diverse student population. This study did not particularly investigate the special education teacher's content knowledge and use of topic-specific strategies. However, the findings of this study do support that content knowledge is important for PCK. Dan believed content knowledge familiarity was important for a special education teacher in order to have an effective co-teaching partnership in which both teachers take a lead role in providing substantive instruction. He believes that to teach a concept a teacher needs to know that concept; only then can he decide an efficient teaching strategy.

As a lead teacher, Dan systematically organized the content into subtopics such as examples, characteristics, and various adaptations. He then used notes cards and summaries not only to help students to make connection between different components, but also to acknowledge their relationship with each other. He said in the debriefings that there are different models to organize and synthesize information and they (he and Kristine) incorporate them in their class. The Frayer model was one of his favorites because it helps students to see things linearly and he learned that from his teaching experiences. He commented that he implemented various pedagogies that provided opportunities for representing and reinforcing the content. Dan believed that science could be best taught through doing and suggested hands-on activities for learning different concept.

Knowledge of curriculum.

Dan's knowledge of the biology curriculum changed from his first year of co-teaching with Kristine to their third year of co-teaching. To Dan, science is "a series of questions and trying to find ways to answer them through experimentation...these questions can be applied to a wide variety of fields, from biological science to social science to physical science...you have a question and you seek to answer it through experimentation" (Interview 3 SE, 5/29/12). Dan believed that science helps students to develop skills such as problem solving and critical thinking, which could be applied not only to school subjects but also in real-life situations. For example, he said students could use the scientific steps in solving an issue with a friend. He felt his students could apply scientific steps outside the four walls of the classroom in real-life situations solving non-science issues. The pragmatic value of science could help students to be critical thinkers and creative.

Dan implemented examples and activities across core content areas such as English and math because he believes in making connections with other school subjects and demonstrated that science cannot be taught in isolation. Judging by the various resources and teaching pedagogies he used in his lessons, it is clear that he was familiar with the available resources and their adequate use. This was a clear reflection of his knowledge of curriculum.

Grouping Dan's PCK into three discrete categories helped me analyze how that knowledge helped him, for example, in the selection of multiple representation of a topic or in his response when a student asked a content-related question. There are teaching

instances and examples in the data that illustrate how Dan's understanding of students and of the content helped him to anticipate the struggles of the students and how he could represent the information in multiple ways to make it accessible. In many cases, however, it was difficult to identify which component of Ball's model influenced him. For example, at times it was difficult to identify whether he was drawing on knowledge of students and content or rather on knowledge of content and teaching. This raised a question about whether parsing into components is helpful. Shulman (1987) noted that PCK is not an absolute category of knowledge, but an "amalgam of content and pedagogy that is uniquely the providence of teachers" (p.8). From the teacher preparation perspective, I believe this model and the parsing could help supervisors and teacher educators to identify the struggles of pre-service and on-the- job teachers in terms of their content knowledge, knowledge of students, and curriculum knowledge.

Implications and Recommendations

Co-teaching is considered one of the most commonly used service delivery options to effectively implement inclusive education (Mastropieri et al., 2005) and better serve all students in the general education curriculum. This research has shown, in order for a co-teaching team to become effective and seamlessly contribute in this instructional partnership it must maneuver its way through the stages of co-teaching. That takes time and the consistent effort of two teachers. Therefore, schools should not frequently regroup co-teaching pairs. They should develop a time framework with parameters in order to determine the right fit. It appears that knowing each other in advance and volunteering for co-teaching are significant contributors to a team's success, and this study confirms that. Principals and building administrators should involve potential co-

teachers in the pairing process and accept their input because forced co-teaching does not result in efficient instructional partnerships.

With the implementation of Response to Intervention (RTI) and the changing roles of both teachers, general and special education (Fuchs & Fuchs, 2012), this question remains: Would a co-teaching model be considered an ideal approach for providing substantive instruction to students with and without special needs in the general curriculum? RTI as a school-wide prevention provides services and interventions to struggling students at increasing levels of intensity and suggests that special education teachers offer expertise at many levels of implementation within a multi-professional team (Fuchs & Fuchs, 2012).

In this study, the co-teaching model the teachers adopted, having Dan teach 50% of the time, worked for them and improved over time. In addition, Dan provided support when Kristine was teaching and helped small groups with their assignments or conducted guided reviews. It not necessary for a special education teacher to always take a lead role. There are six different models of co-teaching and their selection depends upon the content material, ecology of the class, and comfort level of the teachers implementing it (Friend & Cook, 2003; Villa et al., 2004).

