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A Multiple Case Study of Co-Teachers' Technology Integration Knowledge: How It Is Held, Built, and Shared

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A MULTIPLE CASE STUDY OF CO-TEACHERS' TECHNOLOGY INTEGRATION KNOWLEDGE: HOW IT IS HELD, BUILT, AND SHARED

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Deborah Ann Grosser

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Table of Contents

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Abstract

This multiple case study explored how secondary-level co-teachers hold, build, and share knowledge related to technology integration. Co-teaching, a special education service delivery model, involves a general and special educator who share responsibility for planning, delivering, and assessing instruction (Friend, 2014). Through the lens of the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006), I explored the perspectives and experiences of four co-teaching pairs who regularly integrated technology into instruction. Study results suggested that these teachers held knowledge, beliefs, and values that influenced their classroom practices. The micro-level contextual elements in the teachers' workplaces, along with meso-levels supports, influenced how the teachers built and shared knowledge with and from each other. Their collaborative relationships, which were based upon parity, respect, and communication, supported a professional work environment of sharing and learning. As these teachers engaged in dialogue within their teaching and learning partnerships, individually-held knowledge (TPACK) was distributed between the co-teachers. Content-, grade-, and school-level collaborations addressing technology integration also resulted in the distribution of TPACK school-wide. Implications of these results include recommendations for how school leaders may support effective co-teaching, which can enhance teachers' professional learning related to technology integration and encourage the development of distributed knowledge.

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CHAPTER 1: INTRODUCTION

Picture a sixth grade classroom that has two teachers and three small groups of students engaged in various activities using technology. One group is sitting on the floor operating iPad minis to solve math problems and illustrate their results; another is completing worksheets with math problems using calculators; and a third group is solving math problems by manipulating visuals on an interactive whiteboard in the front of the room. All students are focused on the work they are doing and teachers are providing support and facilitation where needed. Each teacher stays close to one of two groups. The third group works independently. There are many sounds in the classroom, but the volume is not overly loud. Students are talking with one another and to their teachers while they are completing their work. The atmosphere is upbeat, and there is a sense of excitement in the room. At regular intervals an electronic timer notifies students to move as a group from one station to another in the room.

On another day in this same classroom, students are engaged in a large-group activity with both teachers presenting and facilitating activities as a team. One teacher uses the interactive whiteboard to model a math problem using virtual manipulatives on the screen. When it appears that not all students understand the content, the second teacher operates the document camera and models the same problem using a worksheet. Students are then paired to complete similar problems on their own. They will be asked to share their solutions on the whiteboard and will provide feedback to one another. As

before, the classroom atmosphere is active, and there is talking and movement in the room.

Co-Teaching Case Study

These descriptions provide examples of co-teaching partners who are integrating technology into instruction. Co-teaching is an instructional approach that requires two licensed professionals to share planning and delivery of instruction to a diverse group of students (Friend, 2014; Murawski, 2009). The purpose of co-teaching is to provide special education services, defined as specially designed instruction, to students with disabilities. In the case from a previous study described here, one teacher, Gina, was a middle school math teacher and the other, Gayle, was a special education teacher.

The co-teachers described here participated in a multiple case study that was designed to explore the elements that influenced their decision-making related to technology integration (Theisinger & Grosser, 2016). Two middle school co-teaching pairs participated in the study—Gina and Gayle as introduced above, and Carla and Carmen (all pseudonyms used to protect confidentiality). The results of this study indicated that context, interpersonal elements, and teaching and learning influenced the decisions that the teachers made related to technology integration. These will be described in more detail below.

Results of Case Study

Contextual elements that influenced co-teachers' decisions regarding technology integration included those that would be part of any typical school setting, such as available time and resources, student characteristics, and district policies and practices (Theisinger & Grosser, 2016). Contextual elements also included the unique

characteristics of the co-taught classroom, such as the beliefs and perceptions of each teacher, the co-teachers' expertise in collaboration and partnering, and the diverse needs of the students in each of the two settings. The unique context of the co-taught classroom afforded the availability of two teachers simultaneously, making possible the use of multiple approaches to grouping students for instruction. For example, Gayle and Gina had enough iPads for half of the students to use them individually at one time. However, because there were two teachers in the room, they were able to use station teaching, a co-teaching approach whereby students are grouped and rotate between stations (Friend, 2014), to provide opportunities for all students to access these devices at some point during a single lesson. Thus, the unique co-teaching context made it possible for all students to participate in math activities using iPads on a single day.

Interpersonal elements that influenced the teachers' decision-making regarding technology integration included the relationship between the teachers, as well as the relationships between teachers and students (Theisinger & Grosser, 2016). Co-teachers participate in a collaborative relationship within one classroom (Friend, 2014; Murawski, 2009). In this case study, the teachers' backgrounds, experiences, and beliefs influenced both how they interacted with one another in the shared classroom, and the decisions they made related to technology integration (Theisinger & Grosser, 2016). Further, these teachers' interactions with students and their concern with student engagement, enthusiasm, and behavior influenced their technology-related decision-making. For example, Gayle discussed the nature of the classroom vis-a-vis her interactions with Gina and their collaborative decisions that supported student learning. Gayle stated,

> I mean the way we work together is we don't really even think about it. We interject. We bounce things back and forth. It's very...I don't want to say free because that doesn't sound right...but it is. It is a very free flowing classroom. We have the flexibility with our relationship where we can look at the kids, and we can look at what's going on, and we know if what we planned is not working, we change it right then and there. And if sometimes it's to include more technology because the kids aren't really getting it? We'll just throw that in. So, sometimes it's a...I don't want to say it is spur of the moment, but it's a reaction to the way the students are getting the information.

Gina illustrated how interpersonal relationships with students influenced her decision-making regarding technology integration as she noted that she learned alongside her students, and at times, from her students (Theisinger & Grosser, 2016). This was illustrated during a classroom observation when a student noticed that Gina did not know how to erase the interactive white board "the quick way." The student explained to Gina how to do this. Carla also learned along with her students, stating, "We'll do something and if it doesn't work out just right, I'll sit down next to the student and we'll figure it out together. So it's learning as I go."

Lastly, teaching and learning elements that influenced the participating teachers' decision-making regarding technology integration included individual teachers' characteristics as well as consideration of how technologies would support student learning (Theisinger & Grosser, 2016). As described above, teachers in this study often took on the role of learner, which ultimately led to increased technology integration. For example, Gayle said that she spent time experimenting with technologies to learn more

about how these might support student learning. Gina noted that she learned about technology integration from other teachers in the grade-level team, the educational technology specialist in the school, and her co-teaching partner. Both teachers were willing to learn more about technology integration if they saw that it could support student engagement and achievement.

Technology-Related Knowledge

Although the multiple case study noted here was focused upon the teachers' *decision-making processes* related to technology integration in the co-taught classroom, the results also provided some insight into co-teachers' technology-related *knowledge* (Theisinger & Grosser, 2016). Such knowledge was held individually by teachers, built within the context of their classroom and school, and shared through their co-teaching partnership.

Knowledge that is held by co-teachers. Although all teachers in the study indicated some level of technological knowledge, in both cases studied, one of the co-teaching partners held more knowledge and expertise in technology integration than the other (Theisinger & Grosser, 2016). For Gayle and Gina, it was the special educator who possessed these skills. In the case of Carmen and Carla, the general education teacher had greater technology-related knowledge.

Knowledge that is built by co-teachers. Teachers in this study stated that they learned from one another in the process of sharing ideas and strategies (Theisinger & Grosser, 2016). For example, Gina indicated that she learned from her co-teaching partner through co-planning lessons, and that Gayle's sharing of her experiences with technology supported Gina's skill development. As Gina increased her knowledge about

technology from Gayle, she became more comfortable with integrating technology into instruction, and stated that she was more likely to do so both within the co-taught classroom as well as in her other, solo-taught classes.

The teachers in this case study also indicated that they worked individually to develop technology-related skills that would support student learning (Theisinger & Grosser, 2016). Carla noted that she was always learning and worked to keep abreast of instructional strategies that best supported her students. She spent time learning on her own, as she did when she learned to use the video software the students were taught to use on their Chromebooks. Gayle also spent time learning on her own, expending extra effort to do so. Gina stated, "If I'm at home, I'll go online and then I'll look at tutorials for how to do stuff. You just have to do it—you just have to practice it."

Knowledge that is shared by co-teachers. At times the co-teachers in this study shared their knowledge (Theisinger & Grosser, 2016). Carla noted that she and Carmen were able to blend their areas of expertise to support student learning. She stated, "[Carmen] is the queen of finding the technology and finding the ideas. Then she sits with me and we talk about whether my students have the attention span or the interest in it."

Further information is needed that relates to all three of these areas. Although the co-teachers in this study referenced which partner held more technology-related knowledge, not enough detail was included to fully understand how knowledge-holding and –sharing occurred in this co-teaching context. Further study with a direct focus on co-teachers' knowledge of technology integration would provide more clarity and

understanding of how co-teachers' technology-related knowledge is held, built, and shared.

Teachers' Knowledge

Teacher knowledge may be an important component in the adoption of technologies to support instruction (Hechter & Vermette, 2013). Summaries of research on effective teachers indicate that there are several common characteristics of quality teachers (Porter & Brophy, 1988; Rice, 2003). Listed among these characteristics are teachers' content and pedagogical knowledge that is used to support student learning. Shulman (1986) identified three components of teachers' content knowledge: knowledge of subject matter, knowledge of how to teach this subject matter, and knowledge of programs and materials used to assist with teaching the subject matter. Pedagogical knowledge includes instructional strategies, classroom management practices, goal setting, and progress monitoring (Porter & Brophy, 1988). Effective teachers make use of materials and resources in ways that will enhance student learning. Shulman (1987) later identified another form of knowledge, termed pedagogical content knowledge (PCK). This is defined as a special blending of content and pedagogy such that teachers transform content knowledge into meaningful learning for students. Current research indicates that teachers' effective integration of technology into instruction is dependent upon their level of *technological* pedagogical content knowledge (Koehler, Mishra, & Cain, 2013). Teachers must know their subject area, effective strategies for teaching students this content, and the affordances and constraints of using different technologies in various ways to enhance teaching and learning within the complex contexts of their classrooms.

Some research indicates that teacher knowledge may be developed in part through dialogue and interactions with fellow educators (e.g., Nore, Engelien, & Johannesen, 2010; Putnam & Borko, 2000). Specifically, Nore et al. (2010) noted that teachers' knowledge related to technology integration could be developed through collaboration with other educators within the school setting. Teachers who reflect upon their experiences can adopt successful practices and adapt or discard those that are not successful (Hashweh, 2013; Shulman, 1987). These notions of teachers' collaborative knowledge-building, along with research-based notions of the nature of teachers' knowledge, will be explored in more depth in Chapter 2.

Co-teachers' knowledge. Research related to co-teachers' knowledge indicates that they may not share similar levels and types of expertise (Linz, Heater, & Howard, 2008; Mastropieri et al., 2005; Sileo & van Garderen, 2010). General educators typically possess knowledge of content and content-specific pedagogies that support students in learning this content (Austin, 2001; Murawski, 2009; Pratt, 2014). In contrast, special education teachers typically possess knowledge of learning strategies to support students with disabilities in the classroom (Walther-Thomas, Korinek, McLaughlin, & Williams, 2000). Additionally, special education teachers have knowledge of how to individualize instruction and how to monitor progress towards mastery (Friend, 2014). The blending of these areas of expertise in a co-teaching context is meant to ensure that students with disabilities have full access to and make progress within the general education curriculum.

Co-teaching research indicates that co-teachers can learn from one another through dialogue and reflection (Roth, 2002; Rytivaara & Kershner, 2012). As co-

teachers discuss past practices and generate new ideas, they can expand their knowledge bases related to content knowledge and instructional practices (Rytivaara & Kershner, 2012). They can mentor one another in learning new skills in content and pedagogy (Pratt, 2014). As such, co-teachers may also influence one another in their development of knowledge related to technology integration, as indicated in the results of the case study described above.

Research related to co-teachers' knowledge does not address technological pedagogical content knowledge directly, but Mastropieri et al. (2005) noted in their case study that the special educator took the lead in technology integration. The authors posited that the teachers' background experiences might have influenced the division of workload. This leads to further questions about co-teachers' knowledge related to technology integration. How does each co-teacher hold this knowledge? Do they share knowledge related to technological pedagogical content knowledge? How is this knowledge built within the co-teaching context?

Further Study Needed

The co-teachers in the case study described above overcame several obstacles—such as connectivity issues, lack of knowledge and experience with technology integration, and time factors—to ensure that technology was incorporated into their lessons (Theisinger & Grosser, 2016). One teacher stated, for example, that she did this because "[technology] really makes a difference [in student learning]." As co-teaching partners, these teachers had a shared goal of supporting student learning with technology integration. Did the partnership influence the teachers' technology integration knowledge development and use? As one teacher stated,

> But her and I always do *everything* together. And we do bounce ideas off each other. And we'll be like, what do you think about that? And one of us is like, I don't know, let's try…or I don't know, maybe we can do this. But we always decide together what's best for that class.

The case study described in this chapter provides limited insight into co-teachers' knowledge related to technology integration (Theisinger & Grosser, 2016). Co-teachers in both cases indicated that technological knowledge was held and developed individually, and was built through collaboration and discussion, as well as through the support of other educators.

This limited exploration of two cases of technology integration within co-taught classrooms raises more questions about how co-teachers hold, build, and share knowledge related to technology integration. Further, current research related to co-teachers' knowledge provides limited information related to these questions. This information is critical to ensuring that the most effective instruction is provided so that students with disabilities can access and make progress in the general education curriculum with the support of digital tools and resources. It will, therefore, be the focus of this research study to answer the question, how do co-teachers hold, build, and share knowledge related to technology integration? Chapter 2 provides further information about what is currently known regarding the topics directly related to this research focus.

CHAPTER 2: REVIEW OF LITERATURE

The current atmosphere of high-stakes assessments, strong accountability measures, and multiple policies and regulations that impact public schools makes teaching a particularly challenging profession (Leyser, Zeiger, & Romi, 2011). Much of the current legislation requires that the needs of all children be met in the general education setting to the extent appropriate (Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010; Murawski, 2009). Serving students with disabilities in the general education setting provides a complex set of challenges, including ensuring effective instruction, providing appropriate supports, and meeting the needs of students with disabilities as well as other students from varying backgrounds in the classroom (Leyser et al., 2011). Effective teaching within this context requires intricate knowledge and skills to ensure student learning.

Educational uses of digital technologies can enhance learning and support access to general education content for students with disabilities (Anderson, Anderson, & Cherup, 2009; Boon, Burke, Fore, & Spencer, 2006; Thomas et al., 2012). However, appropriate use of this technology must be embedded into effective instruction (Kennedy & Deshler, 2010; S. J. Smith & Okolo, 2010). District- and school-wide initiatives have encouraged use of technology to enhance student learning, yet teachers may not have the skills needed to implement these technologies effectively (Beacham & McIntosh, 2014).

In addition to district- and school-wide technology initiatives, there are legal requirements to use technology for students with disabilities within the Individuals with

Disabilities Education Act (IDEA, 2004) and Every Student Succeeds Act (ESSA, 2015). Federal Regulations under IDEA (2004) state,

> Almost 30 years of research and experience has demonstrated that the education of children with disabilities can be made more effective by . . . supporting the development and use of technology, including assistive technology devices and assistive technology services, to maximize accessibility for children with disabilities. (IDEA, 2004, 20 U.S.C. 1400(d) § 601.(c)(5)(H))

Further, this law requires that each school division "must ensure that assistive technology devices or assistive technology services, or both . . . are made available to a child with a disability" (IDEA, 2004, 20 U.S.C. 1400(d) § 300.105). ESSA (2015) requires that states use funds to "increase access to personalized, rigorous learning experiences by . . . [using] technology, consistent with the principles of universal design for learning, to support the learning needs of all students, including children with disabilities" (20 U.S.C. 7119 § 4104(b)(3)(C)(i)(II)).

These laws mandate classroom expectations for technology integration and inform local policies for instructional practices (Leyser et al., 2011). Although pedagogical practices may be influenced by federal, state, or local policies, teachers are, in effect, "gatekeepers" (Van Hover, Hicks, & Sayeski, 2012, p. 281) to policy implementation. In other words, teachers make the final decisions in terms of what practices they will adopt in their classrooms, translating policy into practice (Ramsaroop & van Rooyen, 2013).

Teachers who do not feel comfortable with their knowledge related to technology integration may not incorporate technologies into their teaching (Hechter & Vermette,

2013). There is much research related to knowledge and skills teachers need to support student learning (Porter & Brophy, 1988; Ramsaroop & van Rooyen, 2013) and knowledge and skills needed to effectively integrate technology into classroom instruction (Koehler et al., 2013). The level of expertise that is needed for technology integration "is a complex, multi-faceted challenge" (Hofer & Swan, 2006, p. 182).

An additional challenge for some teachers is the integration of technology into a classroom in which they are expected to co-teach. Co-teaching is a service delivery model for special education services that involves the partnering of two licensed professionals, generally a general education teacher and a special education teacher, who share planning, delivery, and assessment of instruction (Friend, 2014; Murawski, 2009). These educators share a classroom of students and provide access to general education curriculum for students with disabilities, and the evidence-based instructional strategies that support students with disabilities in learning the subject matter (Friend, 2014; Friend et al., 2010; Murawski, 2009). This collaboration offers a means for providing effective instruction in the general education setting (Murawski, 2009; Scruggs, Mastropieri, & McDuffie, 2007), and is meant to increase opportunities for success of students with disabilities in the classroom (Magiera, Smith, Zigmond, & Gebauer, 2005). Each teacher in a co-teaching relationship typically offers differing types of expertise, and must learn how to blend knowledge and skills to ensure student learning (Scruggs et al., 2007; Sileo & van Garderen, 2010; Walsh, 2012).

I am interested in exploring the nature of teachers' knowledge as it relates to technology integration within the co-taught classroom. Research is lacking related to the nature of co-teachers' knowledge of effective technology integration that supports student

learning. How is this knowledge held, built & shared in the context of the co-taught classroom? Exploring this issue may inform effective partnering of special educators and general educators, and identify the professional learning they need to reach all students through technology-enhanced instruction.

Learning for All

ESSA (2015) and IDEA (2004) both mandate through their respective accountability measures that students with disabilities have access to the general education curriculum. ESSA (2015) requires that schools promote, "consistent with the Individuals with Disabilities Education Act (20 U.S.C. 1400 et seq.), the involvement and progress of students with the most significant cognitive disabilities in the general education curriculum" (20 U.S.C. 7119 § 1111(III). Specifically, these laws require that all students are included in accountability assessments, are taught by teachers who meet licensing criteria, and have access to the same content standards as their nondisabled peers. The expectation is that all students will be taught using the same rigorous curriculum to ensure equity (Friend, 2014). Additionally, IDEA (2004) requires that teachers use research-validated strategies to support the learning of students with disabilities, noting that services must be "based on peer-reviewed research to the extent practicable" (20 U.S.C. 1400(d) § 300.320(a)(4)).

IDEA further requires that students with disabilities receive instruction in the "least restrictive environment" (IDEA, 2004, 20 U.S.C. 1400(d)) § 612.(a)5)—the environment in which students are able to make academic progress, provided their unique needs are addressed through special education services and supports. The delivery of special education services in the least restrictive environment is not the same for every

student with a disability, but access to the general education curriculum is required for all.

Access to General Education Curriculum

Based upon the requirements of IDEA, the general education setting is the default placement for students with disabilities (Friend, 2014; Van Hover et al., 2012). Both IDEA (2004) and ESSA (2015) ensure that students with disabilities have access to the same curricular standards as their nondisabled peers. IDEA (2004) was passed to ensure that children with disabilities have access to "a free appropriate public education" designed to prepare them for "further education, employment, and independent living" (20 U.S.C. 1400(d)) § 300.1) As such, schools are required to develop Individualized Education Programs (IEP) for students with disabilities who are determined eligible for special education. These programs include the provision of special education services. For most students with disabilities, these services are provided in the general education classroom (Murawski, 2009).

Special education services, defined as specially designed instruction, may be provided through a continuum of service delivery models (IDEA, 2004). Specially designed instruction is defined as

> adapting, as appropriate to the needs of an eligible child under this part, the content, methodology, or delivery of instruction to address the unique needs of the child that result from the child's disability, and to ensure access of the child to the general curriculum, so that the child can meet the educational standards . . . that apply to all children. (20 U.S. C. 1400(d) § 300.39(b)(3))

Specially designed instruction is provided to students with disabilities through a variety of service delivery models, selected according to the unique needs of each student.

Service delivery models include, but are not limited to, instruction in a general education classroom where the general education teacher receives consultation from a special educator, instruction in a co-taught classroom that includes both a special education teacher and a general education teacher (co-teaching), or instruction in a separate classroom for all or part of the day (Friend, 2014). Co-teaching is one of the most frequently used service delivery models (Murawski, 2009).

Co-teaching. Co-teaching allows for the provision of special education services within the general education setting (Friend & Cook, 2007). The characteristics unique to co-teaching include (a) the presence of two licensed professionals, (b) shared delivery of instruction, (c) teaching a diverse group of students, and (d) a shared classroom. This model requires close collaboration between the special educator and the general educator (Friend, 2014). Each professional plays a critical role in the planning and delivery of instruction to ensure individual student needs are met through specially designed instruction.

History of co-teaching. Co-teaching has a long and varied history (Walther-Thomas et al., 2000). It began as a general education approach in the 1950s when team teaching was implemented in high schools (Friend, 2014). Later, the open school movement continued this approach to teaching (Walther-Thomas et al., 2000) and it extended into elementary classrooms (Friend, 2014). The difference was that these practices involved two general education teachers and a larger teacher-student ratio. After Public Law 94-142 (now called IDEA) was enacted in 1975, co-teaching was introduced

as a means to bring students with disabilities into the mainstream of education (Murawski, 2009; Walther-Thomas et al., 2000). These early practices did not address access to the general education curriculum, however. Rather students with disabilities joined general education classrooms, but were not necessarily engaged in the instruction (Murawski, 2009).

It was not until the 1980s that co-teaching was implemented as a means for students with disabilities to engage with their peers in the learning environment (Friend, 2014). Co-teaching has grown considerably under the current mandates and educators have begun to consider the potential benefits to students with disabilities when true collaboration occurs within the co-taught classroom.

Currently, 94.8% of students with disabilities in Kindergarten through 12th grade are served in the general education classroom for at least part of the school day (United States Department of Education [USDOE], 2014). Co-teaching is a frequently used and widely implemented service delivery model for serving students with disabilities in the general education setting (M. Friend, personal communication, September 13, 2015; Murawski, 2009). Despite the prevalence of co-teaching, there is limited research as to the effectiveness of this approach related to student outcomes (Friend, 2014; Pearl, Dieker, & Kirkpatrick, 2012; Strogilos & Stefanidis, 2015).

Co-teaching approaches. Co-teaching may occur across all content areas and includes six different instructional approaches that are chosen based upon student need and instructional content (Friend et al., 2010). These approaches include (a) one teach/one observe, (b) station teaching, (c) parallel teaching, (d) alternative teaching, (e)

team teaching, and (f) one teach/one assist (Friend, 2014). Each of these approaches has a different purpose and varying degrees of frequency for use.

One teach/one observe involves brief periods of time in which either teacher conducts the lesson while the other gathers important academic and/or behavioral data through observation (Friend, 2014). Data collection may involve one student, a small group of students, or the whole class. Both teachers share decision-making regarding data collection methods and purposes of data collection in advance of the lesson.

Station teaching is helpful when content is best divided into chunks and addressed through a small-group approach (Friend, 2014). Teachers divide the students into multiple groups, one for each planned station where differing content and skills may be addressed, but not sequentially. Each teacher works with a group of students, and students in the other group(s) complete tasks independently. The students then rotate between stations.

Parallel teaching also involves breaking students into smaller groups, but in this case it is two groups of the same size (Friend, 2014). Each group receives the same instruction from one of the teachers. The groups typically do not rotate. Similarly, alternative teaching requires breaking students into two groups to receive instruction from one teacher, but the groups are not of equal size and do not receive the same instruction. In this approach, the smaller group receives remediation, pre-teaching, or acceleration.

Team teaching is used less frequently than the others described here (Friend, 2014). In this approach both teachers lead instruction with the entire class at the same time. It is most often used in experienced partnerships that are comfortable with one

another. It is more difficult to address individual needs with this approach and is therefore recommended for occasional rather than frequent use.

One teach/one assist is the most often used approach (Fenty & McDuffie-Landrum, 2011; Solis, Vaughn, Swanson, & McCulley, 2012; Wischnowski, Salmon, & Eaton, 2004), however it should be the least used (Friend, 2014). One teach/one assist involves one teacher taking the lead for instruction while the other supports students by monitoring student understanding, addressing behavioral issues, handing out materials, or answering student questions.

Co-teaching approaches may be combined within one classroom (Friend, 2014). Decisions about which approaches to use are made jointly in advance and are based upon content, instructional activities, and individual student needs.

Components of co-teaching. Co-teaching requires effective collaboration and communication between partnered teachers (Friend et al., 2010; H. J. Lee & Herner-Patnode, 2009; Murawski, 2009). Professional collaboration involves understanding each other's areas of expertise (Friend et al., 2010), respecting one another as professionals, and valuing one another's skills (Walther-Thomas et al., 2000). Collaboration requires that co-teachers understand roles and responsibilities (Hang & Rabren, 2009; H. J. Lee & Herner-Patnode, 2009) to negotiate how these will be shared and distributed within a single classroom (Friend, 2014). Additionally, collaboration involves flexibility with practices and commitment to the partnership.

Communication is critical both within in the partnership and with others external to it, such as parents, other educators, and administrators (Walther-Thomas et al., 2000). Co-teachers both communicate with external parties regarding student progress. They

must send the message that they are a team and that they share responsibility for the students in their classroom. Additionally, co-teachers must communicate with one another about student progress, instructional goals, and decision-making (Friend, 2014). Ongoing discussion and dialogue builds the co-teaching relationship and establishes a strong partnership (Walther-Thomas et al., 2000). Effective co-teaching results from regular communication about how best to collaborate in terms of teaching and learning (Friend, 2014).

Choice and compatibility are critical components of effective co-teaching (Scruggs et al., 2007). In their meta-analysis of qualitative research studies related to co-teaching, Scruggs et al. found that co-teaching is most effective when teachers volunteer to participate as co-teaching partners. Friend (2014) agrees that the voluntary nature of co-teaching is important, however she notes that even when teachers are assigned to specific partnerships they are able to make a voluntary choice to collaborate within that partnership.

Compatibility refers to shared beliefs, values, and practices related to instruction and inclusion of students with disabilities (Walther-Thomas, 1997). Pratt (2014) used a grounded theory approach to study how co-teachers overcame challenges within their partnerships. He discovered that compatibility could be established through the developing relationship when co-teachers understood each other's differences and relied upon one another's strengths.

Parity, commitment, and trust are also necessary components of effective co-teaching partnerships (Friend, 2014; Pratt, 2014). Parity refers to equality between partners (Pratt, 2014). Both are licensed educators whose differing areas of expertise are

expected to complement one another. Friend (2014) notes that parity is established through early and ongoing communication regarding classroom roles and responsibilities. Further, teachers must acknowledge each other's areas of expertise and recognize the contribution each can make to student learning (Pratt, 2014).

Additionally, co-teachers must be committed to the relationship and the effort to maintain a strong partnership and effective teaching (Friend, 2014; Walther-Thomas et al., 2000). In order for students to benefit from co-taught instruction both teachers must be active contributors, effective collaborators, and "have an unwavering commitment" (Friend, 2014, p. 5) to the process. Trust in each other's professional expertise is necessary for collaboration, communication, and parity.

Supports needed for effective co-teaching. Co-teaching requires administrative and system-level supports (Scruggs et al., 2007; Walsh, 2012), comprehensive co-planning (Friend et al., 2010; Pratt, 2014; Wischnowski et al., 2004), and professional development (Sileo & van Garderen, 2010; Van Hover et al., 2012; Walsh, 2012). Administrative supports include the provision of resources that include co-planning time and professional development (Walsh, 2012). Co-planning was the most often mentioned concern for teachers in several studies (e.g., Bryant-Davis, Dieker, Pearl, & Kirkpatrick, 2012; Solis et al., 2012; Wischnowski et al., 2004). Teachers noted that they would be more effective as co-teachers if they had time to plan for lessons and coordinate roles and responsibilities (Wischnowski et al., 2004).

Research on the effectiveness of co-teaching found that co-teaching was implemented more successfully when teachers had the time to plan for instruction (e.g., Bryant-Davis et al., 2012). This research further indicated that lack of co-planning time

meant that students with disabilities were not provided needed accommodations and instruction and that the legal requirements of implementing the students' IEPs were not being met. Additionally, when co-teachers lack co-planning time, they are unable to use multiple co-teaching approaches in the classroom to meet the needs of students (Embury & Dinnesen, 2012). In their case study of co-teachers in a suburban middle school, Embury and Dinnesen found that when co-teachers were given time to co-plan both teachers were more active in the classroom, took more ownership of instruction, and used more varied co-teaching approaches. Co-planning time is critical in order for co-teachers to be able address important concepts and meet the individual needs of students in the classroom (Fenty & McDuffie-Landrum, 2011).

Administrators must also provide time and support for the professional learning of co-teachers (Gürgür & Uzuner, 2010; Nichols & Sheffield, 2014; Pearl et al., 2012). Co-teachers need to learn how to collaborate within the single shared classroom, the various co-teaching approaches that support students, and the most effective methods for co-planning (Gürgür & Uzuner, 2010). A case study of co-teaching partners conducted by Tzivinikou (2015) compared practices before and after training in co-teaching. Tzivinikou found that participants were more collaborative with one another, more willing to adopt new practices, and more open to suggestions for classroom activities following their professional learning experiences. Similarly, Pearl et al. (2012) found increased implementation, the adoption of more varied approaches, and more positive outcomes for students with disabilities in co-taught classrooms following professional development for co-teaching partners.

Research on co-teaching. Although there is limited empirical research to support the effectiveness of co-teaching as a service delivery model (Murawski & Swanson, 2001), a few studies have shown positive effects on outcomes of students with disabilities (e.g., McDuffie, Mastropieri, & Scruggs, 2009; Murawski & Swanson, 2001; Wischnowski et al., 2004). In their study, Wischnowski et al. (2004) compared academic achievement of students with disabilities with their non-disabled peers and found that students with disabilities in co-taught classrooms achieved high enough to move to the next grade level, scored as well as their peers on standardized tests, and made curricular progress at the level of their peers. Murawski and Swanson (2001) conducted a meta-analysis of co-teaching research. Although they caution that there were limited studies included, they found a moderate effect size for co-teaching on student outcomes. Specifically, studies including students with disabilities showed gains in reading scores for students in co-taught classrooms.

Co-teaching, when delivered appropriately, provides supports for students with disabilities in high-stakes testing environments (Tremblay, 2013), may improve academic achievement for students with disabilities (McDuffie et al., 2009), and ensures the opportunity for students to have a more structured education within the general education setting (Murawski, 2009). In a comparative analysis of a co-taught classroom and a special education classroom, Tremblay (2013) found that students in the co-taught classroom outperformed their peers in the special education class in reading and writing after one year. Similarly, McDuffie et al. (2009) compared students in co-taught classrooms with students in general education classrooms that were not co-taught. They

found that students in the co-taught classroom scored better than their peers on unit tests and post-tests.

Qualitative studies of co-teaching provide additional information. For example, Walther-Thomas (1997) studied 23 school-based teams and discovered benefits for students with disabilities, students without disabilities, and both educators. The benefits for teachers included professional learning, support in the classroom, and greater collaborative opportunities within the school setting. Students with disabilities indicated greater self-efficacy in terms of their learning, increased academic achievement, improved peer relationships, and better social skills.

Other qualitative studies described additional benefits to students (e.g., Rivera, McMahon, & Keys, 2014; Strogilos & Stefanidis, 2015). Co-teachers who adopted effective co-teaching practices agreed that students with disabilities showed improved social skills and behavior in the co-taught classroom (Strogilos & Stefanidis, 2015). These teachers also noted that the learning processes of students improved as a result of participation with peers without disabilities. Rivera et al. (2014) discovered in their interviews with teachers that students with disabilities appeared to have a greater sense of belonging, satisfaction with school, and efficacy for new learning as a result of participation in co-taught classrooms.

The interactive nature of co-teaching can provide the structure teachers need to help their students meet instructional goals and effectively deliver specially designed instruction (Murawski & Hughes, 2009). Interview results from Fenty and McDuffie-Landrum's (2011) multiple case study in eight classrooms indicated that co-teachers felt better supported with another teacher in the room. Additionally, these teachers reported

that they learned from one another and had greater opportunities for differentiating instruction.

Quality of co-teaching. Despite these results, there are concerns regarding the quality of co-teaching practices (Pearl et al., 2012). The quality varies greatly from classroom to classroom (Friend & Cook, 2007; Scruggs et al., 2007). Co-teaching practices and approaches that are expected in co-taught classrooms are not often seen (Scruggs et al., 2007; Strogilos & Tragoulia, 2013). Specifically, Strogilos and Tragoulia (2013) reported that the co-teachers they studied had separate roles and operated in isolation in the classroom rather than as collaborative partners—the general education teacher took responsibility for delivery of instruction while the special education teacher supported students with disabilities.

Additionally, one teach/one assist as a co-teaching approach appears to be the most commonly used co-teaching practice (Fenty & McDuffie-Landrum, 2011; Solis et al., 2012; Strogilos & Tragoulia, 2013). In their observations of co-taught classrooms, Fenty and McDuffie-Landrum (2011) discovered that the main approach to co-teaching was one teach/one assist with team teaching implemented on rare occasions. Similarly, Wischnowski et al. (2004) reported very limited use of approaches other than one teach/one assist in the classrooms they observed.

Reasons for the lack of effective instructional practices and implementation of a variety of co-teaching approaches include lack of common planning time, lack of teacher training, and the number of students with disabilities in the classroom (Fenty & McDuffie-Landrum, 2011; Solis et al., 2012; Strogilos & Tragoulia, 2013). General education teachers may feel unprepared to address the needs of students with disabilities

(Solis et al., 2012) and lack knowledge of characteristics of students with disabilities (Strogilos & Tragoulia, 2013). Co-planning time and professional development would address both of these issues (Fenty & McDuffie-Landrum, 2011; Pearl et al., 2012).

Co-teaching, when implemented appropriately, may support student achievement (McDuffie et al., 2009). However, administrative support, co-planning time, and professional development are critical components to effective implementation (Walsh, 2012). This service delivery model provides access to students with disabilities to the general education curriculum, yet it creates a diverse classroom for teachers (Friend, 2014). Effective implementation is important to address the needs of all students in this setting (Tremblay, 2013). Co-teachers with differing areas of expertise will be better able to address the unique needs of their diverse classrooms.

> As a partnership between professional peers with different types of expertise, co-teaching can be viewed as a reasonable response to the increasing difficulty of a single professional keeping up with all the knowledge and skills necessary to meet the instructional needs of the diverse student population attending public schools and the complexity of the problems that they bring. (Friend et al., 2010, p. 12)

It is through the collaborative partnership of professionals with different knowledge and skills that the needs of some students with disabilities can be addressed in the general education setting.

Technology integration. IDEA (2004) and ESSA (2015) both require the use of technology to support students with disabilities as noted previously. These legal requirements, along with individual district initiatives, require that teachers know how to effectively integrate technology into the curriculum (Anderson et al., 2009; Thomas et al.,

2012). It is important for all teachers to learn how to integrate technology into their classrooms in order to support inclusive practices and ensure students with disabilities have access to the general education content. Even with a significant amount of technology available, teachers may not be using it and they may not be using it most effectively (Beacham & McIntosh, 2014).

Effective integration of technology into classroom instruction goes beyond simply adding technological tools and experiences to instruction (Harris, Mishra, & Koehler, 2009). It includes identification of students' individual learning abilities, and application of technologies that match students' diverse strengths and needs in the classroom. Teachers therefore need to understand how technology can support the delivery of content in the most meaningful way.

Students with disabilities may have difficulty accessing content in the general education setting (Anderson et al., 2009; Boon et al., 2006; Thomas et al., 2012). Technology, defined as hardware and software used for educational purposes, provides access to content for students with disabilities. The meaningful integration of technology into instruction supports academic achievement of students with disabilities in the general education setting (Anderson et al., 2009; Jackson, 2004; Kennedy & Deshler, 2010). Specifically, students with disabilities using technologies that provided visual representations and structured content showed gains in academic achievement (Boon et al., 2006; Kennedy & Deshler, 2010). These technologies include electronic graphic organizers, eBooks that provide a variety of visual options, videos, and computer-based learning strategies. Systematic blending of technology into evidenced-based practices is

the key to student learning (Kennedy & Deshler, 2010). Technology must be embedded into effective instruction in order to support student achievement.

Much of the research related to technology that supports students with disabilities in accessing content refers to two types of technology: instructional technology and assistive technology (e.g., Edyburn, Higgins, & Boone, 2005; Rosenberg, Westling, & McLeskey, 2011). Instructional technology is that which enhances teaching and learning (Rosenberg et al., 2011). Technologies may include use of videos, computer-assisted instruction, or web-based applications (Blackhurst, 2005). Instructional technology can support students' meaningful engagement in the classroom (Malouf & Hauser, 2005).

Assistive technology is defined as "any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized that is used to increase, maintain, or improve the functional capabilities of a child with a disability" (IDEA, 2004, 20 U.S.C. 1400(d)) § 620[1]). Instructional technologies and assistive technologies are subsets of educational technologies, a broader term that encompasses "the design, development, utilization, management, and evaluation of processes and resources for learning" (Luppicini, 2005, p. 105).

Assistive technology. IDEA requires that IEP teams consider assistive technologies that may support students with disabilities in accessing and making progress in the general education curriculum (Rosenberg et al., 2011). Assistive technologies can enable students with disabilities to be more independent learners (Blackhurst, 2005; Haager & Klingner, 2005). These technologies assist students with communication, mobility, and learning (Malouf & Hauser, 2005). For example, items such as laptops and tablets allow students with visual impairments or reading disabilities to access content

with text-to-speech software or magnification options (Haager & Klingner, 2005). Students who struggle with organizational skills may use mobile devices with timers and reminders, and those with fine motor difficulties may use computers or tablets to type notes or record lectures. Some assistive technologies do not require the use of electronic devices (Blackhurst, 2005). For example, pencil grips are helpful for students with fine motor difficulties who have difficulty writing or drawing, but do not require technology as defined in this study.

Assistive technologies support students with disabilities in accessing content and making progress in the curriculum (Bailey, Meidenbauer, Fein, & Mollica, 2005; Malouf & Hauser, 2005; Zabala & Carl, 2005). However, these technologies are often not provided for students with disabilities who may need them (Bailey et al., 2005; Okolo & Diedrich, 2014; Zabala & Carl, 2005) due to teachers' limited knowledge and awareness, types of technology available, and inadequate funding for such resources (Okolo & Diedrich, 2014). Teachers regularly use technology for professional and personal use, but are less likely to incorporate it into instructional practices or provide it for students (Okolo & Diedrich, 2014). Assistive technologies are particularly underutilized for students with mild disabilities, such as students with learning disabilities. Lahm (2005) notes that teachers lack knowledge related to assistive technologies, which may account for its limited use in the classroom.

Using assistive technologies is critical for some students with disabilities in order to achieve academically in the general education setting (Edyburn et al., 2005; Haager & Klingner, 2005). These technologies are identified and selected through the IEP planning process for students identified as eligible to receive special education services. However,

educational technologies and practices that support all learners provide additional means of ensuring access for students with disabilities in the general education setting (Rose, Hasselbring, Stahl, & Zabala, 2005). Universal design for learning (UDL) provides such an approach to meeting the needs of a diverse group of students in one classroom.

Universal design for learning. When used appropriately, technology can provide students with a variety of ways with which to express or engage in their learning and can provide teachers with a variety ways to represent content (Pellerin, 2013; Thomas et al., 2012). UDL provides for flexible representation, engagement, and expression in teaching and learning (National Center on Universal Design for Learning, 2014). UDL is a framework for use in instructional planning that provides avenues for meeting the learning needs of diverse student populations (Meyer, Rose, & Gordon, 2014). The principles of UDL include (a) providing students with multiple representations of content, (b) providing students with opportunities to express their learning through multiple avenues, and (c) providing students with a variety of ways to engage in learning (Rose, Meyer, Strangman, & Rappolt, 2002).

The framework was developed as a result of brain research identifying cognitive principles of learning and educational research on effective instruction (Meyer et al., 2014). While not focused solely or even primarily on technologies, advancements in digital technologies further inform this framework as they provide additional pathways for student engagement, representation of content, and expression of learning. UDL principles inform instructional design, including the selection of appropriate teaching and learning tools. These principles provide a means of adapting curriculum in such a way as to meet the needs of all learners (Haager & Klingner, 2005).

Incorporating UDL principles ensures that students are provided with multiple, flexible options within the learning environment (Rose et al., 2002). In providing a variety of representations teachers may offer both digital and print versions of text. For engagement, students may use the digital version of a text to access further resources, such as hyperlinks to get more information on topics within the text and discover meanings to new vocabulary. Similarly, for expression students may write, type, or record responses to questions related to content within the text.

UDL provides a means of mitigating barriers to accessing content for students with disabilities through its flexible approaches to teaching and learning (King-Sears et al., 2015). When teachers adopt this framework they are able to provide instruction and assessment in such a way that students with disabilities may access and make progress in rigorous content along with their peers.

Implementing technologies that support the principles of UDL in lesson design and delivery is not simple (Edyburn, 2010). It requires the development of expertise in these concepts and practices through effective professional development and the support of educational technology specialists within schools. Edyburn notes that more attention to the intersection of learning goals, characteristics of learning, support strategies, and technologies is needed to ensure effective outcomes of universally designed instruction. UDL is more than adding technology to instructional practices; rather it is about lesson design and solving instructional problems. Technology may be the "delivery system" (Edyburn, 2010, p. 37) for supporting multiple means of representation, expression, and engagement.

Digital technologies provide flexibility that may not otherwise be possible (Edyburn, 2010). For example, print textbooks are created in a format that cannot be altered. When this same resource is provided in electronic format, fonts may be changed, hyperlinks to additional resources may be added, and content may be shared in audio format.

Although students with disabilities may be provided with flexible formats as a part of their individualized program, using these formats within the UDL-designed classroom allows access for any student who needs it—providing "embedded, just-in-time supports" (Edyburn, 2010, p. 39) to all students. In some cases individual supports, or assistive technologies, may exist alongside UDL approaches within the same classrooms.

Co-teaching and Technology Integration

There are comparatively few studies on technology integration in the co-taught classroom. Those that have been done address use of technologies (e.g., Okolo & Diedrich, 2014), effectiveness of technology integration in this setting (e.g., Kim, Woodruff, Klein, & Vaughn, 2006; H. J. Lee & Herner-Patnode, 2009), and the types of professional development that support use of technology in the co-taught classrooms (e.g., Mawhinney, 2010).

Some researchers have found that co-teachers lack the knowledge necessary to effectively integrate technology into instruction, which may explain its limited use in co-taught classrooms (e.g., H. J. Lee & Herner-Patnode, 2009; Okolo & Diedrich, 2014). In one study, general education teachers felt that they needed more support with using technology in the classroom (H. J. Lee & Herner-Patnode, 2009). Specifically, in their

mixed-methods study, H. J. Lee and Herner-Patnode surveyed and interviewed teachers to identify their beliefs related to collaboration, their knowledge related to content and special education, and their thoughts on what assistance they needed to better support students with disabilities in their classrooms. The results indicated that general education teachers felt that they needed more support with using technology in the classroom, specifically in using an interactive whiteboard to support instruction. Both teachers indicated a need to learn more about how to incorporate student-centered activities into the classroom.