Content knowledge familiarity plays a significant role in deciding the role and contributions of special education teachers in content-focused co-teaching contexts. The findings of this study indicate that the quality and quantity of the special education teacher's contribution changed over time with the increase in content knowledge. This implication is echoed by other researchers who also found that the in-depth content

knowledge of special education teachers in co-teaching not only helped them take lead roles; it also helped them make an active contribution in the partnership (Keefe & Moore, 2004; Mastropieri et al., 2005; Scruggs et al., 2007; Rice and Zigmond, 2000). With the emphasis on content preparation for highly qualified teachers and the use of measures such as PRAXIS to define content knowledge expertise, more research is needed to define content knowledge familiarity for special educators. Also, how would this content knowledge familiarity look for special educators teaching either across the content area or in self-contained classrooms?

In this study, Dan pointed out one significant issue during a team interview. Professional development could provide an opportunity to become familiarized with the content. Because special education teachers often co-teach across content areas, in-service professional development should provide opportunities regarding content knowledge familiarity and should include workshops for hands-on experience related to content-specific strategies. Dan described an interesting way to gain content knowledge that worked for him. He kept a journal, scheduled debriefing meetings with Kristine, and closely observed students in the biology class who were struggling with the concept. Special education teacher preparation programs could suggest these strategies to on-the-job teachers as a means to gain content knowledge while co-teaching.

In this study, Ball's model of PCK did provide evidence and an overview of Dan's pedagogical content knowledge. However, there was not enough data to support this evidence in terms of examples or activities that Dan contributed; he drew either from his special education background or from his common knowledge. More research is needed to collect qualitative and quantitative data on the contributions of special

education teachers and their PCK from the initial entry year in the co-taught classroom through a significant period of co-teaching implementation in order to analyze any change in the role of special educators as contributors. Questions such as what are the mediating factors that help in making contributions and is PCK one of them, should be explored?

Limitations of the Study

I was in the field for four months and observed the co-teaching once a week. I cannot say absolutely that these were the only strategies or examples or activities that the special education teacher conducted while teaching biology. I could not always follow Dan as he moved around in the classroom, so was not able to collect all information about what questions students were asking or what was he asking them to be sure they understood the content of the lesson. Even though I collected data using multiple data sources and did the member check to establish trustworthiness, it is possible that my findings would have been different if I had visited the school every day for four months.

Another limitation of this study was that even though I looked for student growth during the academic year in this co-taught biology class, I did not use any measures. Teachers' comments and verbal analysis were used as the data. No school records or documents were considered.

The third limitation of the study was that I did not specifically ask the special education teacher in the interviews or in the debriefings where he felt his knowledge of students came from that allowed him to identify or implement examples and/or activities.

Therefore, I did not have sufficient evidence to connect Dan's contributions in special education with Ball's knowledge of content and students category.

The last limitation of the study is that I did not use any tool to measure the special education teacher's content knowledge. The gain in the content knowledge expertise of the special education teacher in this study was self-reported and further confirmed by the general education teacher.

Summary

The study enumerated the contributions of the special education teacher in planning and co-teaching biology. This study also indicated that the special education teacher's content knowledge played a significant role in the contributions he was able to make, which is consistent with the literature. An interesting finding related to how he gained and used his content knowledge in the classroom in concert with the expertise of the regular education teacher. Lastly, it was possible to get a glimpse of the special educator's pedagogical content knowledge using Ball's model. However, more research is needed to define the nature of PCK in special education and how it is perceived by professionals in the field. This study also raises questions related to the role definition of special educators in the light of school reforms suggested by RTI. Do we actually need two teachers with identical knowledge and skills in co-teaching? (McKenzie, 2009).