Similarly, Okolo and Diedrich (2014) studied teachers' knowledge and skills related to technology integration to support students with disabilities in the classroom, surveying educators who serve in many different roles across the state. There were several areas noted in which both special and general education teachers reported a lack of preparation. These included educational technology, co-teaching practices, and behavior management. In general, teachers indicated a need to learn more about how to incorporate student-centered activities and integrate technology into instruction (H. J. Lee & Herner-Patnode, 2009; Okolo & Diedrich, 2014).

Knowledge and skills in technology integration are critical factors in ensuring teachers' effective practices in this area, but it is also important that co-teachers have resources that support technology integration (Mawhinney, 2010). Technology resources are necessary to ensure that teaching and learning goals are met within this context and that larger organizational goals related to co-teaching can be achieved.

When the resources are available and teachers have the needed expertise, a variety of technologies are used in co-taught classrooms (Kim et al., 2006; H. J. Lee & Herner-

Patnode, 2009; McDuffie et al., 2009). A range of technologies is used in the co-taught classroom for differing purposes, such as computer-based student tutorials, presentation software, and videos (McDuffie et al., 2009). The presentation software and videos are used to present new and previously learned content, and the tutorials support student practice and remediation.

Co-teachers use technologies, such as interactive whiteboards and computers to adapt their environments to meet the needs of students with disabilities and to support the use of multiple co-teaching approaches (H. J. Lee & Herner-Patnode, 2009). Co-teachers in the same classroom may use technology for different purposes. For example, in a study conducted by Van Hover et al. (2012), the general education teacher typically used presentation software to teach content and the special education teacher used the interactive whiteboard for practice activities that engaged students.

Technology integration may assist co-teachers in identifying the roles that each play in provision of instruction (Kim et al., 2006). Additionally, technology integration in the co-taught classroom allows for the use of a variety of approaches to co-teaching and can provide an avenue for effective instructional practices within this context. Planning for technology integration provides an opportunity for dialogue about the needs of students with disabilities and their academic progress. As such, the development of knowledge and skills for technology integration is important for co-teaching partners.

Teaching as a Complex Profession

As noted in the research related to co-teaching and technology integration, teachers do not always feel prepared to address the needs of all learners in their classrooms (e.g., H. J. Lee & Herner-Patnode, 2009; Okolo & Diedrich, 2014). It may be

important to consider the nature of teachers' knowledge to meet the challenges of teaching within the context of today's schools and classrooms.

Nature of Teachers' Knowledge

The United States Department of Education's Office of Educational Research and Improvement funded the development of a report synthesizing research about how people learn (as cited in Donovan, Bransford, & Pellegrino, 1999). Key findings from this research synthesis provide insight into core principles of learning. Donovan et al. focus on three of these principles which include (a) students come with preconceptions that influence how they will integrate new learning; (b) students need to have a strong core of factual knowledge that is organized within a conceptual framework to ensure understanding, and is organized in such a way as to optimize application of new knowledge; and (c) students need to develop metacognitive strategies that will allow them to take control of their own learning.

These learning principles have implications for teaching. Teachers support student learning by designing the classroom environment in such a way as to optimize knowledge development (Donovan et al., 1999). In order to do so, teachers must ensure that classrooms are learner-centered, knowledge-centered, and community-centered and make use of formative assessments that will guide teaching and learning.

Learner-centered classrooms. Learner-centered classrooms are those in which teachers pay particular attention to the knowledge and skills students bring with them (Donovan et al., 1999). Teachers must know their students and be able to adapt their teaching to support their unique needs (Porter & Brophy, 1988; Yerrick & Johnson, 2011). They must discover the preconceptions students possess to assist them in either

correcting misunderstandings or building upon accurate assumptions (Donovan et al., 1999). Connecting new learning with past and future learning is critical to student achievement (Cai, Ding, & Wang, 2014; Richland, Stigler, & Holyoak, 2012).

Teachers must know how to conduct formative assessments in order to discover students' preconceptions, to identify student progress in the learning process, and to make adaptations to teaching where necessary (Donovan et al., 1999; A. Jones & Moreland, 2004). Formative assessments are ongoing, informal measures that provide both students and teachers with information about student progress as learning is taking place rather than at the end of a unit or specific time period (Donovan et al., 1999).

Donovan et al. (1999) note that cultural differences influence the preconceptions that students bring to the classroom. Additionally, cultural differences inform the classroom activities that best support student learning. For example, collaborative learning may be more effective for some students and individualized approaches may be best for others dependent upon cultural background. Teachers must not only know their students' learning needs, but also possess cultural awareness of students from various backgrounds (Shulman, 1988; Yerrick & Johnson, 2011).

To support a learner-centered classroom, teachers must also know how to set meaningful learning goals, deliver effective instruction, and provide feedback to students based upon assessment data (Gaffney & Faragher, 2010; A. Jones & Moreland, 2004; Yerrick & Johnson, 2011). The most critical influence on student achievement is effective instruction (Gaffney & Faragher, 2010). This instruction is supported by pedagogical practices that include designing learning goals, strategically planning and assessing instruction, implementing student-centered and evidence-based strategies,

expressing high expectations for all students, and reflecting on teaching and learning experiences. Teacher leaders support the development of sound pedagogical knowledge in their fellow teachers, a practice that enhances student achievement.

Community-centered classrooms. Community-centered classrooms are those that provide students with opportunities for peer-supported learning, include parents as a part of the learning community, and take learning beyond the classroom (Donovan et al., 1999). School leaders and teachers establish school and classroom norms that set the climate for learning. These norms may include an atmosphere of risk-taking (where making mistakes is seen as opportunity for learning), opportunities to engage in collaborative learning with peers, and shared accountability. Student learning is influenced by the context of the instructional environment.

Porras-Hernández and Salinas-Amescua (2013) refer to three levels and two dimensions of context. The dimensions include both the scope of the environmental influences as well as the people involved, specifically students and teachers. The levels of context are referred to as macro-, meso-, and micro-levels. Global, national and state pressures stemming from political, societal, and technological factors define the macro-level. These may include the legal requirements of IDEA and ESSA, as well as the increase in technologies worldwide. Community and school-level influences are a part of the meso-level. These influences include district- and school-level initiatives, the financial climate of the school or district, and the amount of administrative or peer support that is available. Teachers' personal factors provide the contextual nature of the micro-level. These factors include available resources; teachers' and students' knowledge and skills, beliefs and values, and past experiences that they bring to the

classroom; and the classroom norms to which Donovan et al. (1999) refer. Each of these levels and dimensions of context has a degree of influence upon teachers' practices within the classroom. Effective teachers will adapt and adjust instructional practices to meet the unique context of each classroom (Porter & Brophy, 1988).

Knowledge-centered classrooms. Teachers in knowledge-centered classrooms know what subject matter is critical, why it is important, and how to recognize mastery (Donovan et al., 1999). They provide students with a firm foundation of the content by teaching the most important topics in depth. They help students organize critical facts within a conceptual framework to support greater understanding.

It is important for teachers to have content knowledge, that is, knowledge of their specific subject area, including the concepts, ideas, processes, and theories contained within that content (Koehler et al., 2013). The level of teachers' knowledge influences how much students will learn about a specific subject (Ramsaroop & van Rooyen, 2013). Shulman (as cited in Yerrick, & Johnson, 2011) argued that teachers' content knowledge must be as deep as their "subject-matter major counterparts" (p. 917), such as the mathematician or historian, in order to impact student learning.

Teachers also need expertise in helping students structure content knowledge within a meaningful framework (A. Jones & Moreland, 2004; Ramsaroop & van Rooyen, 2013). Pedagogical practices are critical to student learning and refer to teaching methods and strategies, lesson planning approaches, and classroom management techniques that teachers employ. These practices also involve providing feedback, reinforcement and evaluation of learning (Veal & McKinster, 1999). Pedagogy "involves the observable performance of the variety of teaching acts . . . already well-documented in the research

literature on effective teaching" (Shulman, 1987, p. 17). Teachers who employ sound pedagogical practices provide well-defined facts and vibrant descriptions, assign and check assignments, and interact with students in a variety of ways.

When teachers use these pedagogical practices they help students connect new knowledge with pre-existing knowledge across content areas, within content areas, and with future learning (Porter & Brophy, 1988; Richland et al., 2012). In a review of research on K-12 classroom instruction, Richland et al. (2012) discovered that effective mathematics instruction included "explicit connections in the lesson among mathematics procedures, problems, and concepts" (p. 196). Teachers must provide students with opportunities to engage in challenging content to ensure that they understand these connections in greater depth. The most effective teachers know what parts of the content will be most difficult for students to grasp and those which are most critical, and adjust their practices accordingly (Shulman, 1988).

Both Shulman (1986) and Hashweh (2005) consider the blend of leaner-centered teaching and knowledge-centered teaching within the community-centered classroom. Shulman (1986) refers to this blend of teachers' knowledge as pedagogical content knowledge (PCK); a type of knowledge that is necessary to create the greatest opportunities for learning (A. Jones & Moreland, 2004; Porter & Brophy, 1988; Ramsaroop & van Rooyen, 2013). This knowledge comprises diverse components or constructions that are developed through lesson design, experience, and reflection (Hashweh, 2005).

Pedagogical content knowledge. In his early references to PCK, Shulman (1986) identified three categories of content knowledge that are critical to effective teaching.

These include deep knowledge of the subject matter and its organizational structure (content knowledge), pedagogical knowledge specific to that content (PCK), and knowledge of curriculum including the programs, resources, tools, and materials for teaching (curricular knowledge). A year later Shulman (1987) added four more categories, identifying seven categories of teachers' knowledge, that include (a) content knowledge; (b) pedagogical knowledge; (c) curricular knowledge; (d) pedagogical content knowledge; (e) knowledge of learners and learner characteristics; (f) knowledge of specific context, including classroom, district, and community contexts; and (g) knowledge of educational goals and purposes, and individual values, beliefs, and philosophies.

Shulman (1987) identified PCK as the most critical of these categories and describes it as a special blending of content and pedagogy such that teachers develop an understanding of teaching unique to the subject area taught. PCK is that which distinguishes a content expert from a teacher. The content expert has subject-specific knowledge, but it is the teacher who has the ability to transform this knowledge into meaningful learning for students and adapt it to meet the varying needs of each student. Teachers must have knowledge of an array of representations to ensure all students have access to content. These representations include research-based strategies and practices that teachers develop through experience in teaching a particular subject (Hashweh, 2005; Shulman 1987). Teachers must know how to actively engage students so that they can make explicit connections within all aspects of the content in order to understand it in a deep way (Richland et al., 2012).

Teachers with pedagogical content knowledge are able to make pedagogical decisions that will support student learning of content (Shulman, 1987). Deep content knowledge is linked to pedagogical strategies to ensure student understanding. Teachers make use of curricular materials, make pedagogical decisions, and take action that involves a cycle of "comprehension, transformation, instruction, evaluation, and reflection" (Shulman, 1987, p. 14). In other words teachers must possess content knowledge, transform this knowledge into meaning for students, implement instructional practices that support this transformation, evaluate the effectiveness of these practices, and reflect upon these actions both during and following instruction.

Hashweh (2005) proposes the term, *teacher pedagogical constructions*, as a means of representing teachers' development of PCK. A student of Shulman's, Hashweh first coined the construct as "subject-matter pedagogical knowledge" in 1985 (as cited in Hashweh, 2005, p. 276), noting that this knowledge develops as teachers gain teaching experience in a specific content area. As a result of two decades of research providing little clarity regarding the nature of PCK, Hashweh (2005) proposed a reconceptualization of the construct.

In this reconceptualization, Hashweh (2005) describes PCK as teachers' distinct knowledge that is discovered through interviews whereby they verbalize their lesson planning process. PCK is developed through instructional experiences in which teachers use varying pedagogical practices to teach specific topics. As teachers plan, deliver, and reflect upon their teaching, they will identify practices and strategies that are most effective in teaching students concepts and those that are not. Teachers will then either adopt or discard these practices as a part of their teaching repertoire. These topic-specific

constructions include an array of basic elements, are developed through the design process of teaching, and are influenced by the interaction of multiple categories of knowledge and beliefs. These categories include (a) content knowledge; (b) knowledge and beliefs about the process of learning and the characteristics of learners; (c) pedagogical knowledge and beliefs; (d) knowledge of context; (e) knowledge of resources; (f) curricular knowledge; and (g) educational goals, purposes, and philosophy. Teachers rely upon their memory of events or stories related to teaching specific topics to inform future teaching practices through the development of teacher pedagogical constructions.

Hashweh (2013) notes that PCK is directly connected to teachers' experiences and is most commonly found in successful teachers. Teachers develop PCK through reflection upon the success or failure of instructional practices in supporting student learning. Strategies that teachers find useful will be adopted and implemented in future teaching when the same or similar topics are addressed. These practices further support learner-centered and knowledge-centered classrooms (Donovan et al., 1999).

PCK in learner-centered classrooms. As noted earlier, learner-centered classrooms are those in which teachers pay particular attention to the knowledge and skills students bring to the classroom (Donovan et al., 1999). PCK includes knowledge of learners and characteristics of learners (Shulman, 1987). This involves an awareness of students' background knowledge and the misconceptions they bring to the classroom (Porter & Brophy, 1988; Veal & McKinster, 1999). Overcoming student misconceptions is a critical component of teaching (Shulman, 1986).

Teachers with PCK provide learner-centered instruction by discovering and addressing students' preconceptions on particular topics (Hashweh, 2005). They engage students in correction of misconceptions and connection of accurate preconceptions to new learning. This process includes use of formative assessment practices during instruction that requires knowledge of content, assessment, and processes of teaching (Shulman, 1987).

Knowing students goes beyond identification of preconceptions (A. Jones & Moreland, 2004; Shulman, 1987). It includes knowledge of the relevant facets of students' language, culture, gender, and abilities and how these may impact their learning. This component of PCK is the most critical (Veal & McKinster, 1999). When teachers know their students, they are able to match instructional strategies to support knowledge development. They are then able to bridge the gap between students' prior knowledge and new content (Yerrick & Johnson, 2011).

PCK allows teachers to transform content into meaning for students and to develop independent thinkers (Shulman, 1987; Van Driel & Berry, 2010). In order to do so, teachers develop teacher pedagogical constructions through classroom experience and through reflection on practice (Hashweh, 2005). As teachers regularly conduct formative assessments throughout the interactive teaching process they will identify an array of strategies and practices to support struggling learners. Upon later reflection these teachers will identify effective practices to add to their repertoire for future teaching. Shulman (1987) sees reflection as a component of PCK. This is particularly important because teachers learn through experience. By focusing on student learning in the

reflection process, teachers will be able to identify strategies that support the transformation of content into learning through effective pedagogical practices.

PCK in knowledge-centered classrooms. Teachers in knowledge-centered classrooms know the content so deeply that they are aware of pitfalls for students as well as the foundational concepts that will need more time and attention (Shulman, 1988). PCK includes knowledge of topics that will be more difficult for students to grasp and those that students may learn more easily (Shulman, 1987). Further, PCK includes knowledge of facts, concepts, and processes; how these connect; and effective ways to share this knowledge with students (Shulman, 1986). In order to instruct effectively teachers must understand why these concepts and connections are important, and transform them to support student understanding (Shulman, 1987). This transformation requires teachers to comprehensively plan for instruction that includes multiple means of representation, adapt instruction for the particular class of students taught, and tailor instruction to meet the needs of individual learners. Shulman refers to this as "the performance of teaching" (p. 16).

PCK in community-centered classrooms. Community-centered classrooms connect learning beyond the classroom, consider the support of peers, parents, and community members as it pertains to student learning, and have unique contexts that influence student learning (Donovan et al., 1999). In Hashweh's (2005) reconceptualization of PCK he finds that teacher pedagogical constructions are connected with specific contexts. In other words teachers' develop these pedagogical constructions through teaching experiences with a unique set of students in a specific classroom within a particular school and school district. Further, teachers' PCK is demonstrated through

teaching practices that incorporate the combination of teachers' content knowledge, pedagogical knowledge and knowledge of concepts (Van Driel & Berry, 2010).

Micro- (or personal) contextual factors influence teacher practices through their experiences as noted in the PCK literature (Hashweh, 2005; Van Driel & Berry, 2010). However, macro -and meso-level contexts put pressure on teachers to adopt specific practices as well, such as the integration of technology into instruction (Porras-Hernández & Salinas-Amescua, 2013). This practice requires additional knowledge and skills in order for effective instruction with technology to occur (Mishra & Koehler, 2006).

TPACK. Mishra and Koehler (2006) describe a theoretical framework for technology integration in K-12 settings. This framework informs professional development and teacher preparation programs by identifying knowledge that teachers need to effectively integrate technology into the classroom. Within this framework, Mishra and Koehler identify four elements of knowledge: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPACK). Content knowledge and pedagogical knowledge have been defined in the sections above. Technological knowledge is the evolving and adaptable knowledge of technologies that support teaching and learning.

The TPACK framework defines the four bodies of knowledge including PCK, TCK, TPK, and TPACK (Koehler et al., 2013). PCK has been defined in the previous section. TCK is knowledge of how technology can support or deter learning of content and how technology and content influence one another. TPK is knowledge of how technologies will support or enhance student learning through blending of technologies

into pedagogical practices in the classroom. This may require skills in adaptation of technologies designed for other purposes to meet the needs of the classroom context. TPACK is the interrelation of all three bodies of knowledge within the specific context of the individual classroom. This complex knowledge requires flexibility, creativity, and adaptability of technologies that support pedagogical practices that enhance student learning of specific subject matter within each classroom context.

Technology knowledge is not static; rather it requires teachers to acquire new knowledge as technologies emerge (Abbitt, 2011; Harris et al., 2009; Mishra & Koehler, 2006). In general, teachers must have a broad sense of how technologies support students in processing new information, in communicating their learning, and in solving problems (Harris et al., 2009). The TPACK framework offers an avenue for understanding the nature of teachers' knowledge related to integrating technology effectively into instruction. As Harris et al. (2009) note, TPACK provides "a way to think about effective technology integration, recognizing technology, pedagogy, content, and context as interdependent aspects of teachers' knowledge necessary to teach content-based curricula effectively with educational technology" (p. 393). This description explains how technological knowledge, pedagogical knowledge, content knowledge, and knowledge of contexts are integrated into a blended knowledge that allows for quality teaching with technology integration.

The introduction of TPACK reconceptualized PCK, in which Shulman (1987) included teachers' knowledge of the tools and materials used in teaching as a part of this blended knowledge. This knowledge was necessary for teachers to prepare for meaningful instruction. TPACK is more complex, as it involves the interaction of all

three areas of knowledge (content, pedagogy, and technology) in order to develop instructional activities and strategies that support the specific learners in each classroom (Mishra & Koehler, 2006). Further, it is more complex due to the complexity and range of tools available today compared with the 1980s. TPACK includes knowledge of how technologies support delivery of content that will be understood by all learners (community-centered), make complex topics easier to understand (knowledge-centered), and help students connect prior learning to new concepts (learner-centered).

TPACK in community-centered classrooms. Teachers' knowledge related to technology integration is contextualized within the unique circumstances of their classroom, school, and community environments (Angeli & Valanides, 2013; Harris et al., 2009; Mishra & Koehler, 2012). Context may influence the ways in which teachers' adopt technologies to enhance instruction (Angeli & Valanides, 2013). Technology integration requires that teachers possess TPACK, which includes contextual knowledge. It is the cross-section of these bodies of knowledge (PCK, TPK, TCK, and contextual knowledge) that ensures effective integration of technology into instruction (Mishra & Koehler, 2006).

Context at all levels—meso, macro, and micro—impacts the degree to which teachers integrate technology into the classroom (Porras-Hernández & Salinas-Amescua, 2013). Teachers' knowledge of context influences this integration as well. For example, teachers' awareness of national and local policies related to technology integration may or may not support its use in the classroom. Teachers with deep understanding of technology integration are able to identify new uses for technologies to enhance instruction and meet curricular goals within the unique context of their classrooms

(Nelson, Christopher, & Mims, 2009). They are able to help students make meaning of learning and make connections to their own backgrounds and cultural contexts. For example, the use of safe social networking sites allows students to make global connections and collaborate across and within cultures.

TPACK in learner-centered classrooms. Integration of technology into the classroom requires lesson design that considers both content and context (Koehler et al., 2013). Within the classroom context teachers must know their students, the pedagogical practices that best fit their individual needs, and how these practices support learning of content (Agyei & Voogt, 2012; Ertmer & Ottenbreit-Leftwich, 2010; Harris et al., 2009). Specifically, Harris et al. (2009) refer to the importance of teachers' understanding of students' prior knowledge and preconceptions and how technologies may help in either correcting preconceptions that are inaccurate or reinforcing those that are accurate.

Pedagogical practices that encourage collaboration and creativity support student-centered learning environments (Nelson et al., 2009). Teachers with well-developed TPACK can identify resources that support these practices and how best to incorporate them into the content. Technology integration becomes a natural process whereby teachers incorporate technologies into learner-centered activities that support student learning and provide opportunities for assessment and reflection for both teachers and students.

Collaborative opportunities also support development of teachers' TPACK (Allen, Erickson, Brookhouse, & Johnson, 2010). When teachers engage in collaborative planning and delivery of technology-integrated instruction, they are more likely to incorporate these practices into their individual classrooms. This learner-centered

approach to professional development supports teachers in developing expertise in technology integration and in developing TPACK.

***TPACK in knowledge-centered classrooms*.** Teachers with well-developed TPACK have knowledge related to the affordances and constraints of technologies as they relate to education (Angeli & Valanides, 2013; Harris et al., 2009; Koehler et al., 2013). Appropriate selection and effective integration of technology into instruction provides a means of making complex content understandable to students (Koehler et al., 2013). Further, not all technologies support learning and may, in fact, constrain or keep students from making important connections with content (Koehler & Mishra, 2009). Teachers with well-developed knowledge for technology integration have a clear understanding of these complex concepts.

Teachers who do not feel comfortable with their TPACK may not integrate technologies into their classrooms (Hechter & Vermette, 2013; M. Lee & Tsai, 2008). Experiences with technology integration and support with identifying educational affordances of such use are vital to effective integration of technology into instruction (M. Lee & Tsai, 2008). Further, teachers need to experience successful technology integration experiences either personally or vicariously in order to feel comfortable enough to regularly incorporate this practice into their teaching (Mueller, Wood, Willoughby, Ross, & Specht, 2008).

Researchers have considered how best to support teachers in the development of knowledge and skills related to technology integration in the classroom (e.g., Gaffner, 2015; Habowski, 2012). Opportunities to work alongside an educator with knowledge of technology integration have been found to support the development of this expertise.

Habowski (2012) noted that partnering with an experienced teacher, along with a course on technology integration, supported the development of TPACK and an increase in levels of confidence for technology integration in pre-service teachers. The development of this knowledge influences teachers' willingness and success in adoption of technology for classroom use (Tee & Lee, 2015).

Nature of Special Education Teachers' Knowledge

Special education teachers have a critical and complex role in education (Lavian, 2014). They support and provide services to students with disabilities to ensure access to the general education curriculum and successful transition to adult life (IDEA, 2004). The nature of knowledge for special educators involves multiple areas of expertise. Specifically, the Council for Exceptional Children (CEC, 2012) posits, "The raison d'être for special education lies in the specialized professional knowledge and skills to individualize access to learning in both specialized and general curricula for individuals with exceptionalities" (p. 2). In other words, special education teachers have unique expertise in individualizing instruction and meeting the needs of students with disabilities so that they may access general education curriculum through specially designed instruction.

Special education teachers have multifaceted roles that require knowledge in many areas such as content, pedagogy, learning characteristics, human growth and development, technologies, and disabilities (Brownell et al., 2009; CEC, 2012; D. D. Smith, 2006). Special educators have expertise in the education of students with disabilities and effective methods through which to teach such students (Murawski, 2009;

Sileo & van Garderen, 2010). They are able to adapt material to support the needs of students with disabilities in the classroom (Mastropieri et al., 2005; Murawski, 2009).

Special educators must possess a complex set of skills that require them to support students with disabilities in not only learning essential academic skills, but also many other functional skills that will support students both in school and in post-school life (Grskovic & Trzcinka, 2011; IDEA, 2004). Functional skills include social skills, personal management skills, communication, self-determination, and behavior. Grskovic and Trzcinka (2011) note that special education teachers must address behavioral issues, support the development of social skills and study skills, and ensure students with disabilities receive the accommodations and remediation they need to find success within the general education setting. In order to meet these demands, special educators need skills in data collection, analysis, and interpretation, and knowledge of disabilities and the characteristics of the many different categories of disabilities (Brownell et al. 2009; CEC, 2012).

Special education teachers also need to have knowledge in classroom management strategies (Brownell et al., 2009; Ficarra & Quinn, 2014), instructional strategies, and technologies that support students with disabilities in the classroom (CEC, 2012; IDEA, 2004; D. D. Smith, 2006). Specifically, special education teachers must have knowledge of evidence-based strategies that will support student learning, particularly those that support struggling learners, and they must know how to implement those strategies effectively (CEC, 2012; D. D. Smith, 2006). They must understand learner characteristics of not only students with disabilities, but also all students and use

this knowledge to identify the best approaches to instruction that address individual needs (CEC, 2012).

It is also important for special educators to have knowledge of the content they are teaching (Brownell et al., 2009; CEC, 2012; Drame & Pugach, 2010). IDEA (2004) requires that special education teachers have knowledge of the content to the level at which they are teaching. This law requires that teachers be prepared to ensure that students are learning grade level content standards. Special education teachers may provide instruction in either a general education classroom along with the general education teacher, or they may provide this instruction in separate, self-contained classrooms (Drame & Pugach, 2010). Special education teachers who teach in self-contained settings need the content knowledge to the level of general educators in order to ensure access and progress in general education curriculum for students with disabilities.

CEC (2012) further recognizes that special education teachers must know how to collaborate. Special educators collaborate with general educators, parents, related service providers, paraprofessionals and school counselors as they address the needs of students with disabilities.

Additionally, special education teachers must be aware of technologies that support students with disabilities (CEC, 2012; D. D. Smith, 2006). State education agencies are required to ensure that funds are available for improvements in the use of technology to support the learning of students with disabilities (IDEA, 2004). As such, special education teachers need technological knowledge to provide assistive technology,

in addition to technologies that support learning in general education classrooms for all students (CEC, 2012; IDEA, 2004).

Research related to special education teachers' knowledge of technology integration has involved pre-service teachers and how best to support their development of this knowledge (e.g. Benton-Borghi, 2015; Lyublinskaya & Tournaki, 2014). Development of TPACK for special education teachers is important as more special education teachers are partnering with general educators in the co-taught classroom (Lyublinskaya & Tournaki, 2014). These researchers posit that since the special educator is "the expert in differentiation of instruction" (p. 256), high levels of TPACK will result in effective technology integration that supports the needs of all learners in the co-teaching context.

It is clear that special education teachers have a complex, challenging role (Lavian, 2014). The planning and delivery of special education services is most critical for students with disabilities to access and make progress in the general education curriculum. Co-teaching provides one means of delivering these services (Friend, 2014; Murawski, 2009).

Nature of Co-Teachers' Knowledge

Co-teaching is based upon the premise that each teacher brings a particular area of expertise to the partnership (Murawski, 2012). Co-teaching partners share the classroom and planning, but may not share levels and types of expertise (Linz et al., 2008; Mastropieri et al., 2005; Sileo & van Garderen, 2010). Although co-teachers are partners and share responsibilities, this does not mean that they have exactly the same roles in the co-taught classroom (Friend, 2014; Walther-Thomas et al., 2000). General educators

have knowledge of curricular content and special educators have knowledge of strategies to support a diverse group of learners (Murawski, 2012).

The general education teacher is the content expert and has knowledge of the content-specific pedagogies that ensure students meet curricular standards (Austin, 2001; Murawski, 2009; Pratt, 2014). They are aware of what students should be able to do at a particular grade level and within a specific content area (Murawski, 2009). General education teachers have "significantly different" (Friend, 2014, p. 13) knowledge and skills from the special education teacher. These include curricular knowledge, classroom management expertise, knowledge of instruction and pacing, and awareness of students in the general population.

General education teachers may lack expertise in differentiation of instruction, co-teaching practices, and how best to address the needs of students with disabilities in the inclusive classroom (Murawski, 2009). Additionally, general educators may not know characteristics of students with disabilities and methods of adapting materials to ensure learning for these students (Earley, 2005).

In contrast, special education teachers have expertise in learning strategies and adaptations to support students with disabilities, in study and social skills that support student success in the classroom, and in techniques that assist students with disabilities in monitoring their own achievement and behaviors (Walther-Thomas et al., 2000). Additionally, Friend (2014) notes that special education teachers have knowledge of learning processes, how to individualize instruction, and how to monitor progress towards mastery. As such, special educators typically take the lead in these aspects of instruction in the co-taught classroom.

The focus for the special education teacher is the individual learning needs of students with disabilities in all aspects of development—social, emotional, academic, and behavioral (Murawski, 2009). They are the experts in remediation strategies, and adaptations and accommodations to ensure access to content (Austin, 2001, Pratt, 2014). Special educators have knowledge of differentiation strategies and inclusive practices (Murawski, 2009). In his case study of co-teaching partners, Earley (2005) found that special education teachers supported general education teachers in differentiating instruction, adapting materials, individualizing instruction, and managing behavior. Often special educators are more comfortable working with smaller groups or individual students and may lack expertise in instruction to larger groups of students as required in the co-taught classroom (Murawski, 2009).

The lack of expertise in content for special educators and the lack of expertise in special education for general educators create challenges in the co-taught classroom (Linz et al., 2008; Scruggs et al., 2007). The challenge is how teachers with differing backgrounds find commonalities to teach together in the classroom. There is disagreement, however, about the most effective way for these professionals to support a classroom of learners. Some researchers state that co-teachers must learn and develop knowledge of each other's areas of expertise (e.g., Grskovic & Trzcinka, 2011; Linz et al., 2008; Mastropieri et al., 2005; Van Hover et al., 2012). For example, Scruggs et al. (2007) stated, "Without both sets of skills, it is more likely that they [special educators] will remain classroom assistants than become instructional partners" (p. 19). Van Hover et al. (2012) suggest that co-teachers need a shared vision of teaching and learning and that content-driven approaches must be co-planned in order to effectively deliver

instruction in the context of the co-taught classroom. The shared knowledge of content ensures that instructional strategies and activities best match the subject area taught.

Other researchers posit that it is best for co-teachers to maintain separate areas of expertise (e.g., Magiera et al., 2005; Sileo & van Garderen, 2010). The blend of these areas of expertise may support students in learning challenging content. Magiera et al. (2005) note that the special education teacher should not become an equal expert in content to the general education teacher, rather the special education teacher should provide expertise in how to use strategies to make the content meaningful to students with diverse learning needs. Mastropieri et al. (2005) found that co-teaching partners both had knowledge of pedagogical skills, the special education teacher was the "adaptation expert" (p. 264), and the general educator was the content expert.

The blend of differing areas of expertise provides support for each teacher in managing their unique roles in the classroom (Murawski & Hughes, 2009). Specifically, the general educator, who may lack knowledge of how to support students with disabilities in accessing the curriculum, is provided with a colleague so that together they can address these challenges. In her study, Pratt (2014) found that co-teachers' differences allowed them to better communicate with students and support their learning needs.

Student learning in the co-taught classroom occurs as a result of the balance of the differing knowledge and skills that partners bring to the classroom (Walther-Thomas et al., 2000). Co-teaching partners work towards shared instructional goals but contribute differing expertise in designing instruction. These teachers come from very different preparation programs (Murawski, 2009). These differences should result in distinctive

approaches to instruction and "a classroom in which teaching and learning reflect the blended best of each perspective" (Friend, 2014, p. 15). Pratt (2014) refers to this blend as a mutually beneficial relationship in which the differing areas of expertise enhance teaching and learning for the benefit of both teachers and students.

There are some skills that both teachers require in order for successful co-teaching to occur (Friend & Cook, 2007). These include interpersonal skills, problem-solving skills, and decision-making skills. Both teachers need to be committed to the relationship, flexible, and engaged in teaching and learning (Friend, 2014; Friend & Cook, 2007). They need to know how to co-teach (Scruggs et al., 2007; Sileo & van Garderen, 2010; Van Hover et al., 2012; Walsh, 2012). Skills such as communication, shared ownership, and how to develop a shared vision are critical. These skills are particularly important considering that co-planning is necessary for effective co-teaching to take place (Scruggs et al., 2007; Walsh, 2012). Both teachers must have skills and expertise in collaboration that enable them to work effectively together in the context of the co-taught classroom and to provide specially designed instruction for students with disabilities (Friend & Cook, 2007).

The research related to co-teachers' knowledge does not directly address technological knowledge in relation to the co-teaching partnership, however Mastropieri et al. (2005) briefly discussed technology as it related to one of their case studies. In that specific case the special educator assumed more leadership when it came to technology integration in the classroom. This was observed on each occurrence of technology use during instruction. Mastropieri et al. posit that the teachers' background experiences may have influenced the division of workload. This tacit knowledge may have some impact

on the ways in which these co-teachers interact and collaborate within their classroom context (Tee & Lee, 2015).

Tacit knowledge. Some knowledge is unseen and based upon life experiences that influence behavior and practices within the classroom in both positive and negative ways—what Tee and Lee (2015) refer to as tacit knowledge. Teachers may implement pedagogical practices with which they were once taught as children, or they may adopt new practices based upon experience through pre-service or mentor programs. Teachers' knowledge is not static (Porter & Brophy, 1988). Teachers continue to learn and develop knowledge from their own and other teachers' experiences. Shulman (1987) notes that reflection upon experiences and practices support this learning and the development of PCK. Regardless of the experiences that teachers drawn upon, this tacit knowledge is difficult to measure and is often overlooked (Tee & Lee, 2015).

Experienced teachers continue to learn and to develop their skills to positively impact student learning (Paolini, Di Blas, & Torrebruno, 2015). Teachers acquire PCK mainly through experience with teaching (Hashweh, 2005; Van Driel & Berry, 2010). Teachers continue to cultivate this knowledge throughout their careers and are most able to integrate this knowledge after having taught for several years (Veal & McKinster, 1999). Van Driel and Berry (2010) expressed concern that there were limited examples of PCK due to "the tacit nature of teachers' knowledge" (p. 656) and the limited opportunities available for teachers to share their knowledge.

Building and sharing knowledge. Co-teachers learn from one another (Mastropieri et al., 2005; National Science Teachers Association [NSTA], 2009; Scruggs et al., 2007). Co-teaching partners learn skills and strategies from each other that are

adopted and used in other classrooms with students with and without disabilities (NSTA, 2009; Walther-Thomas, 1997). Working in close proximity to another teacher with differing knowledge and skills provides "the best professional growth opportunity of their careers" (Walther-Thomas, 1997, p. 401). Continuing opportunities to share their unique expertise allows teachers to learn new ideas and to increase their teaching repertoires.

Pratt (2014) notes that co-teachers mentor one another in developing knowledge and skills related to their varying areas of expertise. They actively participate in dialogue and reflection related to lesson planning and in review of the successes and failures of those lessons (Rytivaara & Kershner, 2012). Ideas are discussed and shared and new ideas are generated within this process (Friend, 2014; McDuffie et al., 2009). As such, co-teachers have a larger repertoire of knowledge that can be applied to the classroom context than what one teacher alone has (Rytivaara & Kershner, 2012). In this case, "not everybody needs to know everything if learning is shared" (p. 1006). This further emphasizes that co-teaching partners are more effective when each has a unique knowledge base (Walther-Thomas et al., 2000).

Rytivaara and Kershner (2012) posit that reflection, instructional experiences, and dialogue that are shared between co-teachers provide effective professional learning opportunities. These opportunities would not be possible if both partners had the same knowledge and skills (Walther-Thomas et al., 2000). Friend and Cook (2007) state, "Co-teachers are not expected to master all of each other's expertise, but they learn from each other in ways that enhance their own skills" (p. 119). As such, the co-teaching partnership may provide an opportunity for co-teachers to learn and develop their skills related to technology integration.

Co-teaching may be seen as an avenue for professional development and change of practice (Roth, 2002). Through shared dialogue, planning, and instruction co-teachers learn from one another and adopt the practices of one another. Roth's (2002) study addressed a curriculum specialist co-teaching with a content expert, rather than a special educator and general educator, but this research supports the notion that co-teaching provides space for teacher learning. Roth posits that three-months spent in a co-taught setting provides an avenue for transformation of teacher practice.

Distributed or shared knowledge is developed through organizational learning systems and across organizations (Nore et al., 2010). It is developed through collaborative learning experiences and collaborative planning amongst teachers related to technology integration. Zhao, Lei, and Frank (2006) note that the social network of schools creates opportunities for sharing of technology knowledge and skills. They posit that computers will be used more regularly in classrooms when teachers have the chance to collaborate with this technology integration. In these instances, teachers will be better able to support one another in incorporating technology into instruction.

Teachers, when working collaboratively, are able to develop PCK (Gaffney & Faragher, 2010). New teachers working with experienced teachers who engage in dialogue towards a common goal for student learning are more likely to have better student outcomes (A. Jones & Moreland, 2004). Van Driel and Berry (2010) note that this dialogue may lead to shared PCK. They state, "discussing and sharing such key notions among teachers may contribute to the establishment of a collective PCK, that is, a shared or common form of teachers' professional practical knowledge about teaching certain subject matter" (p. 660). In other words, by engaging in subject-related dialogue

and how best to deliver this content to students, teachers may develop shared knowledge of practices that support student learning of content.

Thesis

The contextual demands at the meso-, macro-, and micro-levels (Porras-Hernández & Salinas-Amescua, 2013), the importance of teaching a diverse population of students in the general education classroom (Friend et al., 2010; Murawski, 2009), the pressure to integrate technology into students' learning (Puckett, Judge, & Brozo, 2004), and the intricate nature of all types of knowledge that teachers must possess, all combine to make teaching a complex and challenging profession (Hofer & Swan, 2006). IDEA (2004) and ESSA (2015) both require schools to ensure that students with disabilities have access to the general education curriculum and that they make progress within that content. However, national statistics indicate that students with disabilities are far behind their peers in terms of academic achievement and long-term outcomes (Sanford et al., 2011; USDOE, 2014). It is vital that we determine how best to serve this population and what levels and types of knowledge teachers need to do so.

Research related to teachers' knowledge within the co-taught classroom has been related to content and pedagogical expertise (e.g., Mastropieri et al., 2005; Murawski, 2012; Scruggs et al., 2007). A missing component is co-teachers' degree of knowledge related to technology integration and how this is held, built, and shared in the co-taught classroom. Puckett et al. (2004) note that teachers' lack of knowledge related to technology integration impacts their level of support for students with disabilities in this setting.

Considering the TPACK framework in relation to the co-taught classroom, what

is the nature of co-teachers' technological pedagogical content knowledge to more effectively integrate technology into the classroom? How is it fostered, developed, and shared? Is this type of knowledge individual, distributed, or both? Special educators often lack content knowledge in co-teaching partnerships (Linz et al., 2008; Magiera et al., 2005; Sileo & van Garderen, 2010). Co-teaching is based upon the premise that each teacher brings a particular area of expertise to the partnership (Murawski, 2012). How do these areas of expertise manifest themselves in the co-taught classroom where technology initiatives have been implemented?

It is important to explore co-teachers' knowledge related to context, technology, pedagogy, and content, and the intersection of all within co-taught classrooms. Both ESSA (2015) and IDEA (2004) require states and school divisions to ensure that teachers develop skills and knowledge related to technology integration that supports students with disabilities in the classroom. School leaders must consider how to develop co-teaching partnerships, to plan professional learning approaches to support these partners, and to measure the effective implementation of technology initiatives within their school communities. The context of the co-taught classroom provides unique opportunities for knowledge building and sharing. Discovering more about these processes will provide valuable information to administrators as they consider the factors noted above. Most importantly, discovery of how co-teachers hold, build, and share knowledge related to technology integration will inform efforts to develop co-teachers' expertise so that students with disabilities will achieve to their highest academic potential.

CHAPTER 3: METHODS

Students with disabilities must have access to the general education curriculum, and as such, the general education setting is the default educational placement for them (Friend, 2014; Van Hover et al., 2012). Digital technologies for education can support students with disabilities in learning general education content (Anderson et al., 2009; Boon et al., 2006; Thomas et al., 2012). However, teachers may not have the skills needed to incorporate these technologies effectively into instruction (Beacham & McIntosh, 2014). TPACK is the complex form of knowledge needed for teachers to integrate technology in ways that support the unique learners in each classroom (Mishra & Koehler, 2006).

Co-teaching is one of the most frequently used special education service delivery models to help students with disabilities succeed in the general education setting (Murawski, 2009). Within the context of co-teaching, each teacher brings particular areas of expertise to the partnership (Murawski, 2012), and may not share levels and types of expertise (Linz et al., 2008; Mastropieri et al., 2005; Sileo & van Garderen, 2010). Reflection and dialogue between co-teachers can provide effective professional learning opportunities (Rytivaara & Kershner, 2012), and such opportunities may not be possible if both partners possess the same knowledge and skills (Walther-Thomas et al., 2000). As such, the co-teaching partnership may provide an avenue through which collaborating teachers may increase their knowledge and expertise related to technology integration.

If this is the case, how is co-teachers' technological pedagogical content knowledge fostered, developed, and shared? Is this type of knowledge individual, distributed, or both? How does this area of expertise manifest itself in the co-taught classroom, where multiple co-teaching approaches are incorporated and technology initiatives have been implemented?

Current research that focuses upon co-teachers' knowledge is limited, and most of this research does not directly address co-teachers' knowledge related to technology integration. Eight studies address co-teachers' knowledge in their findings (H. J. Lee & Herner-Patnode, 2009; Linz et al., 2008; Mastropieri et al., 2005: Rytivaara & Kershner, 2012; Scruggs et al., 2007; Van Hover et al., 2012; Walsh, 2012; Walther-Thomas, 1997), but do not include co-teachers' knowledge related to technology integration. Most of these studies used a non-positivistic approach, with two being case studies. They addressed co-teachers' successes, failures, and challenges (Mastropieri et al., 2005), co-teachers' knowledge, attitudes, and perceptions (H. J. Lee & Herner-Patnode, 2009), how co-teachers work together (Van Hover et al., 2012), and co-teachers' shared knowledge (Rytivaara & Kershner, 2012). Other studies looked more broadly at co-teaching, addressing a number of elements within their studies, similar to those noted above, rather than just one area of focus (e.g., Linz et al., 2008; Scruggs et al., 2007; Walsh, 2012; Walther-Thomas, 1997).

To explore co-teachers' knowledge related to technology integration in depth, I employed a multiple case study approach. Each case included a special education teacher and a general education teacher involved in a co-teaching partnership as a special education service delivery model. Studying multiple cases allowed for a greater

understanding (Stake, 2006) of co-teaching partnerships as they relate to knowledge development and sharing for technology integration. Further, this approach provided for comparison across cases to better understand how the co-teachers involved held, built, and shared technological pedagogical content knowledge.

Research Framework

In order to discover how co-teachers hold, build and share knowledge related to technology integration, this multiple case study was grounded in the interpretivist/social constructivist research paradigm (Rossman & Rallis, 2003). This paradigm is based upon the premise that people create the social worlds in which they live. Within this paradigm, research participants, as creators of their own realities, are assumed to provide the most meaningful data about topics of study through sharing their experiences, perceptions, and interpretations. Situating a study within an interpretivist/social constructivist paradigm provides a means for viewing the focus of a study through the perceptions of the study's participants. In my study, this was accomplished through interviews and observations with a goal of achieving a deep understanding of each case and how each case compared with the others. By studying co-teachers' understandings of their actions and interactions related to technology integration, I was able to discover how they held, built, and shared knowledge to support this integration.