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Appendix A

Tool for Measuring PCK

<i>Ball's PCK Categories</i>	<i>Ball's indicators (Ball et al, 2008)</i>	<i>Guided examples-Biology</i>	<i>Examples from the Teaching Episodes-one</i>	<i>Examples from the Teaching Episodes-two</i>
Knowledge of Content and Students (KCS)	<p>Teachers must anticipate what students are likely to think and what they will find confusing.</p> <p>When choosing an example, teachers need to predict what students will find interesting and motivating.</p> <p>When assigning a task, teachers need to anticipate what students are likely to do with it and whether they will find it easy or hard. Teachers must also be able to hear and interpret students' emerging and incomplete</p>	<p>Considering concepts with multiple scientific terminology and/or processes, concepts that are new to the students</p> <p>Considering examples from day-to-day life, personal experiences, or/and TV shows related to biology</p> <p>Considering activities that would help students either to</p>		

	<p>thinking as expressed in the ways that pupils use language.</p> <p>In addition to Ball's indicators-</p> <p>Anticipates while planning the struggles of students with disabilities such as difficulty with memory, abstract reasoning or taking notes</p>	<p>Considering activities such as copying long notes, multi-layered diagrams, difficult scientific terminology or processes</p>		
Knowledge of Content and Teaching (KCT)	<p>Teacher sequence particular content for instruction.</p>	<p>Breaking down a concept into different parts such as definition, types, examples or characteristics, so that is comprehensible by most students. Demonstrating relationships, similarities and differences between and among sub-topics.</p>		

	<p>They choose which example to start with and which example to use to take students deeper into the content.</p> <p>Teachers evaluate the instructional advantages and disadvantages of representation used to teach a specific idea and identify what different methods and procedures afford instructionally.</p>	<p>Providing examples that students might already know and then tapping into the information that the teacher wants them to know.</p> <p>Teaching topic “scientific process” through an experiment, so that students learn different steps by doing an activity, but understands it would be a challenge for some to make a connection between conceptual and procedural knowledge.</p>		
<p>Knowledge of Curriculum (KC)— Shulman’s Def.</p> <p>a.Lateral Curriculum knowledge</p> <p>b.Vertical Curriculum Knowledge</p>	<p>Knowledge of the curriculum being taught to the curriculum that students are learning in other classes</p> <p>Vertical knowledge includes “familiarity with the topics and issues that have</p>	<p>Considering examples or activities from geography, math, or English language arts</p> <p>Considering what students know about topic “heredity” then builds on it and also, what would</p>	.	

	been and will be taught in the same subject area during the preceding and later years in school and the materials that embody them” (Shulman, 1986, p.10)	they be learning in their next biology class about heredity		
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Appendix B

Interview Protocol

First Interview-Special Educator

Thanks for participating in this study. I assure you that information provided by you will be held confidential, and no identifying information will be used in the results. At any given point of the interview if you feel uncomfortable you could request to either stop the interview or audio tapping the information.

Section A: School Context

Describe the school in which you are currently working.

Describe the mission and vision statements of the school and how you see yourself connect to that.

How would you define inclusion?

What kinds of models for serving students with disabilities are used in your school?

How does your school support co-teaching?

Section B: Classroom context

How many students are there in your co-teaching class?

How many students with special need are there in this class?

What different disabilities you work with?

How long have you been working with these students?

Describe your class as a whole.

Describe the curriculum used in teaching biology in this class.

What state standards do you implement in teaching science at the high school level particularly in this science class?

Section C: Demographics

What is your educational background? How and where did you obtain your teaching license?

Tell me about your majors and minors that you took in undergraduate and/or graduate programs.

Which were your favorite and less favorite content areas, and why?

Describe some collaborative experience(s) you have had in your teacher preparation program. (like group projects, assignments, classroom activities, classes)

Section D: Teaching context

For how many years have you been teaching?

Walk me through your teaching experience.

What motivated you to go into teaching?

Why did you go in special education?

Tell me about yourself as a teacher.(teaching beliefs, philosophy, strengths, challenges)

What are your experiences in co-teaching? What core academic subjects have you been co-teaching in your current position?

What are your favorites co-teaching subjects and why?

For how long you have been in the current co-teaching position?

How did you come to participate in this co-teaching partnership?

Describe your current co-teaching role.

Second Interview-Special Educator

Section A: Co-teaching

Generic

How do you define co-teaching?

Explain benefits of co-teaching in inclusive settings

Describe one positive and one less positive co-teaching experience

What essentials do you think are important for effective co-teaching at the high school level and why?

School

What different models of co-teaching have you implement in your current school?

How did you decide upon on those models?

Is there any specific model that works better in the current biology class? Why?

Biology class

What factors encouraged you to be in the current co-teaching partnership?