Theoretical Framework

As described in Chapter 2, TPACK provides a framework for teachers' knowledge of technology integration that considers the interrelation of pedagogical, content, technological, and contextual knowledge (Mishra & Koehler, 2006). Researchers provide differing conceptualizations of the TPACK framework (Angeli &

Valanides, 2013). For example, Mishra and Koehler conceptualize four distinct bodies of knowledge (as described in Chapter 2) within TPACK as the basis for quality teaching with technology (Koehler et al., 2013). They emphasize the interdependence of these intersecting bodies of knowledge as they are applied within the contexts of classrooms and schools. The different knowledge components are interconnected, and it is the interactions of those components that allow teachers to develop technology-enhanced instructional activities that support the specific learners in each classroom (Mishra & Koehler, 2006). According to these authors, teachers who possess TPACK know the contexts in which they teach, the content they need to teach, the pedagogical practices that support learners in understanding the content, and technologies that support those pedagogical practices.

Angeli and Valanides (2008) refer to a *transformative* conceptualization of TPCK whereby pedagogical knowledge, content knowledge, technology knowledge, contextual knowledge, and knowledge of learners all contribute to teachers' TPCK, but not necessarily interdependently. These authors see TPCK as a unique and separate body of knowledge. Further, Angeli and Valanides conceptualize technology knowledge as knowledge of information and communication technologies (ICT), defined as computer-based technologies. ICT knowledge is knowledge of computer operation, computer software, and troubleshooting techniques to address problems with computers. This differs from Mishra and Koehler's (2006) technological knowledge, which includes knowledge of many types of devices and software—not only those that are computer-based. This is a key difference in these two models. More importantly, in this

transformative model, teachers' knowledge is transformed from individual knowledge of the types listed above into a separate and distinct form of knowledge, termed TPCK.

Both conceptualizations incorporate notions of individual bodies of knowledge. Where Angeli and Valanides (2013) consider the transformation of these components when they are combined into a distinct and different type of knowledge, Mishra & Koehler (2006) address the interactions of the separate bodies of knowledge that ensure effective technology integration. The distinct knowledge to which Angeli and Valanides (2013) refer includes specific competencies that support technology integration in instructional delivery in order for students to better learn content. Teachers who possess transformative TPCK are able to transform learning for students through computer-based applications that enhance instruction. For example, particularly difficult concepts may be better understood through use of computer-based technologies that provide students with opportunities to interact with the content on the screen. Conversely, Mishra and Koehler (2006) posit that knowledge of context, content, effective pedagogical practices, and technologies to support these practices interact in such a way as to allow for incorporation of technology into the classroom. For example, instruction may be enhanced when appropriate technologies are integrated into effective teaching practices to support content learning, such as use of animated visuals of photosynthesis for science.

Critics of the TPCK/TPACK framework argue that the construct is too large, and the individual knowledge components comprising the construct are difficult to measure (Brantley-Dias & Ertmer, 2013; Cox & Graham, 2009; Kopcha, Ottenbreit-Leftwich, Jung, & Baser, 2014). They call for more clearly defined individual bodies of knowledge (e.g., Shinas, Yilaz-Ozden, Mouza, Karchmer-Klein, & Glutting, 2013) as well as simpler

means with which to measure these constructs (e.g., Archambault & Barnett, 2010). The lack of clarity related to separate knowledge components within the TPACK framework has made it difficult for researchers to find replicable means to measure the constructs (Cox & Graham, 2009). Some researchers suggest that, due to the difficulty of separating its component parts quantitatively, the individual domains of the TPACK construct may not actually exist (Archambault & Barnett, 2010). Brantley-Dias and Ertmer (2013) further suggest that the difficulties with measuring this construct may be due to the complexity of it, and the blurred lines that are drawn between each of the component parts. Developing a valid and reliable means to measure these components within different contexts and content areas is also an area of concern (Archambault & Barnett, 2010).

Neither Mishra and Koehler (2006) nor Angeli and Valanides (2013) meant for the TPACK construct to be conceptualized as the simple sum of its component parts. Koehler et al. (2013) posit that it is the "dynamic equilibrium among all components" (p. 17) that allows teachers to effectively integrate technology into instruction. Angeli and Valanides (2013) posit that development of the individual bodies of knowledge that comprise transformative TPCK do not directly support the development of the construct as a whole. Instead, they note that researchers must focus on TPCK as a separate and unique body of knowledge. In other words, it is the interactions among the component parts in both models of TPACK/TPCK, rather than the individual parts in action, that comprise teachers' technology integration knowledge as a whole.

For the purpose of this study, therefore, TPACK was applied holistically as a construct in the manner in which Mishra and Koehler (2006) describe, emphasizing "the

connections, interactions, affordances, and constraints between and among content, pedagogy, . . . technology" (p. 1025) and teaching/learning contexts. Within this conceptualization, it is the complex interrelationships among teachers' knowledge of content, pedagogy and technology within their unique contexts that informs the integration of technology into classroom instruction.

I explored how TPACK was held, built, and shared by co-teachers. As co-teaching is based on the premise that each teacher possesses differing areas of expertise (Murawski, 2012), it was important to view the TPACK construct as a blend of component parts that enhances teaching and learning through technology integration (Mishra & Koehler, 2006) rather than as a unique knowledge base that transforms instruction when technologies are included (Angeli & Valanides, 2013). In using the integrative lens, I explored whether TPACK is shared among the co-teachers or is held individually by each. For example, I wondered: is it possible that the general education teacher possesses PCK and the special education teacher possesses TPK, and together they share the TPACK needed to incorporate technology into the co-taught classroom? Could it instead be that the general educator holds TPACK and the special education teacher holds TPK? Or does each teacher hold and build TPACK individually? The integrative view of TPACK allowed me to explore the construct as an interrelation of knowledge components possessed by each teacher, built individually or collaboratively, and/or shared between both teachers.

This exploration was conducted through a multiple case study that allowed me to explore and analyze individual cases as well as make comparisons across cases (Stake, 2006). Using the TPACK framework as a guide throughout the data collection,

generation, and analysis, I was able to discover how co-teachers' knowledge of technology integration is held, built, and shared within the unique teaching and learning contexts in which they collaborate.

Research Approach

A multiple case study approach, including four instances of co-teaching partners, was used to explore how co-teachers held, built, and shared knowledge related to technology integration. Each case included a special education teacher and a general education teacher involved in a co-teaching partnership as a special education service delivery model. Case study is a non-positivistic approach that involves the investigation of a case or cases within specific contexts for the purpose of developing a deep understanding of an issue or topic (Creswell, 2013). A case is a particular entity that is analyzed, such as the co-teaching partnerships in this study. This research approach involves an in-depth investigation using multiple sources of data that will be further described below. The purpose of using the multiple case study approach was to generate a better understanding how co-teachers hold, build, and share knowledge related to technology integration by exploring their experiences and perceptions of those experiences. Further, this approach provided a deeper understanding of the focus of study and allowed for comparison across cases (Stake, 2006). Each case was selected using the purposive sampling method described below and included co-teaching partnerships at the middle and high school levels.

Participant Sample

Purposive, criterion-based sampling (Patton, 2002) was appropriate for this study due to its specific focus. Purposive sampling allowed for identification of participants

whose experiences were relevant to the focus of the study (Bazeley, 2013; Schwandt, 2007), in this case, co-teachers who were integrating technology into classroom instruction.

It is important to identify the conditions, or criteria, through which to effectively answer the research question (Schwandt, 2007). In this study, the criteria included co-teachers who had been working together during the academic year in which data generation took place, and who were employing multiple co-teaching approaches as described in Chapter 2. It is important for co-teaching partners to employ multiple co-teaching approaches beyond one-teach/one-assist, as effective co-teaching includes the use of these multiple approaches to best meet the learning needs of students with disabilities (Friend et al., 2010). Additionally, these co-teaching partners participated in co-planning and integrated technology regularly into classroom practices. Technology integration was a critical component of the sampling criteria because the research questions addressed how knowledge related to technology integration was held, built, and shared within the context of the co-taught classroom. Co-planning is an element of effective co-teaching, and is also the avenue through which co-teachers share their reflections and dialogue about past and future instruction, which is an aspect of how co-teachers engage in professional learning (Rytivaara & Kershner, 2012). As such, co-planning was a critical component in this study's sampling criteria so that participants could respond to questions about how they built and shared knowledge in the co-taught classroom. Co-teachers were selected based upon the criteria noted here and participated in the study in the manner described in the next section.

Data Generation/Collection

Multiple types of data were generated to permit an in-depth exploration of each co-teaching case (Creswell, 2013). These types included individual and partner interviews, and observations of planning and instruction. Further, several sources of data were explored. These sources were the cases that were included in the study. Multiple types and sources of data are important to enhance the quality of these data (as will be further described in the next section), provide for deeper analysis, and ensure that the results stem from the perceptions and experiences of the participants rather than the researcher (Creswell, 2013). Further, this practice helps to ensure that the research is rigorous and provides for deeper understanding (Tracy, 2010). Triangulation, an important component of quality research, is comparison of multiple types of data from multiple sources to ensure accuracy of results (Yin, 2014). Results are more credible if two or more sources point to the same conclusion (Tracy, 2010). I was able to affirm inferences drawn from one source by comparing cases in which multiple types of data had been generated, better supporting the quality of my research findings (Bazeley, 2013).

Data were generated through paired interviews with co-teachers, (one at the beginning of data generation and one at the end of it), two classroom observations, one co-planning observation, and individual interviews with each teacher. These types of data generation are described in more detail in the next sections.

Paired Interviews

The primary data generation approach in this study was interviews. In-depth interviews provide an effective means through which to gather rich data within case

studies (Yin, 2014). A total of four interviews per case were conducted—two paired interviews and one individual interview with each teacher. The research focus and theoretical framework were used to design interview questions. Questions were open-ended to permit depth and breadth of answers. Interviews were semi-structured in that I identified initial questions in advance (as listed below), but added follow-up questions as needed during interviews, asking participants to expand upon aspects of their answers relevant to the study's focus (Creswell, 2013).

I started data generation by conducting semi-structured interviews with co-teachers together. Interviewing partners at the same time was helpful because the interaction between partners yielded rich information. These interviews were scheduled for approximately one hour each to allow time to delve deeply into topics addressed. Questions that I asked co-teaching pairs included:

1. What knowledge and expertise does each of you bring to the co-teaching partnership?
2. Which, if either, of you has technology-related knowledge? Pedagogical knowledge? Content knowledge?
3. In what ways, if any, do you and your co-teaching partner blend your areas of expertise and knowledge?
4. How, if at all, do you learn from and with each other?
5. Please describe how you and your co-teacher build knowledge related to technology integration with each other, if at all.
6. Please describe how you and your co-teacher share knowledge related to technology integration with each other, if at all.

7. Is there anything else that you would like to share related to your knowledge of technology integration?

I audio-recorded the interview sessions and created transcripts of the interviews afterwards. Recording and transcribing interviews was an important part of managing and preparing data for later analysis (Bazeley, 2013), which will be further described in the data analysis section. After transcribing each interview, I summarized the data in writing and shared the summaries with participants. These member checks, whereby participants reviewed and corrected summaries of the content of the interviews, were completed following each interview to establish accuracy of study results (Creswell, 2013; Tracy, 2010).

Classroom Observations

Classroom observations for each case were conducted, allowing me to become more familiar with the cases' contexts (Bazeley, 2013). I observed two separate classes per case and employed an observation protocol (see Appendix A) that identified areas of focus—behaviors and/or communication around which I paid particular attention. During these observations, I recorded field notes that included rich detail as well as impressions I gained. I recorded observations chronologically with a focus on my research questions. I recorded descriptive and reflective notes. Descriptive notes are direct observations and reflective notes incorporate questions and impressions that are gained in the observation process (Creswell, 2013). Reflective notes provide space for the researcher's expression of thoughts, questions, and perceptions during data generation. Honesty and authenticity are important quality criteria in research (Tracy, 2010). By recording my views during observations, I ensured transparent and open

documentation of not only my direct observations, but also my initial feelings on what these might mean in terms of the study. I recorded rich observational detail, to capture the essence of the observation as it pertained to the focus of the study (Bazeley, 2013).

The information gained from the observations provided insight into how co-teachers partnered in the classroom, the technologies that were incorporated, and the activities and structures that were employed. This ensured a broad view of the context within which each partnership collaborated and helped me better understand the co-teachers' perspectives and experiences as they shared information through the interview process. Further, it allowed for richer descriptions of the cases within their unique settings (Creswell, 2013). Providing concrete, specific, rich detail is helpful in ensuring credible results (Tracy, 2010). In other words, I provided a clear illustration of the conditions in which events took place, demonstrating that meaning is derived from co-teachers' experiences within their unique contexts, rather than from my perceptions primarily.

Individual Interviews

I conducted individual interviews with each co-teacher. As with the paired interview that was conducted first, interviews were semi-structured in nature and were scheduled for approximately one hour. I conducted individual interviews with each teacher to learn more about their background and experiences, their perceptions of the co-teaching partnership, and their perceptions of how knowledge was held, built, and shared within those partnerships. I asked individual teachers similar, and in some instances, the same questions that I asked the pairs to further triangulate the data (Bazeley, 2013; Creswell, 2013; Yin, 2014). Questions for individual interviews included:

1. How long have you been teaching?
2. How many years of experience have you had co-teaching?
3. How long have you worked with your current co-teaching partner?
4. Were you assigned to your co-teaching partner or did you both volunteer to work together?
5. How did you learn to co-teach?
6. What areas of expertise in general do you believe you bring to the co-teaching partnership?
7. What experience with technology integration, if any, did you have prior to working with your co-teaching partner?
8. What formal learning, if any, have you had related to technology integration?
9. What informal learning, if any, have you had related to technology integration?
10. What knowledge of technology integration, if any, do you hold?
11. What knowledge of technology integration, if any, does your partner hold?
12. Please describe how you and your co-teacher build knowledge related to technology integration with each other, if at all.
13. Please describe how you and your co-teacher share knowledge related to technology integration with each other, if at all.
14. Is there anything else you would like to share related to you and/or your co-teacher's knowledge of technology integration?

As described earlier, these interviews were audio-recorded and transcribed with summaries sent to participants for member checking. Further information about this process will be shared in the data analysis section.

Second Classroom Observation

I conducted a second classroom observation to generate additional data within the context of the instructional environment. I observed a class during which co-teachers were incorporating at least one technology that was different from the technologies used during the first observation. The information generated provided further insight into how co-teachers partnered in the classroom and the activities that were employed when technology was integrated into the lesson. By viewing the integration of different technologies, I gathered additional detail ensuring richer descriptions of the cases (Creswell, 2013). Further, I was able to identify additional follow-up questions to address in the second paired interviews.

Co-Planning Observation

I observed one co-planning session for each co-teaching pair to get a sense of how these teachers planned together for instruction that incorporated technology. As such, I observed a planning session that included technology integration discussion. As before, I used the observation protocol to record observations chronologically with a focus on my research questions and the behaviors and/or communication around which I paid particular attention. These field notes were used for later analysis (Bazeley, 2013). The planning session observation allowed for triangulation of the data obtained from individual interviews and classroom observations (Bazeley, 2013; Creswell, 2013; Yin, 2014).

Second Paired Interview

Finally, I conducted semi-structured interviews with co-teachers together a second time. I asked partners the same questions as in the first paired interviews to further

triangulate my data (Bazeley, 2013; Creswell, 2013; Yin, 2014). I asked questions directly related to the second classroom observation, where necessary, to clarify or address questions that arose.

As with the first paired interviews, I audio-recorded and transcribed interviews, requesting participants to review summaries for member checking. This practice supported data analysis as described further in the data analysis section.

Reflexive Journal

A researcher's reflexive journal was maintained throughout this study. It is helpful for researchers to keep a journal that includes perceptions and experiences related to the study (Bazeley, 2013). Through this process, I recorded ideas, emotions, and biases associated with the research topic, as well as questions that arose and decisions I made throughout the study (Schwandt, 2007). Journaling provides for honesty and transparency in research, ensuring that thoughts, decisions, and events are documented throughout the process (Tracy, 2010). I tracked each step of the research process from the literature review through writing of the study's results and implications. I began with questions I had and what I expected to discover. During the study, I recorded perceptions, questions, and plans. Journaling allows for continual processing of information throughout the study, helping researchers to make better sense of the data and avoid drawing inaccurate conclusions (Bazeley, 2013). For my study, I highlighted initial perceptions in the data generation process and reviewed these during the data analysis process to either confirm these early insights or correct misconceptions. In this way, reflexive journaling further supported the quality of my study's results.

Data Analysis

Both within-case and cross-case analysis was used to consider the similarities and differences across cases (Bazeley, 2013; Stake, 2006). The benefit of conducting both is that it allows for views of each individual case (within-case analysis) while considering the patterns and themes across cases (cross-case analysis). Both holistic and categorical approaches to case analysis were used (Creswell, 2013). Holistic analysis involved looking at the cases as wholes, discovering themes within the broader analysis. Categorical analysis allowed for coding of data based upon the theoretical framework, as well as through codes that emerged during data analysis. More detail will be shared about both of these approaches in the descriptions below.

Data analysis occurs throughout the process of data collection and generation (Bazeley, 2013). This allows the researcher to reflect on and explore data, to become more familiar with these data, and to develop a greater understanding of participants' experiences through these reflections. Further, continuous analysis provides opportunities to record ideas and assumptions related to the data, identify areas where further data generation or clarification are needed, and gain a holistic view of data as they are generated. This was accomplished through the following practices.

Observations

During classroom and co-planning observations, I recorded both descriptive and reflective notes. I read through the notes as soon as possible following the observations. This process allowed me to establish a holistic or broad view of the data, providing a sense of the context as a whole before more closely analyzing the details (Bazeley, 2013).

Next I read through observation notes with more precision with my research questions as my guide, reviewing each notation and recording initial thoughts and questions. I recorded these ideas as memos within the observation notes, and transferred them to my electronic database for further analysis as will be described later in this chapter. Memos are initial ideas that emerge through data collection and review (Yin, 2014). Thoughtful processing and note-taking during review of data allows for greater understanding, deeper analysis, and supports emergence of themes (Bazeley, 2013). Initial thoughts, ideas, and questions related to the observations were reflected in my reflexive journal. Lingering questions or areas that appeared unclear were addressed in the interview process. The use of the reflexive journal for recording initial impressions and the initial review of the observation notes allowed for greater depth of analysis during later review, as I was capturing these important details immediately follow the data generation process.

The organization of the reflexive journal must allow for easy access to related concepts during later data analysis (Bazeley, 2013). I kept my journal in an electronic format, using the highlight and comments features to track items to which I returned later. Further review of observation notes and memos will be discussed later in this section.

Interviews

I audio-recorded all individual and paired interview sessions. Soon after each interview I listened to the entire recording, getting a broad sense of what was shared, recording initial ideas, thoughts and perceptions in my reflexive journal. I transcribed the interviews verbatim for the more categorical or detailed data analysis that took place next. As mentioned previously, a summary of each interview was sent to the participants

for member reflection and checking. Based upon their responses to the summary, I made adjustments and/or additions to the summaries. Summaries, similar to observation notes, provided a more holistic view of the data. Transcriptions require a more categorical or detailed analysis through the use of coding (Bazeley, 2013).

Coding

Categorical data analysis requires segmenting data into smaller fragments, which are labeled, and then combined into themes for further comparison and interpretation (Creswell, 2013). Codes are words or phrases that identify a characteristic for a specific data segment (Saldaña, 2013). Some codes, called a priori codes, are identified in advance of data analysis, and are based upon the research questions and theoretical framework used the guide the study. The a priori codes I used were based upon the TPACK framework and my research questions (see Appendix B). Each code was defined so that I could determine data segments that matched each code description. In conducting the analysis of transcripts, I came across segments of data that did not fully fit with any of the a priori codes. I, therefore, established additional codes within which to sort my data, and added codes as necessary throughout the analysis. For example, contextual knowledge was identified as an a priori code, based upon the theoretical framework used for this study. However, teacher statements such as, "I wanted that interaction with my kids. I wanted them up and moving around and not just listening. I wanted student-centered and not teacher-centered," informed the generation of a new code, "student-centered" that was added as an emergent code.

A software program was used to assist with storing, organizing, and analyzing data. This allowed for more flexibility and ease with data analysis (Bazeley, 2013). Each

transcript was uploaded into the software program, Dedoose. Within this data management system I uploaded each interview transcript, analyzed the transcripts line-by-line, and coded segments of data for later analysis (an example is provided in Appendix C). I completed these steps as soon as possible after each interview.

Themes

After all data had been collected and generated, and initial data analysis had been conducted as described above, I merged codes and memos into larger themes. Themes are broader categories derived by combining codes into "common ideas" (Creswell, 2013, p. 302). They are described in phrases or sentences that provide meaning to data (Saldaña, 2013). In other words, codes provide attributes to a set of data, such as the example of student-centered noted above. Similar codes may be merged into a theme that describes this data set more clearly and completely. For example, for the case study described in Chapter 1, with student engagement, student enthusiasm, students' best interests, and student behavior, we found a pattern of student elements that influenced teachers' decision-making (Theisinger & Grosser, 2016). The theme "student elements" categorized data more broadly, encompassing all student-related data, further summarizing data into meaningful results. Similar to coding, I wrote a description of each theme, and updated theme descriptions as necessary during further data analysis, to ensure accuracy.

Triangulation

After I analyzed transcripts and sorted data into codes and then into themes, I returned to the observation notes and reviewed memos I had written, sorting these into extant or new themes as appropriate. I considered whether these data supported themes

that I had identified. If there appeared to be inconsistencies in the data, whereby the observational data did not support the interview data, I would have needed to conduct additional interviews or observations, an unnecessary step in this study. This flexibility to return to data generation and collection during data analysis is one of the benefits of non-positivistic research approaches, however (Bazeley, 2013).

Another aspect of triangulation references the ideas, thoughts, and assumptions I noted in my reflexive journal as I was generating and analyzing data. I returned to these notes and followed a similar process as I did with observation data, looking for confirmation, areas of concern, or mistaken assumptions, and making note of these in the latest journal entries. It was important for me to note mistaken assumptions and compare these with my conclusions. The purpose of this comparison was to ensure that my assumptions were not inadvertently included in my conclusions. If I had found that they had been included, I would have corrected and rewrote these conclusions, an unnecessary step in this study. In aligning my conclusions with actual results rather than my assumptions I ensured credibility in my research (Tracy, 2010).