Describe how you two plan, manage the instruction, and assessment (curriculum, instructional strategies, modifications & accommodations, assessment, IEP goals)

Tell me about how you and your co-teacher work through conflicts or unforeseen events

Tell me about what both of you bring to this partnership

Section B: Pedagogical content knowledge

Generic

How do you define pedagogies?

Are there content specific pedagogies? Give example

Why do you think it is important for a teacher to have mastery of content specific strategies?

Section C: Knowledge of students and teaching (Component)

What about students do you and your co-teacher keep in mind while planning a lesson?

What does each of you bring to the planning?

How do you anticipate misconceptions of students, if any, related to a specific concept while planning a lesson? Give an example

How do you address those misconceptions in planning as well as teaching that concept?

How do you identify evolving or partial understanding of students in different activities and assignments?

How do you decide that a particular concept requires an additional activity, example, or a narrative?

Section D: Knowledge of content and teaching (component)

What essentials do you keep in mind while breaking down a specific concept into sub-concepts?

What strategies do you implement for illustrating a connection between concept and sub-concepts or among sub-concepts?

How does knowledge of content help you decide appropriate strategies for a particular content?

How important is the special education teacher's content knowledge in co-teaching? Give an example

Section E: Knowledge of curriculum (component)

How important is the knowledge of horizontal and vertical curriculum for a special education teacher in co-teaching?

Is it important for a teacher to know what a student brings to the class for planning for a specific concept? Why or why not?

Do you think knowledge of curriculum helps you to identify and decide on teaching strategies for a particular concept? How?

Third Interview-Special Educator

How would you define science?

Why do you think it is important to include science in the school curriculum?

How do you think science should be taught at the high school level?

How do you help students see connections within the content material and between science and other subjects?

What do you want your students to take away from this biology class?
(facts/principles/science process/inquiry skills)

What different pedagogies do you use most in your biology class?
(examples/diagrams/experiments/concept maps/illustrations)

Do you think the nature and the use of these pedagogies would change if you were teaching chemistry instead? If so, how and if not, Why?

How often do you think of an alternative explanations while planning and teaching a concept and why?

How often do you engage the whole class in discussions and how do you involve students with and without disabilities in that?

How often do you demonstrate scientific principles in your biology class and how do you do that?

Do you think science could be taught through playing scientific games at the high school level? Explain benefits of this strategy.

How would you teach the following concept “parts of a flower” assuming you have 50/50 student population i.e. 50% students with disabilities and 50% students without disabilities?

What consideration would you keep in mind in doing so?

Do you think your knowledge in the special-education field would help you deciding on these pedagogies? How?

Do you think not having an educational background in science gets in your way deciding how to teach a particular concept? If so, give an example.

First Interview-General Educator

Section A: School Context

Describe the school in which you are currently working.

Describe the mission and vision statements of the school and how you see yourself connect to that.

How would you define inclusion?

What kinds of inclusion models are used in your school?

How does your school support co-teaching?

Section B: Classroom context

How long have you been working with the current biology students?

Describe your class as a whole.

Describe the curriculum used in teaching biology in this class.

Tell me about how you and your co-teacher work through conflicts or unforeseen events whether it is classroom management or planning a lesson.

Section C: Demographics:

What is your educational background? How and where did you obtain your teaching license?

Tell me about your majors and minors that you took in undergraduate and/or graduate programs.

Which were your favorite and less favorite content areas, and why?

Describe some collaborative experience(s) you have had in your teacher preparation program. (like group projects, assignments, classroom activities, classes)

Explain potential benefits and challenges of implementing collaborations at the high school level.

Section D: Teaching context

For how many years have you been teaching?

Walk me through your teaching experience.

What motivated you to go into teaching?

Tell me about yourself as a teacher (teaching beliefs, philosophy, strengths, challenges)

What are your experiences in co-teaching?

What are your favorites co-teaching subjects and why?

For how long you have been in the current co-teaching position?

How did you come to participate in this co-teaching partnership?

What factors encouraged you to be in the current co-teaching partnership?

Describe your current co-teaching role.

Tell me about what both of you bring to this partnership

Describe how you two plan, manage the instruction, and assessment (curriculum, instructional strategies, modifications & accommodations, assessment, IEP goals)

First Team Interview

Part I

Classroom environment

What considerations did you make while developing the seating arrangement plan/chart for the biology class? And will it remain the same for the entire school year.