Thematic Groupings

After I identified and described themes within the data, I looked for links and connections among these themes, further weaving the results of data analysis through theme groupings. These groupings were discovered by identifying similarities among themes and combining similar themes into larger conceptualizations of data (Bazeley, 2013). As with codes and themes, I provided descriptions of these groups, and analyzed them by making connections with the extant literature as well as my theoretical

framework. Further, I looked for and described connections among the groups to identify the overarching results of the study.

As noted previously, cross-case analysis involves consideration of patterns or relationships that exist across cases (Bazeley, 2013). I conducted cross-case analysis by comparing codes and themes, looking for similarities across cases. Differences across cases were highlighted and considered in the findings also. Looking at cases individually allowed a view into how co-teachers, within their unique contexts, held, built, and shared knowledge related to technology integration. The cross-case analysis afforded comparison across cases related to this research focus.

Quality Criteria

Tracy (2010) describes eight criteria for high-quality non-positivistic research. There is flexibility within these criteria that permit multiple means through which to ensure quality results. Each of the criteria directly supports quality findings based upon the design of my study as described below. Many of these quality-focused methods have been described in the previous section. Tracy's eight criteria are described in detail here.

Worthy Topic

The first criterion of a high-quality non-positivistic study is researching a worthy topic, meaning that the research focus is relevant and of interest to the field (Tracy, 2010). As noted previously, current legislative mandates require that students with disabilities have access to the general education curriculum and technologies to support their learning (Puckett et al., 2004). As co-teaching is one of the most frequently used service delivery models (Murawski, 2009), and national statistics indicate that students with disabilities are far behind their peers in terms of academic achievement and long-

term outcomes (Sanford et al., 2011; USDOE, 2014), identification of how co-teachers hold, build, and share knowledge related to technology integration is a timely and suitable research focus.

Rich Rigor

Rich rigor is another of the eight criteria for high quality research (Tracy, 2010). This means that the research includes abundant data, detailed descriptions, and deep analysis. Further, the researcher must have sufficient, relevant data; include contextual information; and use appropriate data collection and generation procedures for the design of the study. In order for me to derive meaning from co-teachers' experiences as they relate to how they hold, build, and share knowledge related to technology integration, I engaged in rich, rigorous research. This is not a phenomenon that can be observed directly, and therefore requires deep, well-triangulated exploration.

I employed multiple types and sources of data as described above, spent time immersed in the multiple co-teaching contexts, and made use of observation notes, interview protocols, and interview recordings to generate data. I used member checks to ensure the accuracy of my understanding of what was communicated during the interviews, and provided a description of data analysis procedures in the previous section of this chapter. All of these practices contribute to rich rigor (Tracy, 2010).

Sincerity

Sincerity as a quality criterion means the researcher demonstrates honesty and transparency throughout the study (Tracy, 2010). Transparency involves clear and well-explained research practices, detailed record-keeping, and thorough descriptions of plans and procedures. Because the nature of how co-teachers' hold, build, and share

knowledge is not readily apparent, I needed to ensure that the study's results reflected participants' perceptions and experiences, rather than my own. I did this by recording my initial expectations in the Researcher as an Instrument statement (see Appendix D) and my perceptions throughout the study through reflexive journaling. This practice, along with clearly describing the data generation and analysis processes as shared in this chapter, and identifying the limitations of study results later in this manuscript, demonstrate sincerity within the research process.

Credibility

The fourth criterion, credibility, refers to the trustworthiness or believability of the results (Tracy, 2010). This is supported through rich descriptions and triangulation as explained above. Further, multivocality, defined as multiple opportunities for participant input and a variety of perspectives, is important. Member reflections, or seeking participants' input actively during data generation and analysis, ensure credibility. It is important for all research to be credible, but it was particularly necessary to address it directly in this case study, as I needed to capture experiences and perceptions of co-teachers and translate those into a true illustration of how they held, built, and shared knowledge related to technology integration in their unique contexts (Stake, 2006).

By using multiple types and sources of data, I provided well-triangulated, detailed descriptions relevant to the study's focus. Conducting both individual and paired interviews, as well as employing a multiple case study approach, allowed for multivocality. Member reflections were offered through the use of semi-structured interviewing and member checks, providing opportunities for participants to not only correct or confirm the data, but also to elaborate upon it. The credibility of my study's

results was enhanced by these practices, as well as the use of reflexive journaling, a theoretical framework to guide the design and implementation of the study, and data analysis practices as described in the previous section of this chapter.

Resonance

Tracy (2010) defines resonance, the fifth criterion, as research results that are meaningful and important to the audience. This is supported through the writing of the research report, and is achieved through aesthetic merit and transferability. Aesthetic merit refers to how well the writing engages the reader and encourages thought and emotion. This can be accomplished, to some extent, through clarity in writing, detailed descriptions, and explanations that are meaningful to readers. Transferability refers to research results that may be useful to readers in their own contexts, and can be applied to their own circumstances. Because of the unique nature of my research focus, and the need for research that addresses co-teachers' technological pedagogical content knowledge, it is vital that the findings have merit for readers and provide information applicable to their own settings. I addressed resonance as a quality criterion by providing clear descriptions of contexts, recounting participants' experiences and perceptions in detail, and sharing results and conclusions with meaning and clarity.

Significant Contribution

Quality research makes a significant contribution to the field, the next criterion (Tracy, 2010). There are four types of significance, including theoretical, heuristic, practical, and methodological. Theoretically significant research extends, builds upon, and/or critiques scholarly knowledge. In other words, this is research that generates new understandings and provides unique explanations within a particular discipline. The

literature review conducted for this study provides insight into research related to the study's focus. This study was designed to extend current research on teachers' technological pedagogical content knowledge into the context of the co-taught classroom, and may therefore provide new understandings.

Research that is heuristically significant motivates others to question and explore similar research or the same focus in other contexts (Tracy, 2010). Practical significance refers to results providing insight into a particular issue and motivating readers to action. I addressed heuristic significance by including potential for future research in my conclusions. Further, I addressed practical significance by describing the potential value of the results in relation to how administrators can support technology integration practices in co-taught classrooms. Although I cannot control how readers react to results of my study, I can potentially influence action and further research by completing the activities noted here.

Finally, methodological significance is achieved by introduction of a new methodological approach (Tracy, 2010). This may be a new approach to the research focus, such as using non-positivistic research where only positivistic research has been conducted. It may also be a unique or creative approach to data generation and/or analysis. As noted earlier, no studies involve the use of a multiple case study approach to address co-teachers' knowledge related to technology integration, indicating that this study may achieve methodological significance as described by Tracy (2010).

Ethical

Ethical research is important to high-quality studies (Tracy, 2010). This criterion consists of procedural ethics, situational ethics, relational, and exiting ethics. As I

conducted a study that required direct interaction with people, ethics were a particularly critical consideration to ensure confidentiality, prevention of harm, and respect for human dignity. Procedural ethics are driven by the Institutional Review Boards, present in organizations, that mandate and monitor research practices (Tracy, 2010). A proposal to conduct the study must be presented to this board with clear, detailed descriptions of the purpose, rationale, and design of the study. Upon approval of this proposal by my dissertation committee, I submitted an application for human subjects approval from the School of Education's Institutional Review Committee (EDIRC) at the College of William and Mary. This application outlined the purpose of the study, the theoretical framework, the research approach, and plans for data generation and analysis. A participant consent form (see Appendix E) that ensures fully informed consent was included in the application. This form addressed safeguards for participants that included assurance of privacy and confidentiality, commitment to do no harm and avoid deception, and the freedom for the participant to disengage from the study at any time. Additionally I requested permission to conduct the study from each school division in which I selected participants. Procedures for this approval varied depending upon the division; therefore I completed the required application process for each as specified by the division. Following school district and university approval, I obtained consent from participants using the form noted above and found in Appendix E.

Other ethical considerations include situational and relational ethics (Tracy, 2010). Situational ethics considers the decisions researchers make that may arise as a result of particular circumstances in which they find themselves while doing research (Tracy, 2010). For example, I observed classrooms in which students were learning. I

therefore needed to consider how best to conduct my observation so as not to interfere with instruction or cause distractions for students. As such, I sat in a location removed from students and in the back of the classroom in most cases. As events may have arisen in the classroom or school, I was prepared to decide whether to conduct the observation, or whether to reschedule. For example, in the event of an intruder in the school, schools conduct a "lock-down" procedure whereby classroom doors are locked and students and teachers must remain in the classroom until it is safe for them to be dismissed. In this instance, I would have needed to remain in the classroom as well, but would have rescheduled the observation, as this would not be a typical classroom experience due to the atmosphere of concern in the school. Fortunately, this type of scenario did not present itself during my observations.

Similarly, relational ethics have less to do with procedures and are about decisions that researchers make to maintain healthy relationships with participants (Tracy, 2010). This includes respect for participants' time, space, and privacy; following through on commitments; and a non-judgmental approach to the process. I scheduled observations and interviews when it was convenient and most appropriate for participants, kept my appointments, shared summaries when promised, and remained neutral in my responses during interviews.

Finally, exiting ethics are considered in reporting and sharing of data, so as not to mislead readers or misrepresent participants' statements (Tracy, 2010). By using the data analysis approach described above, I ensured that results were consistent with data. A summary of preliminary study results was shared with participants to allow for clarification and correction. Also, conclusions were directly connected to results based

primarily upon participants' experiences and perceptions, rather than my opinions and expectations as a researcher. As mentioned previously, reflexive journaling, whereby I recorded my ideas, thoughts, and perceptions throughout the study, allowed me to keep the focus on participants.

Meaningful Coherence

Meaningful coherence is the last quality criterion, and refers to research that reflects its purpose and demonstrates alignment throughout the study (Tracy, 2010). These studies demonstrate interconnection among the research design, theoretical framework, and data generation and analysis. Further, the study's findings must align with related research and address the research questions directly and completely. Meaningful coherence was important in my study to ensure findings directly addressed the research focus and provided new knowledge to the field, as research with this focus was lacking. By aligning each component of this research study, ensuring solid research design, providing a comprehensive literature review, and situating my findings within relevant literature, I have addressed this aspect of quality research. Further, data analysis was a critical component of ensuring quality results through meaningful coherence, as described in the previous section.

Conclusion

The use of a multiple case study approach in this study allowed for exploration and discovery of co-teachers' experiences and perceptions related to my research focus (Creswell, 2013; Stake, 2006). Research related to how co-teachers' technological pedagogical content knowledge is held, built, and shared was lacking in the extant literature. Teachers need this knowledge to support students with disabilities in the

general education setting (Puckett et al., 2004). It was important, therefore, to explore co-teachers' knowledge related to technology, pedagogy, content, and context, and the intersections among all four. This information may be helpful to school leaders as they partner special education and general education teachers, consider professional learning for these partners, and encourage technology integration within their school communities. Further, it was important to consider how co-teachers' hold, build, and share knowledge related to technology integration to ensure that students with disabilities are provided with opportunities to achieve at or above the levels of their peers.

CHAPTER 4: RESULTS

Effective co-teaching provides supports for students with disabilities (Tremblay, 2013), provides a more structured education within the general education environment (Murawski, 2009), and can positively influence achievement of these students (McDuffie et al., 2009). Co-teaching can benefits teacher as well (Murawski & Hughes, 2009), as they develop skills and expertise with one another and share in instruction and planning (McDuffie-Landrum, 2011). Co-teaching can serve as an avenue for professional development and change of practice (Roth, 2002). Co-teachers learn from one another through shared dialogue, planning, and instruction. They blend their areas of expertise in their shared classroom (Pratt, 2014). Co-teachers in this study blended their knowledge and built and shared their individually-held knowledge with one another as described next.

Co-teachers from four different classrooms participated in this study. Two of the partnerships taught in the same urban middle school—one in eighth grade English and the other in eighth grade mathematics. Both sets of partners had been co-teaching together for fewer than two years. The other two cases involved high school teachers located in rural areas on opposite sides of the same U.S. state. One partnership taught Algebra 1 and the other Earth Science. These partners had been co-teaching together for more than five years.

Teachers in this study co-planned lessons, employed multiple co-teaching approaches, and integrated technology into instruction. The teachers in all four cases participated in a statewide co-teaching initiative that is described next.

Co-Teaching Initiative

The State Department of Education (SDOE) initiated a statewide co-teaching project as a means of promoting and improving co-teaching as a service delivery model for students with disabilities (SDOE, 2016). Representatives of the SDOE, through an application process, selected co-taught classrooms across the state that demonstrated co-planning, co-teaching, and collaborative implementation of strategies that support students with disabilities in the general education classroom. The selected teaching partners model effective co-teaching to other educators throughout the state during on-site visits, providing professional development through demonstration, consultation, and resource-sharing. The selected partners also participated in the development of online resources made available through the state department's website.

Model sites were selected based upon four criteria including (a) a description of how they would provide positive observation experiences for visiting teachers, (b) a lesson plan with corresponding video of a co-taught lesson, (c) evidence that the school has a successful co-teaching model, and (d) letters of commitment from teachers and administrators.

Demonstration sites received professional development and technical assistance as well as grant funding. The partners participated in a two-day professional learning event that included a national expert in co-teaching. They learned components of effective co-teaching, co-teaching approaches, co-planning strategies, and culturally

responsive instructional practices. During the event they engaged in interactive activities with their co-teaching partner. Following this summer session, co-teaching partners received three to four site visits from a technical assistance provider throughout the fall semester to assist them with the implementation of co-teaching in their classrooms. They then received further technical assistance based upon individual teacher or team needs.

Each demonstration site received grant funds to purchase instructional materials, assistive and educational technologies, or professional development resources to support the achievement of students with disabilities. Co-teaching partners received a stipend for participation as well. Co-teachers in all four cases participated in this statewide initiative. They also taught in schools that were fully accredited in the 2016-17 academic year according to the state-wide accountability system as described below.

State Accreditation

The schools in this study were fully accredited according to the state accountability system for the 2016-17 school year (SDOE, 2016). For a school to be fully accredited in this state, student pass rates must be 75% or higher in English and 70% or higher in mathematics, science, and history on the state's standardized assessments or approved alternative assessments. High schools must also attain a point value of 85 or greater based on the Graduation and Completion Index (GCI).

The GCI calculation includes students in the cohort of expected on-time graduates (SDOE, 2016). On-time graduates are those who have graduated within four years of entering high school. The calculation adds students who transfer into the school over the four-year period and subtracts those who have transferred out of the school. Students who do not receive a diploma within four years are "carried over" and calculated with a lower

point value. A student earning a diploma who entered ninth grade for the first time five years prior is an example of a carryover student. Carryover students are included in annual GCI calculations until they graduate or leave school for other reasons. Students with disabilities and those with limited English proficiency are included in the GCI calculation when they earn a diploma, GED, or certificate of completion. These completion options receive lower point values. The total point value is divided by the number of completers. This value is the GCI. Further details about school accountability results will be described in the sections that follow.

Context

The context in which the participants in this study co-taught influenced how they held, built, and shared knowledge related to technology integration. As noted in Chapter 2, there are three levels of context (Porras-Hernández & Salinas-Amescua, 2013) referred to as macro-, meso-, and micro-levels. The macro-level includes broader international, national and state demands including political and societal pressures. For these cases the macro-level context included the legal requirements of IDEA and ESSA.

Context at the meso-level involves division- and school-level influences such as new initiatives, financial factors, and personnel support (Porras-Hernández & Salinas-Amescua, 2013). The micro-level includes resources for instruction, classroom norms, student and teacher preferences, and learning goals. Each of these levels of context has an influence upon teachers' practices within the classroom.

The legal requirements of IDEA and ESSA, as described in Chapter 2, ensure a free appropriate public education for students with disabilities in their least restrictive environment. Co-teaching, as a service delivery model, provides an avenue to do so.

These laws also require that school divisions provide technology resources to support student learning.

At the meso-level school administrators partnered teachers in this study and provided resources such as co-planning time, professional learning opportunities, educational technologies, and personnel resources to support implementation of co-teaching and integration of technology. At the micro-level the knowledge, values, and beliefs that these teachers brought to the classroom informed their practices within the partnership and the classroom, allowing them to further build and share their knowledge.

The cases described in detail below were most directly influenced by the school and co-teaching contexts (meso- and micro-levels). The school context provided time together, technology resources, personnel resources, and access to professional learning. The co-teaching context included the individual knowledge, beliefs, and values of each teacher and the practices they adopted as a result of these. Their practices as co-teaching partners included collaboration, communication, and learning from and with each other. Within-case analysis results are described next and will provide greater detail regarding the ways in which these contexts influenced how teachers in this study held, built, and shared knowledge of technology integration.

Julie and Laura

Julie and Laura co-taught Earth Science at Mountain View High School. Their classroom was a model co-teaching site in the statewide co-teaching initiative described above.

Mountain View High School

Mountain View is a public high school located in Smith County, a rural community of a mid-Atlantic state. Smith County has a population of over 18,000 residents and is located approximately 20 miles from a major city. Although the majority of the labor population works outside of the county, the largest local employers are retail, food service, and local government.

Mountain View High School enrolled over 900 students at the time of this study. The school demographic information showed the student population included 75% students who are White, 10% students who are Black, 7% students who are Hispanic, 2% students who are Asian, and 6% of students of two or more races. Less than 40% of students received free and reduced-price lunch. Students with disabilities made up 5% of the student population at Mountain View High School, and most were identified as having Learning Disabilities.

Mountain View High School had been identified as fully accredited according to the state accountability system for the 2016-17 school year (SDOE, 2016). Reporting data indicated that Mountain View had an 89% pass rate in English, an 81% pass rate in mathematics, an 88% pass rate in history, an 85% pass rate in science, and a 94-point GCI.

This high school operated on a block schedule with classes that met every other day for almost 90 minutes. Students were able to participate in seven classes over the course of two days throughout the year.

Co-Teachers

Julie and Laura were co-teaching partners in Earth Science and had been teaching together for eight years. They co-taught four classes within a seven-block schedule. Julie and Laura had not received formal professional development related to co-teaching until two years prior to this study when they joined the statewide initiative as a model co-teaching site. Julie and Laura incorporated multiple approaches to co-teaching in the classroom as a result of attending this conference. These variations included station teaching, alternative teaching, and parallel teaching as described in Chapter 2.

Julie. Julie, the general education teacher, was certified in Earth Science and had been teaching for 14 years. She began her first experience with co-teaching when the administration at Mountain View High School assigned her to co-teach with Laura. When not sharing a classroom with Laura, Julie taught two solo-taught Earth Science classes. Julie indicated that she had content and pedagogical knowledge and had learned technology integration through her partnership with Laura, individual exploration, and conference attendance. She had no formal classes related to technology integration. Prior to co-teaching with Laura, Julie had incorporated only presentation software and Web Quests into her instruction.

Laura. Laura had been teaching for over 30 years at the time of the study and co-taught 11 of those in both science and math. Although she was the special education teacher in her partnership with Julie, Laura was also certified to teach Earth Science. She noted that she had pedagogical knowledge, knowledge of strategies to support students with disabilities, and technological knowledge. Laura had been interested in learning more about technology integration and adding technologies to her classroom since she

started teaching at Mountain View High School 10 years prior. She had no formal coursework in technology integration, but learned through exploration, conference attendance, and other types of professional development.

Julie and Laura had been integrating technology into instruction from the beginning of their partnership. They started by incorporating a portable device that made whiteboards interactive. Laura had received training in the use of this device immediately prior to working with Julie and then recommended that Julie receive the training as well. They then adopted additional technologies and began using a variety of hardware and software to support classroom instruction.

Holding, Building, and Sharing Knowledge of Technology Integration

Their school and co-teaching contexts influenced how Julie and Laura developed and shared knowledge and expertise related to technology integration. The school leadership provided them with co-planning time, technology resources, and the opportunity to engage in professional learning. These supports, in conjunction with their individual knowledge, beliefs, and values, informed classroom practices that fostered learning from and with each other.

Julie and Laura brought individual knowledge and past experiences to their partnership. They both believed in the power of teaching and learning and were committed to improving instruction for their students. Julie and Laura valued learning and engaged in formal and informal learning around technology integration. They believed technology integration engaged students and provided opportunity for a student-centered classroom.

Their similar qualities fostered greater collaboration and a rich partnership. As such, they collaborated in implementation of new practices in the classroom and participated in shared learning experiences. Their meso- and micro-contexts as described above, and in more detail below, influenced how Julie and Laura held, built, and shared knowledge related to technology integration.

School context. Julie and Laura had been co-teaching partners for several years. Their school leaders initially assigned them as partners and continued to do so. They were scheduled to co-teach multiple classes and co-plan during the school day. Julie and Laura had access to technologies to support their instruction. They regularly engaged in professional learning, attending conferences and participating in division-level professional development activities. Their school leadership supported these efforts.

Time together. Julie and Laura had longevity in their relationship, having worked together for eight years. They were able to share their knowledge with one another over this time. Julie and Laura spent most of the day together in co-teaching and co-planning. This collaborative planning and delivery of technology-integrated instruction supported the development of teachers' TPACK (Allen et al., 2010). Julie and Laura indicated co-teaching and co-planning were avenues for learning and sharing technology-related knowledge.

Laura noted that scheduled co-planning time made communication easier and provided for "more productive" planning and sharing. Julie believed that observing each other in teaching allowed for learning from one another. Laura explained, "We'll be teaching together and one of us will do something and the other one will go, 'Oh! I didn't know we could do that! Yea! Show me how.'"

Both teachers noted that their time together was valuable. Julie expressed that they "constantly" shared ideas with one another over the course of the day and the school year. Their productive time together allowed for shared learning. Access to technologies also supported Julie and Laura in building and sharing their knowledge of technology integration.

Access to technology resources. Although Julie and Laura purchased many of their classroom technologies using their own funds, their school leadership provided hardware and software as well. For example, teachers at Mountain View High School had access to LCD projectors, computer carts, iPad carts, student response systems, and software subscriptions. The special education department had a set of Chromebooks, and several content-level teams had computer carts for their access only. Julie noted that the school had increased the number of technologies each year. Laura added, "even though we are a small district and a small school, we have quite a bit of technology."