How do you select materials and things that are displayed in the classroom or on the bulletin board?

Are students involved in this process of selection? If so, how?

How do you develop classroom norms or expectations?

How do you decide on the classroom supplies for your biology class? Is there any standard protocol or some guidelines for that?

Time management and transition

How do you decide the time framework for students to complete classroom activities?

What criteria do you observe in providing extra time to students for turning-in assessments, projects and/or homework?

What strategies do you implement indicating transition from one activity to another and from one concept to another?

Is there a standard protocol that you follow for incomplete homework and assignments? Explain

What different reinforcers do you provide to students when they meet the expectations and how are they decided?

Part II

Presentation of material-Differentiated instruction

What things do you keep in mind while developing the pacing guide for current biology class?

How do you make sure that students understand learning expectations of a lesson or a teaching unit?

Are your expectations same for all the students in the class? If so, how do you set the expectations for students with and without disabilities?

How do you finalize teaching strategies for teaching a specific concept? (needs of students/difficulty level of the concept/different learning styles)

Why do you select more than one teaching strategy for teaching a particular concept?

Do you think your knowledge of content plays a significant role in selecting these strategies? If so, how?

Are there any subject specific teaching strategies in science? If yes, give an example.

What about students do you keep in mind in creating handouts or fill in notes?

Assessment and grading

What different types of formative and summative assessments do you use in your biology class? And how do you finalize them?

Do you incorporate alternative assessment in your biology class? How do you decide? Give an example.

Second Team Interview

Walk me through the professional development process for teachers at your current school?

Do you have any PD goals for improving your co-teaching for the next school year? if so, how would you achieve them?

Explain if you have any PD goals for honing in new teaching strategies for teaching biology?

How does your school support your PD goals?

Did you get some orientation or attended some hands on workshop to co-teach before co-teaching? And did it help?

How did your co-teaching instructional partnership grow over the years? Give an example.

What strengths and areas of expertise you both bring in for teaching of science and how has it helped you in co-teaching?

How would you define Science?

Explain your goals for teaching science at the secondary school level.

How did you incorporate differentiated instruction in your current biology class?

Which teaching strategies do you think facilitate student interest and learning in science? Give an example.

What indicators tell you students were learning instead of just doing the activity or the lab work?

How do you integrate content, teaching strategies, and technology in your biology class?

Appendix C

Consent Letters/Forms

Informed Consent
UW - Milwaukee

IRB Protocol Number:12.139

IRB Approval date:11/9/2011

**University of Wisconsin – Milwaukee
Consent to Participate in Research**

Study Title: The role of pedagogical content knowledge (PCK) of a special education teacher in co-teaching at the secondary school level: A Case Study (*Changed*)

Person Responsible for Research: Doctoral student-Bharti Tandon and her advisor Dr. Judith Winn.

Study Description (Note to reviewer): The purpose of this research study is to explore the relationship between pedagogical content knowledge (PCK) and the role of a special education teacher in an effective co-teaching team at the high school level. One co-teaching team comprised of a general and a special education teacher will participate in this study.

For special education teacher: This study will focus on subject specific strategies that a special education teacher brings to co-teaching in order to provide substantive instruction to children with and without disabilities in a general education curriculum. Furthermore, the study will also explore how the teacher selects and implements different strategies in conjunction with knowledge of learners-their strength, misconceptions, and difficulties-in teaching a specific concept within a co-teaching partnership. I will be conducting a minimum for five audio-taped interviews; each will be approximately an hour in length. These interviews will be conducted outside of your work hours. I will also do at-least five classroom co-teaching observations. After the observations, I will most likely want to debrief with you about what occurred In addition, I will be collecting course artifacts such as your lesson plans, assessment tools, and school policies about co-teaching.

Risks / Benefits: Risks that you may experience from participating are considered minimal. I understand that you might feel hesitant to share information with me, but I anticipate you will feel more comfortable sharing information overtime. There are no costs for participating. You may be recognized as a participant of the study, but I will work to hide your identity. Your participation, and what I learn from it, will lead to me by providing suggestions to improving instruction in teacher preparation programs.

Confidentiality: Your information collected for this study is completely confidential and no individual participant will ever be identified with his/her research information. Data from this study will be saved on a password protected computer for five years and then destroy. Paper copies of the data will store in the privacy of the researcher's UWM office. Only Bharti Tandon, and her advisor Dr. Judith Winn will have access to the information. However, the Institutional Review Board at UW-Milwaukee or appropriate federal agencies like the Office for Human Research Protections may review this study's records.

Voluntary Participation: Your participation in this study is voluntary. You may choose not to take part in this study, or if you decide to take part, you can change your mind later and withdraw from the study. You are free to not answer any questions or withdraw at any time. Your decision will not change any present or future relationships with the University of Wisconsin Milwaukee.

Who do I contact for questions about the study: For more information about the study or study procedures, contact Bharti Tandon at btandon@uwm.edu and/or 414-232-8642 and Dr. Judith Winn at jwinn@uwm.edu and/or 414-229-4109.

Who do I contact for questions about my rights or complaints towards my treatment as a research subject? Contact the UWM IRB at 414-229-3173 or irbinfo@uwm.edu.

Research Subject's Consent to Participate in Research:

To voluntarily agree to take part in this study, you must be 18 years of age or older. By signing the consent form, you are giving your consent to voluntarily participate in this research project.

Informed Consent
UW - Milwaukee

IRB Protocol Number:12.139

IRB Approval date:11/9/2011

**University of Wisconsin – Milwaukee
Consent to Participate in Research**

Study Title: The role of pedagogical content knowledge (PCK) of a special education teacher in co-teaching at the secondary school level: A Case Study (*Changed*)

Person Responsible for Research: Doctoral student-Bharti Tandon and her advisor Dr. Judith Winn.

Study Description (Note to reviewer): The purpose of this research study is to explore the relationship between pedagogical content knowledge (PCK) and the role of a special education teacher in an effective co-teaching team at the high school level. One co-teaching team comprised of a general and a special education teacher will participate in this study.

For general education teacher: This study will focus on subject specific strategies that a general education teacher brings to co-teaching in order to provide substantive instruction to children with and without disabilities in a general education curriculum. Furthermore, the study will also explore how the teacher selects and implements different strategies in conjunction with knowledge of learners-their strengths, misconceptions, and difficulties-in teaching a specific concept within a co-teaching partnership. The focus is on the special education teacher but, as co-teaching is an important component, the teaching they both do will be important. The study will also investigate your input in planning, teaching, and/or evaluating students. I will be conducting a minimum of one audio-taped interview of you and the special education teacher on the team, which will be approximately an hour in length. These interviews will be conducted outside of your work hours. I also, will do five classroom co-teaching observations. After the observation, I will most likely want to de-brief with you about what occurred. In addition, I will be collecting course artifacts such as your lesson plans, assessment tools, and school policies about co-teaching.

Risks / Benefits: Risks that you may experience from participating are considered minimal. I understand that you might feel hesitant to share information with me, but I anticipate you will feel more comfortable sharing information overtime. There are no costs for participating. You may be recognized as a participant of the study, but I will work to hide your identity. Your participation, and what I learn from it, will lead to me by providing suggestions to improving instruction in teacher preparation programs.

Confidentiality: Your information collected for this study is completely confidential and no individual participant will ever be identified with his/her research information. Data from this study will be saved on a password protected computer for five years and then destroy. Paper copies of the data will store in the privacy of the researcher's UWM office. Only Bharti Tandon, and her advisor Dr. Judith Winn will have access to the information. However, the Institutional Review Board at UW-Milwaukee or appropriate federal agencies like the Office for Human Research Protections may review this study's records.

Voluntary Participation: Your participation in this study is voluntary. You may choose not to take part in this study, or if you decide to take part, you can change your mind later and withdraw from the study. You are free to not answer any questions or withdraw at any time. Your decision will not change any present or future relationships with the University of Wisconsin Milwaukee.

Who do I contact for questions about the study: For more information about the study or study procedures, contact Bharti Tandon at btandon@uwm.edu and/or 414-232-8642 and Dr. Judith Winn at jwinn@uwm.edu and/or 414-229-4109.

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Informed Consent
UW - Milwaukee

IRB Protocol Number:12.139

IRB Approval date:11/9/2011

UNIVERSITY OF WISCONSIN – MILWAUKEE
CONSENT TO PARTICIPATE IN RESEARCH
PARENT/STUDENT CONSENT FORM

1. General Information

Study title:

Title: The role of pedagogical content knowledge (PCK) of a special education teacher in co-teaching at the high school level: A Case Study (*Changed*)

In this research study I will be observing the co-teaching between the two teachers in your biology class-the way they teach, communicate, share ideas, and divide responsibilities. In addition I will be interviewing both teachers to understand the way they plan a lesson and use different methods in teaching a concept. To better understand how they work together, I am also going to be videotaping their teaching. You may be in the videotapes.