As new technologies were added, Julie and Laura expanded their knowledge in order to effectively use them in and out of the classroom. They had access to planning software and taught themselves how to use it. As they tried out this technology on their own, they shared what they learned with one another. Julie described, "I was at my computer and she was at hers, and we were at home texting back and forth—can you see this? Can you get in here? Can you do this? Hey, this is how you add that."

The school context in which Julie and Laura taught included time together and technologies to support teaching and learning. They were also provided with avenues through which to increase their learning.

Access to professional learning resources. Julie and Laura sought new opportunities for learning and attended "nine or ten conferences" together. Their school leadership supported this effort by providing professional leave, substitutes to cover the classroom, and funding (when needed) for attendance. When Julie and Laura found new technologies through their conference attendance, they requested funding from the principal for those most beneficial to student learning. Some of these requests were granted. For example, their principal purchased mobile interactive white board technology for the entire school based upon the recommendation of Julie and Laura.

Smith County Schools' leadership provided training on newly purchased technologies to their teachers. Julie and Laura took advantage of these opportunities. Laura was a member of the school division's technology team and, as such, she had further opportunity to learn more about technology. She noted, "they are always pulling me in for new training . . . for various things that the school's giving or the district is giving."

The school context in which Julie and Laura taught included provision of time together as co-teaching partners, access to technology resources, and opportunity to participate in professional learning. The co-teaching context provided supports for knowledge building and sharing as well.

Co-teaching context. Their specific co-teaching context allowed Julie and Laura to create a collaborative partnership. They each held knowledge, values, and beliefs that influenced their teaching practices. They shared these through their interactions with one another and developed a strong relationship. This partnership created a context to support learning and the development of TPACK.

Teacher knowledge. Julie and Laura expressed that they each had individually-held knowledge related to content, pedagogy, and technology. Laura had knowledge of specially designed instruction for students with disabilities. Both teachers had a blend of knowledge that supported technology integration. They knew the pedagogical practices that supported student learning of specific content (PCK), technologies that enhanced or deterred student learning of content (TCK), and technologies that blended with pedagogical practices to support student learning (TPK). TPACK is the interrelation of all of these bodies of knowledge (Koehler et al., 2013), and Julie and Laura described practices within the Earth Science classroom that illustrated this blend of knowledge.

Julie and Laura recognized that technology must support content, enhance instructional activities, and meet the needs of students; therefore they did not incorporate technology into every lesson. Teachers who integrate technology into instruction often do so to address the needs of students and ensure that they make progress in the general education curriculum (Anderson et al., 2009; Jackson, 2004; Kennedy & Deshler, 2010). Julie and Laura selected technologies that supported student learning and made use of them when it was most appropriate to do so.

Laura's individually-held knowledge. Laura noted that knowing content and supporting technologies allowed her to better design instruction for students with disabilities and made it easier to identify technologies that supported learning for all students. She stated, "I see how technology can be used to enrich the classroom experience and enrich the teaching where others don't."

Laura developed technological knowledge by searching for and taking advantage of opportunities to learn. As a new teacher at Mountain View High School, Laura

wanted to learn more about technology integration, but she had no technology in her classroom. She discovered a conference that provided training as well as free technology. She attended sessions and browsed vendor stations to learn and discover technologies that could be incorporated into her special education classroom. Upon her return from the conference she shared what she learned with her co-teaching partner. Laura noted that she was "very slowly convincing the teacher there that this could be exciting if you just let it be." Laura shared her individually-held knowledge with Julie as her new co-teaching partner.

Julie's individually-held knowledge. Julie noted that she had greater knowledge of content and pedagogy than of technology. She believed she had to spend more time in learning technology, and much of what she knew she learned from Laura. Julie shared that she had been using limited technology at the beginning of their co-teaching partnership. She was using presentation software for instruction and web quests for student activity. She developed TPACK through her co-teaching partnership, exploration and praxis, and conference attendance. She noted that her greatest learning had been through her partnership with Laura, and her teaching practices changed "dramatically" as a result of this collaboration.

The individually-held TPACK that Laura brought to this partnership supported Julie's growth and development in technology integration. As Julie built her knowledge, she realized that technology supports a student-centered classroom. Both Julie and Laura continued to develop their knowledge of technology integration to ensure student engagement in the learning process. Their passion for teaching and belief in this profession motivated them to continue to develop their knowledge and skills.

Teacher beliefs. Julie and Laura brought individual expertise to their partnership. They were committed to their profession, had a passion for teaching, and believed that technology enhances classroom experiences for both teachers and students.

Laura noted that she believed that technology integration supported student success and was worth the time and effort needed to use it effectively. These teachers incorporated newly discovered technologies in the classroom, discussed their impact, and adopted those that were effective or discarded those that were not. They built their knowledge of technology integration in order to enhance their teaching skills and provide a student-centered environment.

Julie and Laura provided a variety of activities in their lessons that allowed for greater interaction with their students. They wanted to provide instruction that was student-centered versus teacher-centered, believing that this practice ensured student success. Laura stated,

> It's definitely about student engagement. *Definitely* . . . I feel you have to be careful that you don't overuse technology, because there are some students that don't do as well with the technology. So you have to be sure that there is a good blend of hands-on and technology, and that it's not all technology all the time, because you will lose some students that way. So, we have to look at what kind of learners we have . . . to make sure you reach everybody.

The desire to support student learning was the impetus for Julie and Laura to find opportunities for professional learning, take risks in trying new technologies in the classroom, and keep abreast of the latest innovations. They believed that these practices enhanced their knowledge and skills in technology integration and provided opportunities

for exemplary teaching. As described in these two sections, the knowledge and beliefs that Julie and Laura brought to their partnership informed how they built and shared knowledge of technology integration. They also held values that further informed their professional practices.

Teacher values. Julie and Laura valued learning both for themselves and their students. They regularly engaged in informal and formal learning, as they recognized the need to keep abreast of new technologies. Technology knowledge requires teachers to acquire additional expertise as new technologies emerge (Abbitt, 2011; Harris et al., 2009; Mishra & Koehler, 2006), allowing them to identify innovative uses for technologies to enhance instruction (Nelson et al., 2009). Julie and Laura engaged in exploration to find new software and tools that supported student learning. Julie stated,

> I think we both . . . have that mentality of—we just want to continue to make ourselves better because we know it's going to help the kids. And we look for . . . all the different ways that can happen and we just push ourselves.

Laura initiated technology integration into this co-taught classroom, but Julie quickly recognized its value. They were both committed to teaching and improving their practices through continuous learning. As such, Julie and Laura attended and presented at several conferences together. Laura expressed, "We love to go to conferences . . . just to find what somebody else is doing, so we can come back and do that too. As many different things as we can possibly do."

These co-teachers did not allow time limits to restrict their learning, and indicated that they found time and were not bound by the hours of the school day or workweek.

They expressed a strong commitment to their profession. Laura shared, "You know, everybody makes time for the things that they are passionate about." Julie stated,

> I love learning. I love finding new activities. I love that part of it and so . . . for me to sit down at a computer or with an iPad to find ideas—that is relaxing to me. I don't view it as work . . . and I don't think Laura does either. I think we both are just driven by wanting to be the best at our craft.

Julie and Laura held individual knowledge, beliefs, and values that influenced how they built and shared knowledge. These elements of their co-teaching context informed their professional practices both in and out of the classroom.

Professional practices. Julie and Laura's co-teaching context included the knowledge, beliefs, values that they held and the practices in which they engaged. Their professional practices included communication, collaboration, and professional learning. Julie and Laura regularly participated in informal learning experiences, engaged in effective collaboration within their co-teaching context, and established a strong partnership based upon regular communication and openness to sharing.

Communication. Julie and Laura both expressed the importance of communication in the co-teaching partnership. They believed consistent communication helped them to develop a strong relationship and learn from one another. Teacher knowledge and expertise is developed, in part, through interactions with other teachers (e.g., Nore et al., 2010; Putnam & Borko, 2000).

Julie and Laura noted that they built and shared their knowledge "organically" through their interactions with one another. Their years of collaborating and the amount

of time they spent together created a culture of sharing and growing. There was a natural flow of information and ideas within their partnership.

As co-teachers discuss experiences and generate ideas they expand their knowledge of effective instructional practices (Rytivaara & Kershner, 2012). Laura noted that she and Julie engaged in "constant" dialogue about how lessons went, what practices needed to be changed, and future plans for teaching. They communicated often—before and after school, through email and text outside of school hours, and between classes. Laura noted, "It really didn't matter that the school day was over or the school day hadn't started yet. If we had something to talk about, we found the time to do it."

Julie thought that their openness to new ideas fostered a cohesive partnership. She stated, "I do think it all boils down to just communication with each other, and just the openness that we have with each other, and sharing stuff, and being willing to listen and accept it and take it in." Their relationship of openness and sharing fostered collaboration within the co-teaching context.

Collaboration. The context in which Julie and Laura co-taught supported the individually-held knowledge, beliefs, and values that informed their professional practices. These practices involved regular communication, collaboration, and professional learning. Julie and Laura's consistent dialogue fostered a truly collaborative relationship.

Collaboration supports development of teachers' knowledge of technology integration (Allen et al., 2010). Julie and Laura collaborated both in and out of the classroom through co-teaching, co-planning, and ongoing communication. They each

described a genuine partnership with one another. Laura shared that she and Julie were always willing to share ideas with one another and stated, "we understand the concept of a team." Julie added, "I think when you find that right person to work with and you just click, it is just so natural." They viewed their collaboration as an opportunity to enhance skills, develop teaching repertoires, and increase knowledge of technology integration. Julie and Laura engaged in professional learning with one another.

Professional learning. As Julie and Laura communicated and collaborated, they shared their knowledge with one another. Much of the professional learning in which Julie and Laura engaged was collaborative and stemmed from their co-teaching partnership, as well as their individual beliefs and values.

Julie and Laura engaged in a variety of professional learning practices. These included exploring individually, sharing with one another, and trying out new technologies in the classroom. Laura taught herself how to use technologies discovered through online exploration and conference attendance. She then implemented them in the classroom with Julie, and they both reflected upon their effectiveness.

Julie and Laura were not afraid to take risks and try something new. Following implementation of new practices, they reflected upon outcomes and discussed affordances and constraints. Some new technologies were adopted and others omitted from future use. Julie believed that their willingness to try new technologies in the classroom provided the greatest avenue for learning. She stated, "And I think that is when you learn best too, when you just kind of experiment with it." Julie and Laura experimented on their own time and through their collaboration in the classroom.

These professional learning practices further enhanced Julie and Laura's knowledge and skills and allowed them to build a comprehensive repertoire of instructional activities. Teachers develop knowledge and learn strategies through implementation of new approaches (Hashweh, 2005; Shulman, 1987). Co-teachers learn strategies from each other through their shared classroom experiences (NSTA, 2009; Walther-Thomas, 1997). Julie and Laura learned through their individual exploration, sharing with one another, and implementation of newly discovered practices in the classroom. The context of their co-taught classroom supported these informal learning experiences.

Summary

The school and co-teaching contexts influenced how Julie and Laura shared their individually-held knowledge with one another and built their knowledge together. The context of the school in which they co-taught provided time together, access to technology, and professional learning opportunities. The co-teaching context included the knowledge, beliefs, and values they held, as well as the professional practices in which they engaged.

Partners in the next case that is described, Chris and Emily, also built and shared their knowledge of technology integration as a result of the cohesive partnership that they had with one another. Like Julie and Laura, they developed a supportive relationship through their longevity as partners, their time together, consistent communication throughout the day, and their openness to new ideas. Chris and Emily had access to other teachers from whom they could learn, a resource that was not available to Julie and

Laura. They also had technology resources more readily available within their classroom context.

Chris and Emily

Chris and Emily co-teach Algebra 1 at Valley View High School. Similar to Julie and Laura, they held, built, and shared knowledge related to technology integration as a result of their school and co-teaching context. There were unique differences between their school and classroom contexts as compared with the first case. These differences are described below.

Valley View High School

Valley View is a public high school located in Jefferson County, a rural community of a mid-Atlantic state. Jefferson County has a population of over 30,000 and is located approximately 70 miles from a major city. Most employment opportunities are found in the fields of education, health services, and manufacturing.

Valley View High School had a population of nearly 1200 students at the time of this study. Demographic data indicate that there were 93% White students, 4% Hispanic students, 2% students of two or more races, and 1% students of other ethnic backgrounds. Forty-eight percent of the student population received free or reduced-price lunch. Students with disabilities made up 7% of the student population at Valley View High School, and most were identified as having Learning Disabilities.

State Accreditation data indicated that Valley View High School was fully accredited for the 2016-17 school year with an 86% pass rate in English, a 73% pass rate in math, an 87% pass rate in history, an 85% pass rate in science, and a 94-point GCI (SDOE, 2016).

Valley View High School operated on a four-by-four schedule, meaning that students attended four classes per day with each class meeting daily for one semester. Students were then scheduled for four new classes during the second semester of the academic year. Teachers provided classroom instruction for three of these four blocks and received one planning block per day.

Co-Teachers

Chris and Emily had been teaching together for six years at the time of this study. They co-taught two of their three instructional blocks and co-planned for one block, spending three-quarters of their day together. They noted that some semesters they co-taught three blocks and co-planned for the other, spending their entire day together.

Chris and Emily were initially assigned to be co-teaching partners, but had no formal professional learning for how to effectively co-teach. They learned to co-teach through trial-and-error in their shared classroom and interactions with other co-teachers in the building. They both noted that they quickly developed a cohesive relationship that fostered a quality co-teaching environment.

Emily. Emily, the special education teacher, was in her 12th year of teaching, 11 of these in co-taught classrooms. She had a business background, but chose to change careers and became certified as a special education teacher. She noted that she had knowledge of math content prior to co-teaching in this subject area. She co-taught with another Algebra 1 teacher for the additional instructional block in the four-block day. Emily noted that the only formal training related to technology integration that she received was a class for use of interactive white boards.

Chris. Chris, the general education teacher, was in her ninth year of teaching, six of these in co-taught classrooms. Emily had been her only co-teaching partner. Chris noted that her strongest area of expertise was her mathematics knowledge. She also had knowledge of technology integration, which she learned from her college courses. Specifically, Chris learned to use interactive white board technology while in college. She taught one class of statistics when not co-teaching with Emily.

The Algebra 1 classroom in which Chris and Emily co-taught was located in a computer lab where they had 24 computers and a set of iPads. They also had an interactive white board and a student response system. They used a variety of software to support student learning. Chris learned to integrate technology through her pre-service program and in collaboration with Emily. Emily learned about educational technologies through working with other teachers in the building and through her partnership with Chris.

Holding, Building, and Sharing Knowledge of Technology Integration

The school and classroom context allowed Chris and Emily to share their knowledge related to technology integration with one another and build this expertise together. The knowledge, beliefs, and values that Chris and Emily held supported the development of a cohesive partnership. Their collaborative relationship provided for dialogue and reflection, learning with and from each other, and shared knowledge. The school context in which Chris and Emily co-taught provided a number of technology resources, knowledgeable teachers, and opportunities to learn. As they collaborated within this context, Chris and Emily further developed their individual knowledge and skills.

School context. Chris and Emily were provided with co-planning time, technology resources, and access to other knowledgeable teachers. The resources provided within their school context supported their knowledge-building and sharing related to technology integration.

Two specific differences between this and the first case were access to professional learning resources and access to knowledgeable teachers. Julie and Laura were able to attend many conferences and were supported by their school leadership in doing so. This was described in detail above, but will not be addressed for Chris and Emily or for the other cases, as it was unique to Julie and Laura's school context.

Another difference was that Julie and Laura did not have access to other knowledgeable teachers in their school. They were leaders in terms of technology integration within their school context. Chris and Emily, as well as co-teachers in the other cases, worked with colleagues who had knowledge of technology integration from whom they could learn. This is described in further detail below.

Time together. Chris and Emily had been teaching together for several years and spent most of the school day together, similar to Julie and Laura. Their time together allowed for shared dialogue about integrating technology into instruction and supporting student learning. Chris and Emily noted that time together allowed them to share knowledge with one another.

Structured co-planning during the school day provided Chris and Emily with time to plan, explore, and expand their knowledge. Chris noted that the co-planning block made it "convenient" to engage in meaningful dialogue that fostered learning. They were

able to brainstorm ideas for how best to approach challenges in the classroom. Chris stated,

> We are basically attached at the hip, so we do a lot of things together and discuss it. And we're together a lot of the day, so that really helps us to be able to have the time to, not only teach together, but to plan and reflect together, too.

The leaders at Valley View High School provided Chris and Emily with time together, continued to pair them as co-teachers each year, and ensured that technologies were available to support student learning.

Access to technology resources. The school context in which Chris and Emily co-taught included resources that supported continued building of knowledge related to technology integration. Although all the co-teaching partners in this study had access to educational technologies in their school context, Chris and Emily had the fewest challenges associated with integrating technology, such as connectivity and available computers.

Chris and Emily's school leaders scheduled their classes in a computer lab, allowing them access to technology on a daily basis. Whereas Julie and Laura had to secure computer carts, competing with other teachers to do so, Chris and Emily had ready access to this technology.

Chris and Emily had access to other technologies in their classroom as well. They used a learning management system and software that supported student learning, data collection, and document sharing. They noted that having technologies readily available inspired them to find more ways to effectively integrate them into the classroom. As

such, Chris and Emily reached out to other teachers in the building who could share technology-related knowledge.

Access to knowledgeable teachers. Both of the cases described thus far indicated that the teachers had time together to co-plan and access to technologies to support student learning. Chris and Emily also had access to colleagues in their school with whom they consulted.

When they wanted to expand their knowledge of technology integration, Chris and Emily approached other teachers in their school. Teachers learn from the experiences of other teachers (Porter & Brophy, 1988). Chris stated,

> We are fortunate enough to have access to other teachers who integrate technology into their classrooms and . . . people with a technology background close by in the school if we have an issue, or if we have a question, or need to know about something, we can go and ask. And they are all very open to that.

The school context in which Chris and Emily co-taught provided resources, such as time together, technologies, and other knowledgeable teachers. This context, along with their unique co-teaching context, influenced how Chris and Emily developed and shared expertise related to technology integration.

Co-teaching context. Chris and Emily held knowledge, beliefs, and values that influenced their classroom practices. Their time spent in dialogue and reflection, collaboration, and informal learning allowed them to build and share knowledge related to technology integration. Similar to Julie and Laura, Chris and Emily had a strong partnership that fostered learning from and with each other.

Teacher knowledge. Chris and Emily both had knowledge of context, content, pedagogy, and technology. They knew when to integrate technology to support classroom activities (TPK) and to support student learning of the content (TCK). They also held knowledge of strategies that supported meaningful delivery of content (PCK) and the blend of all of these components to support effective integration of technology into instruction. Each had specific areas of strength, however, that supported their shared expertise in the classroom.

Chris's individually-held knowledge. Emily believed that Chris had greater expertise in the area of technology integration. She noted that, although she had many ideas, she needed Chris to identify the technologies that best supported implementation in the classroom. Chris often took the lead with technology, using Emily's ideas and "making them happen" in the classroom. Emily noted, "It just depends on what the program is and how much experience I've had with picking up on it. She just kind of . . . she's able to pull something up and figure it out." Chris' individually-held knowledge related to technology integration supported their successful incorporation of technology into instruction.

Emily's individually-held knowledge. Chris shared that Emily had expertise in pedagogical practices that supported all learners. Emily was able to modify assignments, when necessary, for students with disabilities. She had a business background that provided her with content knowledge, and her experiences as a teacher allowed her to develop pedagogical knowledge to support the delivery of content in a meaningful way. Emily learned to integrate technologies in the classroom as a result of working in a computer lab for several years with other knowledgeable teachers. She noted, "I've been

blessed to have math classes in computer labs for the last ten plus years. So, I've had access to that and always tried to use that."

In my classroom observations I saw Chris and Emily each teach the same lesson to two separate classes. They used team teaching as the co-teaching variation, but switched roles from one class to the next. Both teachers were able to cover their assigned roles with no difficulty. I had observed something similar to this with Julie and Laura. Although they were able to rotate their roles, Chris and Emily noted that there were specific topics for which each brought greater depth of knowledge and stronger practices for instruction. Julie and Laura did not express this, nor indicate it to be the case in their partnership, therefore shared knowledge was not noted within their case description. The knowledge that Chris and Emily held as partners was distributed within their classroom as described next.

Shared knowledge. Chris and Emily blended their knowledge and skills in the classroom. Co-teachers may share their knowledge and blend their areas of expertise to support student learning (Theisinger & Grosser, 2016). As such, neither teacher needs to have proficiency in all areas (Rytivaara & Kershner, 2012). Chris noted that they both had strengths in pedagogical content knowledge, but each was stronger in teaching certain concepts. She explained,

> I feel like approach-wise we both have that ability—that background in the pedagogy—that we're able to contribute something. I feel like it depends—especially between the two of us—on what topic we're teaching. When it comes to teaching a specific content area, I feel like one of us is usually stronger. So, I

> mean, I feel we are really fortunate in that we complement each other, not only in our content knowledge, but the way that we are able to explain different topics.

Chris and Emily had difficulty in identifying where they each had particular strengths, as they believed their expertise was shared. Chris stated, "It is really hard to separate it, because after six years, obviously we just cooperate so well, it's hard to break it down really." She was, however, able to identify,

> I feel like I address the content and think about where we need to be, what we need to be teaching, what the lesson should look like. And Emily is really good at coming up with activities and figuring out different ways to approach a certain lesson—the individual needs—and specialize the instruction that we might need inside the co-taught classroom.

Chris and Emily often shared ideas and blended these to ensure the most effective activities were added to the lesson. The blend of differing areas of expertise provides better support for each teacher in the classroom (Murawski & Hughes, 2009), allows for dialogue, and the opportunity to meet students' learning needs (Pratt, 2014). Chris stated, "It's all together when we create or change something."

This sharing of ideas and strategies was a product of the beliefs and values that each teacher brought to the partnership. Chris and Emily held individual knowledge, believed that technology integration supported student learning, and valued professional learning opportunities and their co-teaching partnership. The knowledge, beliefs, and values these teachers held influenced their professional practices within their co-teaching context.