Person in Charge of Study (Principal Investigator):

PI-Judith Winn PhD
Associate Professor
Department of Exceptional Education
University of Wisconsin-Milwaukee

Student PI- Bharti Tandon
Doctoral Student
University of Wisconsin-Milwaukee

This study is not sponsored but is one of the requirements in my PhD program.

2. Study Description

You are being asked to participate in a research study. Your participation is completely voluntary. You do not have to participate if you do not want to.

Study description:

The purpose of this study is to understand co-teaching between the two teachers teaching your classroom. I will be coming on most Wednesdays during the 3rd and 4th term of your academic year and will be observing and videotaping first teaching block, biology, during my visits. My focus is on the teachers and how they teach. I will be observing and videotaping the class.

3. Study Procedures

What will I be asked to do if I participate in the study?

Since my focus is on classroom teaching, I would like you to participate in classroom activities as usual. The reason I am video recording classroom teaching is that it will help me to understand the way you're both teachers work together. If you decide not to be recorded, you can stay in the class. Those students who do not wish to be recorded will have their faces obscured.

4. Risks and Minimizing Risks

What risks will I face by participating in this study?

There are no foreseeable risks for participating in this research study.

5. Benefits

Will I receive any benefit from my participation in this study?

You would be helping in the completion of my dissertation research project about how your teachers work together.

6. Study Costs and Compensation

Will I be charged anything for participating in this study?

You will not be responsible for any of the costs from taking part in this research study.

Are subjects paid or given anything for being in the study?

You will not be paid or give extra credits for taking part in this research study.

7. Confidentiality

What happens to the information collected?

All information collected about you during the course of this study will be kept confidential to the extent permitted by law. We may decide to present what we find to others, or publish our results in scientific journals or at scientific conferences. Information that identifies you personally will not be released without your written permission. Only, Bharti Tandon and her advisor Judith Winn will have access to the information. All video-tapes will be stored in a locked cabinet. They would be destroyed in one year after completing this study.

8. Alternatives

Are there alternatives to participating in the study?

If you decide not to be videotaped, that is fine. That is the only thing beyond participating in class that we are asking you to be in the videotapes while you are doing your regular work.

9. Voluntary Participation and Withdrawal

What happens if I decide not to be in this study?

Your participation in this study is entirely voluntary. You may choose not to be videotaped. Those students who do not wish to be recorded will have their faces obscured. Your decision will not change anything in the XXXX High School.

10. Questions

Who do I contact for questions about this study?

For more information about the study or study procedures, contact Bharti Tandon at btandon@uwm.edu and/or 414-232-8642 and Dr. Judith Winn at jwinn@uwm.edu and/or 414-229-4109.

Who do I contact for questions about my rights or complaints towards my treatment as a research subject?

The Institutional Review Board may ask your name, but all complaints are kept in confidence.

Institutional Review Board
Human Research Protection Program
Department of University Safety and Assurances
University of Wisconsin – Milwaukee
P.O. Box 413
Milwaukee, WI 53201
(414) 229-3173

11. Signatures**Research Subject's Consent to Video Recording:**

It is okay to videotape me while I am in this study and use my videotaped data in the research

Students consent:

Parental/Guardian Consent:

Principal Investigator

I have given this research subject information on the study that is accurate and sufficient for the subject to fully understand the nature, risks and benefits of the study.

BHARTI TANDON

University of Wisconsin-Milwaukee, School of Education
2400 E Hartford Ave, Enderis 610, Milwaukee, WI 53201
btondon@uwm.edu

University of Wisconsin-Milwaukee Milwaukee, WI
Doctor of Philosophy in Special Education May 2013
Dissertation: An Exploration of a Special Educator's Contributions to Co-teaching in Relation to Content and Pedagogical Content Knowledge (PCK).

HONORS AND AWARDS

UW-Milwaukee School of Education Scholarship	2011-2012
UW-Milwaukee Chancellor's Graduate Student Award	2008-2012
Graduate Student Travel	2010-2013
Asian Staff and Faculty Award	2009-2010

PRESENTATIONS

Tandon, B. (2013). *Contributions of a Special Educator in Co-teaching Biology at the High School Level*. Annual School of Education Poster Presentation. University of Wisconsin-Milwaukee, Milwaukee, WI.

Tandon, B. (2013). *Inclusive Education in India: An Overview*. Council for Exceptional Children, San Antonio, TX.

Otis Wilborn, A. & **Tandon, B.** (2012). *Disseminating your work through Poster Presentations*. Fall 2012 School of Education Research Forum. University of Wisconsin-Milwaukee, Milwaukee, WI

Tandon, B. (2012). *The Role of Pedagogical Content Knowledge (PCK) of a Special Education Teacher in Co-teaching at the High School Level: A Case Study*. Teacher Education Division (TED) Conference, Grand Rapids, Michigan, MI.

Tandon, B. (2012). *Special Education in India: What Needs to be in Place?* Presentation at Council for Exceptional Children Convention & Expo. Denver, CO.

Tandon, B. (2011). *The Role of Pedagogical Content Knowledge in Co-teaching: An Exploratory Study*. Presentation at Teacher Education Division (TED) Conference, Austin, TX.

Otis Wilborn, A. & **Tandon, B.** (2011). *Cyber Supervision in Special Education*. Presentation at Teacher Education Division (TED) Conference, Austin, TX.

Hung, Y & **Tandon, B.** (2011). *Co-teaching as a Collaborative Strategy in Teacher Preparation Programs*. Presentation at Scholarship of Teaching and Learning (SOTL) Conference, Milwaukee, WI.

Tandon, B. (2011). *The Influence of Pedagogical Content Knowledge on Co-teaching of a High School Special Educator*. Presentation at School of Education Conference, UW-Milwaukee, Milwaukee, WI.

Tandon, B. (2010). *What Novice Special Educators say about Barriers to Collaboration?* Poster presentation at Teacher Education Division (TED) Conference, St.Louis, MO.

Tandon, B., & Drame, E. (2010). *Barriers to the Implementation of Collaborative Strategies by Novice Special Educators*. Poster Presentation at UW System President's Summit Conference, Madison, WI.

Winn, J., Drame, E., & **Tandon, B.** (2010). *Supporting New Special Education Teachers: Mentor Support and Resiliency Strategies*. Presentation at Council for Exceptional Children (CEC) Conference, Nashville, TN.

Otis-Wilborn, A., Winn, J., and **Tandon, B.** (2009). *Improving Teaching through Looking at Student Work*. Presentation at Spring Tonic Conference, Manitowoc, WI.

Otis-Wilborn, A., Winn, J., & **Tandon, B.** (2009). *Formative Assessment Skills in Pre-service Special Education Teachers*. Presentation at Teacher Education Division (TED) Conference, Charlotte, NC.

PUBLICATIONS

Tandon, B., Drame, E., & Owen, L. (2012). Beginning General and Special Educators Perceptions of Collaborative Instruction in Inclusive Settings. *International Journal of Education and Psychological Research*. 1(2), 36-44.

Drame, E.R., Martell, S.T., Oxford, R., & **Tandon, B.** (2010). Pre-service educators' understanding of science and the value of informal settings in supporting academic learning in urban students. *Myriad*, 10-14.

WORK IN PROGRESS

Tandon, B. & Hung, Y.T. (2012). *Co-teaching and teacher preparation programs*. (Currently transcribing audiotape interviews of faculty and instructors in teacher preparation programs).

REVIEWER

Kaleidoscope, Teacher Education Division of Council for Exceptional Children.	2011-12
Teacher Education Division of Council of Exceptional Children (TED)	2012
International Society for the Scholarship of Teaching & Learning (ISSOTL)	2012 & 13
Journal of International Special Needs Education	2013

GUEST EDITOR

Journal of International Special Needs Education	2013
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PROFESSIONAL AFFILIATIONS

Council of Exceptional Children (CEC)

- Division for Teacher Education (TED)
- Division of International Special Education and Services (DISES)
- Division of Culturally and Linguistically Diverse Exceptional Children (DDEL)

American Education and Research Association (AERA)

- Division K: Teaching and Teacher Education
- SIG: Special Education Research

International Society for the Scholarship of Teaching and Learning (ISSOLT)

International Association of Special Education (IASE)