Teacher beliefs. As noted in the previous case description, Julie and Laura believed that technology enhanced the classroom experience for both teachers and students. In a similar way, Chris and Emily believed that technology supported the meaningful delivery of content and learning for students. They used technology daily in order to engage students in the learning process.

Chris and Emily also believed their own professional learning was most effective when they tried new technologies in their classroom. Chris noted that much of her knowledge had been developed through integrating technology into the lessons and using it regularly. She stated, "a big part of it is the experience in the classroom . . . and just the experience that you gain from the trial-and-error."

Chris and Emily held knowledge of technology integration and believed that technology supported student learning. They also believed that engaging in professional learning through praxis would further build their technology knowledge. Their co-teaching context included their individually-held knowledge and beliefs as well as their values as explained in the next section. All of these elements informed teaching practices that allowed for building and sharing of knowledge.

Teacher values. Similar to Julie and Laura, Chris and Emily valued learning for themselves and their students. These teachers spent time throughout the day reflecting upon their teaching practices. They thought about affordances and constraints of the technologies used, and considered the impact on student learning. Chris and Emily also considered other strategies, technologies, or activities that could be more effective for future lessons and spent time exploring better avenues for instruction.

Chris and Emily were both interested in building their knowledge related to technology integration. Chris shared that she was "driven to go find new ways to approach technology in the classroom." Co-teachers learn from one another through the co-planning process in which they share ideas and strategies (Theisinger & Grosser, 2016). Chris and Emily noted that their co-planning time allowed them to share knowledge with each other. Emily stated, "[I am] fortunate enough to work with someone who is patient enough to sit down and say, 'This is how it works. What do you want it to do? Let me show you.'"

Chris and Emily's knowledge, beliefs, and values informed their practices. Similar to Julie and Laura these practices included regular communication, collaborating as partners, and learning together.

Professional practices. Chris and Emily communicated regularly, collaborated on all aspects of teaching, shared their individual knowledge with one another, and engaged in new learning together. Chris and Emily referred to their relationship as a "team effort" and agreed that regular communication allowed for a rich partnership. Emily stated, "It's hard for us to decide who's the expert in doing what because we just kind of do it together. It's kind of hard to separate the two." She noted that the time they spent together, throughout the day and throughout the year, fostered a shared commitment to one another.

Communication. As was the case for Julie and Laura, Chris and Emily communicated regularly. They engaged in dialogue and reflection and fostered a strong relationship. Chris stated, "As long as we talk to each other, we can support each other."

Emily added that they often brainstormed ideas related to their co-teaching practices as they attempted to find the most effective methods for instruction.

Co-teachers mentor one another in an informal learning process (Pratt, 2014) and may also support each other's development of knowledge related to technology integration (Theisinger & Grosser, 2016). Chris and Emily learned from one another through dialogue and sharing of ideas. Both described times when Emily had an idea, and Chris recommended a specific technology to support it.

Chris and Emily used co-planning time to discuss concerns related to their shared classroom. They made decisions as a team. As they considered technologies to support instruction, they engaged in discussion that allowed for exploring and learning from one another. Emily described,

> When there is some kind of technology that we want to integrate into a lesson and maybe I say 'Well, let's use the [a specific technology]; I'm not sure how to set this up'. And then Chris can show me how . . . So, most of [learning] comes from watching and talking and having that conversations about how do you do this.

Both Chris and Emily shared that time spent in dialogue was critical to their success as co-teaching partners and an important component of their knowledge development. In essence, they learned from one another through this practice. Their regular communication fostered a collaborative partnership.

Collaboration. Just as communication was a teaching practice in which Chris and Emily engaged in their co-teaching context, so was collaboration. Their strong collaborative partnership was similar to what Julie and Laura shared. Chris noted that, as

co-teachers, she and Emily shared responsibility for planning and delivery of instruction. She stated, “We definitely share in all of it. I think we each have our strong points, but neither of us is solely responsible for any one part of the classroom or a lesson.”

Chris and Emily attended professional development opportunities related to technology integration, engaged in dialogue related to their new learning, and shared with one another. Chris stated, “We do a lot of it as a team. So we’ll learn new things and we kind of bring our own point of view and discuss it.”

Although she had learned about technology integration prior to their co-teaching assignment, Emily believed that most of her learning related to technology integration came from her lengthy partnership with Chris. Emily explained that Chris was collaborative in this sharing process. She described,

> [Chris] has been great. She’s great to just sit down and show me how to do something. Not just say ‘I’ll do it for you.’ It’s, ‘Let’s do this together.’ . . . a lot of the learning comes from that.

Co-teachers develop their skills and abilities through the professional growth opportunities that are found in the context of the co-taught classroom (Walther-Thomas, 1997). Chris and Emily both expressed that they learned from one another as a result of their strong partnership. As a new teacher to the school Chris was paired with Emily in a classroom with a variety of resources available. Chris noted that Emily introduced her to the technologies in the classroom and showed her how they had been used.

Chris and Emily collaborated in their co-teaching partnership. They each brought knowledge, beliefs, and values to their partnership that informed their collaborative practices. They engaged in regular professional growth opportunities.

Professional learning. As described in the previous case, Julie and Laura learned through individual exploration and sharing with one another. They implemented new technologies in the classroom and then discussed the results. They attended conferences together so that they could share in the learning process. This was very similar to what Chris and Emily expressed. They also explored and shared with one another, learned through trial-and-error in the classroom, and participated in collaborative learning experiences. They did not attend as many conferences as Julie and Laura described, however.

Chris and Emily engaged in collaborative learning experiences so that they could more easily share what they had learned. Chris explained that they searched the Internet for new software and obtained information from other teachers. She and Emily then discussed any newly discovered technologies, chose those they should incorporate, and reflected upon their effectiveness after implementation. Chris noted that all aspects of these experiences were done collaboratively.

Chris and Emily learned by implementing technology-integrated lessons in their instruction. Teachers learn through the experience of teaching (Veal & McKinster, 1999). Emily shared that she learned most effectively through working with other teachers, observing them in practice, and implementing observed practices in her own classroom. She is willing to "just jump in and figure it out."

As they implemented new strategies into lessons Chris and Emily adjusted practices as needed—in the middle of a lesson or for a class later that day. Emily noted that this "trial-and-error" approach was enhanced when they had a number of different

technology resources from which to choose. Their professional learning practices were supported through their school context.

Summary

Chris and Emily partnered in a school and co-teaching context that influenced how they held, built, and shared knowledge related to technology integration. Their school administration provided them with opportunity to co-teach multiple classes, co-plan daily, and partner year-after-year. Chris and Emily had access to technologies and knowledgeable teachers within their school context. Each teacher brought knowledge, beliefs, and values that informed their practices and shaped their learning experiences within their co-teaching context.

Teachers in the next case, Patty and Kelly, taught in a very different school context than either Chris and Emily or Julie and Laura, but had similar knowledge, beliefs, values, and practices related to technology integration. Like Chris and Emily, Patty and Kelly found that they learned from their colleagues within the school. Their collaborative relationship with each other fostered their learning, as was the case with both teams described thus far. They did not have longevity in their partnership as the co-teachers in both of the first two cases did, having only been teaching together for the past two years.

Patty and Kelly

Patty and Kelly co-taught eighth grade mathematics at Lake View Middle School. Their classroom was a model site in the statewide co-teaching initiative described above. They held knowledge related to technology integration and further built and shared from and with one another as a result of their school and co-teaching contexts.

Lake View Middle School

Lake View is a public middle school located in Madison City in a mid-Atlantic state. Madison City has a population of over 200,000 residents. There are several industries in the city including shipping, manufacturing, and health care. Additionally this community is home to a number of military families.

Lake View Middle School had a population of over 900 students at the time of this study. Demographic data indicates that there were 40% students who are White, 33% students who are Black, 10% students who are Hispanic, <1% Asian, 10% students of two or more races, and 6% students of other ethnic backgrounds. Thirty percent of the student population received free or reduced-price lunch.

Students with disabilities made up 14% of the student population at Lake View Middle School, and most were identified as having Learning Disabilities or Other Health Impairments. Students with Other Health Impairments are often students with Attention Deficit Hyperactivity Disorder, but they may also include students with other health conditions who have an educational need for special education services.

State Accreditation data indicated that Lake View Middle School was fully accredited for the 2016-17 school year with a 77% pass rate in English, a 76% pass rate in math, a 93% pass rate in history, and an 86% pass rate in science. This middle school operated on a bell schedule that included seven class periods of 45 to 60 minutes each.

Co-Teachers

Patty and Kelly co-taught one period of eighth grade mathematics and had been teaching together for two years at the time of the study. They co-planned during content-

level team meetings once per week. They communicated daily both in the classroom and when they found time throughout the day.

Patty. Patty, the general education teacher, had 28 years of teaching experience. She spent the first few years of her career as a high school math teacher. After completing her Master's degree in special education, Patty taught elementary special education for 13 years. She chose to return to math instruction and taught middle school math for next 13 years. She co-taught for over 20 years, half of which she considered quality co-teaching.

Patty learned to co-teach from other teachers with whom she had taught and through attendance at many conferences. She co-taught with Kelly one class period per day. Patty also taught two periods of Algebra, one period of Geometry, and one period of eighth grade mathematics without a co-teaching partner at the time of this study. Patty integrated technology into the classroom on a regular basis, having developed this knowledge through her interactions with other teachers, through the educational technology specialist in her school, and through the professional development opportunities offered by her school division.

Kelly. Kelly, the special education teacher, was in her second year of teaching when she participated in this study. She began co-teaching the previous year, partnering with Patty and learning to co-teach from this partnership. Prior to her current teaching assignment Kelly was a long-term substitute for marketing education. She had a degree in Marketing Education and was working towards her special education endorsement. Although she had taken some classes in technology integration, Kelly noted that most of her learning had been from implementing technologies in the classroom.

At the time of this study, Kelly co-taught eighth grade mathematics with Patty for one period and with another general education teacher for another period. She also co-taught a history class, and taught one academic support class independently. Kelly learned much of the mathematics content during her first year and was competent in teaching this subject. She had strong classroom management skills and demonstrated a natural ability to connect with students.

Patty and Kelly used a variety of technologies in the classroom including an interactive white board, document camera, tablets, computers, and calculators. Additionally, they employed a variety of software that supported student learning.

Holding, Building, and Sharing Knowledge of Technology Integration

Patty and Kelly held, built, and shared knowledge related to technology integration as a result of the school and co-teaching contexts in which they worked. Each teacher had individually-held knowledge, beliefs, and values that informed their professional practices. Both teachers wanted to provide an instructional environment that engaged students and enhanced their learning. The collaborative relationship that Patty and Kelly shared, allowed them to learn from and with each other.

The school context in which Patty and Kelly taught fostered the development of collaborative relationships through Professional Learning Communities (PLCs). Patty and Kelly had access to technology resources and had the support of an educational technology specialist. The collaborative relationships Patty and Kelly developed with other school personnel provided for open sharing and learning.

School context. Patty and Kelly taught in a school that provided technology resources, access to other knowledgeable teachers, the support of an educational

technology specialist, but limited structured time together. Patty and Kelly had less time together during the school day as compared with co-teachers in the first two cases described. They only co-taught for one period and did not have common co-planning time as partners. Although they participated in planning during their PLC meetings, there was no structured planning time for just the two of them.

Time spent together for Patty and Kelly was a result of their co-teaching context and the effort they made to do so, rather than their school context. As noted earlier, Patty and Kelly did have other resources to support knowledge-building and sharing. These are described next.

Access to technology resources. Although Patty and Kelly did not teach in a computer lab as Chris and Emily did, they had access to technologies to support instruction. They were similar to Julie and Laura in this regard as they needed to sign up for computer access and had challenges with Internet connectivity.

Patty and Kelly had access to a computer resource lab and used it to integrate free software that they discovered through their own exploration and the recommendation of their educational technology specialist. Their school provided software to support instruction as well. Patty and Kelly had an interactive white board, document camera, and tablets in their shared classroom.

Patty and Kelly were frustrated with the time it took for their students to connect to the Internet. They did not, however let this be a barrier to technology integration. The software that was available to support student learning made them willing to incorporate technology even with these challenges. Patty described,

> What I like about [a specific technology] is that I can control it, so it's not like the kids can skip ahead. I like it that I can see everybody's response. With that I can just glance at the screen and as the things come in I go, 'Oh, they're getting it.' I like the fact that you can get data from it. You've got a record of what they did.

Their school context provided access to these technologies, and Patty and Kelly spent time learning how to use them effectively. They also accessed other knowledgeable teachers within their building.

Access to knowledgeable teachers. Just as Chris and Emily had access to teachers from whom they could learn about technology integration, Patty and Kelly did as well. They participated in their PLC meetings where teachers shared their knowledge with one another. Opportunities for interaction and collaboration with other teachers supported the development of teachers' knowledge of technology integration (Allen et al., 2010). Patty noted that she believed teacher sharing provided the best professional learning. She stated, "You know, whenever you're around a bunch of teachers, they are going to share whatever they can share."

Patty and Kelly also learned from teachers outside of their department and school. Kelly learned from teachers with whom she collaborated last year, and Patty learned from other mathematics teachers across the school division. They built their knowledge of technology integration and learned together through collaboration with colleagues, such as the educational technology specialist in their school.

Access to educational technology specialist. Patty and Kelly had access to technologies and teachers from whom they learned within their school context. They had

the additional advantage of access to an educational technology specialist. Co-teachers in the first two cases did not note this type of support in their school contexts.

The educational technology specialist at Lake View Middle School attended PLC meetings monthly and supported teachers in implementation of technologies. Patty and Kelly valued these interactions. Patty stated, "When I think of building knowledge, I think of being in the PLC, of [educational technology specialist] coming down and sharing." She added that she has learned most of her technology knowledge from the educational technology specialist.

Patty and Kelly built and shared their knowledge related to technology integration through access to colleagues in the building. Their co-teaching context was a factor as well.

Co-teaching context. Patty and Kelly held knowledge, beliefs, and values that informed their professional practices. Both teachers had knowledge and experiences related to technology integration. Kelly used technology throughout her college learning experiences, and Patty had extensive teaching experience during which she integrated technology. They desired to learn more about technology integration and were often exploring ways to improve instruction for students. Patty and Kelly believed it was important to engage students in the learning process and to prepare them for a technological society. They valued learning for themselves and their students.

Teacher knowledge. Patty and Kelly both had knowledge of math content. Teachers must have deep knowledge of the subjects they teach, including underlying theories, processes, and concepts (Koehler et al., 2013), in order for students to learn the content in a meaningful way (Ramsaroop & van Rooyen, 2013). Patty and Kelly knew

the instructional practices that supported effective delivery of the math content (PCK). They both had knowledge of technology integration and an understanding of how to select the most appropriate technologies to support student mastery of content (TCK) and student engagement in classroom activities (TPK). Patty and Kelly had the blend of these within their classroom context (TPACK). Teachers with TPACK understand how technologies support content instruction and transform it in a meaningful way for the unique learners in their classrooms (Mishra & Koehler, 2006).

Patty and Kelly knew how to integrate technology into the context of their co-taught classroom, blending co-teaching variations with technologies to address each student's individual learning needs. Their use of station teaching, a co-teaching variation, supported differentiated learning. Patty noted, "It's been very, very effective. It makes us feel like we can target what they need. So if we do that—if we are breaking them up—one of the groups is usually technology-based." Although they both had knowledge of effective technology integration, they had differing areas of expertise.

Kelly's individually-held knowledge. Kelly, as a new teacher, indicated that she had learned content, pedagogical strategies, and technology integration through her co-teaching relationship with Patty. She stated, "I'm still learning because, like Patty said, this is only my second year teaching. She's much more knowledgeable. I'm learning a lot from her." Collaborative relationships among teachers facilitate professional learning (Hanover Research, 2016) and allow for the sharing of expertise (Sun, Loeb, & Grissom, 2017). Knowledge is transferred to newer teachers through observation and interaction with experienced teachers.

Both teachers believed that Kelly had grown a great deal in her knowledge of math content during her partnership with Patty. Patty stated, "She has picked up the math content beautifully, so she probably has just as much understanding of it." Kelly noted that her marketing education background and substitute teaching provided her with an understanding of how to teach math content as well.

In terms of technology knowledge, Kelly believed that she had knowledge of newer technologies through her educational experiences as a learner. She shared, "When I went to school things were taught differently; things were integrated differently in the classroom. And I guess I just bring the new side." She had always been involved in educational experiences that included technologies.

Patty's individually-held knowledge. Patty had extensive knowledge of math content. Both teachers shared that Patty's many years of experience and teaching several math subjects better prepared her to teach the content. She taught all levels of mathematics and had deep knowledge of the concepts and processes of each.

Patty also had many years of experience with technology integration both in and out of the classroom. She participated in after school activities involving robotics and programming. Patty learned through exploration and talking with colleagues. Kelly shared that Patty had "more experience with different programs and websites" discovered through researching on her own.

Both teachers acknowledged that, although Patty had more experience in the classroom, they learned from one another. Patty and Kelly built knowledge through collaboration with one another. They believed that technology supported student learning and made the classroom more engaging.

Teacher beliefs. Similar to both of the cases previously described, Kelly and Patty believed that technology supported student learning. As such, they were open to finding new ways to reach students in the classroom. Patty expressed, "I guess there's a lot of things out there that has got me trying to think about the content. We're always trying to get these kids to just think more rather than just spit out rote stuff." Their concern for student learning motivated both Patty and Kelly to build their knowledge related to technology integration and to share with one another.

Kelly and Patty believed that technology was an avenue for student engagement. Patty shared that integrating technology into instruction helped to hold students' attention. She described an experience with a student who struggled to stay focused during practice activities. After completing an activity using a new software program, the student told Patty that he was less distracted when using this technology.

Patty and Kelly believed that students should enjoy class and have fun while learning. They were motivated to learn more about technology integration to increase student interest in the lesson. Kelly noted that students found learning more enjoyable when technology was included. She stated, "they think it's cool. Rather than just sitting there taking notes . . . It engages their learning . . . And it is also student-driven." Patty shared, "You want kids to go out and go, 'That was fun!' or 'That was great!' or you want to see the light bulb go off or just that they learn it." Kelly believed that both teachers and students had fun in their classroom.

Both teachers persisted in building their knowledge of technology integration for the benefit of students. Kelly believed that students needed to be well prepared for the future. She noted,

> I would say, look at our society and this generation and the generation after it . . . everything based on technology, and if our kids don't know how to use technology or integrate technology themselves . . . then, well, we're doing them a disservice.

Patty and Kelly wanted to support student learning, make learning engaging, and ensure an enjoyable classroom environment. They believed technology was an avenue to do so. As such, they strived to increase their knowledge and skills related to technology integration.

Teacher values. Co-teachers in the first two cases valued learning for themselves and their students. Patty and Kelly did as well. They were willing to take risks and to share with other teachers. Teachers' willingness to try new things, to change their practices, and to reflect upon their experiences inspires other teachers to do the same (Keane et al., 2016). Kelly observed that, although Patty had been teaching for many years, "she's so open to learning new things. Which is really cool, because most teachers who've been teaching 20 plus years are kind of set in their ways. And they don't want to change how they do things."

Kelly was also willing to learn. She adopted new practices both in the co-taught class and in her individual classrooms. Kelly noted that there "is always room for improvement" in teaching and thought she had much to learn. She wanted to explore and learn the many different approaches to instruction that were available to teachers. Patty defined technology integration as continual learning. She explained,

> When I think of technology integration I think of being aware of what's out there and also having the desire and motivation to find out other stuff that I may not

know . . . And then being able to integrate it into the instruction so that it's appropriate. And then how to use that data that you collect from it to guide instruction further.

Patty and Kelly valued learning and strived for ways to improve their knowledge and skills for the benefit of their students. The knowledge, beliefs, and values they held informed their practices. They engaged in communication, collaboration, and professional learning within their co-teaching context.

Professional practices. Patty and Kelly communicated often and shared the responsibilities of the classroom. They engaged in professional learning experiences to build their knowledge of technology integration. These practices were similar to those of Julie, Laura, Chris and Emily.

Communication. As partners Patty and Kelly communicated regularly. They talked about new technologies they discovered, how lessons went, and how they could better support student learning. They both stated that they learned from one another through communication and sharing of ideas. Kelly stated, "Now, we do like to put our heads together a lot, and we'll bounce things off one another." Patty and Kelly shared ideas throughout the day, both within class and when they found opportunities outside of the classroom.

Teacher communication has been linked to improved instructional practices for teachers (Sun et al., 2017). Communication among co-teachers provides opportunities for learning and sharing of expertise (Walther-Thomas et al., 2000). Patty and Kelly reflected upon and talked about what went well in the classroom, what further supports students needed, and what adjustments could be made.

Their consistent communication and collaborative relationship were critical factors in how Patty and Kelly built and shared knowledge with one another. Kelly stated, "You've got to have that open line of communication to talk to one another. If you don't have that, you are obviously not going to learn from one another." They had limited co-planning time within their school context, yet they made effort to communicate regularly within their co-teaching context. This dialogue fostered a collaborative relationship.

Collaboration. Patty and Kelly shared responsibilities for planning and delivery of instruction. This was true of the first two cases described as well. These experiences allowed them to develop a comfortable, respectful relationship. Patty noted, "This year's been great . . . we've developed as a team a lot closer—a comfort level with each other." They both expressed respect for the expertise of the other and demonstrated parity in their co-taught classroom.

Patty believed that it was their relationship that made both of them more willing to take risks and to try new things. She shared, "because we have that relationship I can say to her, 'You know, we'll try it, but I don't think it's going to work' versus not doing it. I see this as half her classroom . . . it's our room." Patty and Kelly's relationship was enhanced by collaboration within and outside of the classroom, sharing of knowledge and expertise, and regular communication. They engaged in professional learning experiences and then shared with one another.

Professional learning. Patty and Kelly were actively engaged in and had preferences for their professional learning experiences. Julie and Laura enjoyed going to conferences to learn more about technology integration. Chris and Emily learned through

exploration and classroom implementation. Although they learned together within their PLC, Patty and Kelly engaged in more individual learning than what was shared in the other cases, where the co-teachers spent most of their time in collaborative learning experiences. Patty and Kelly shared their individually learned technologies with one another in their co-taught classroom.

Kelly preferred to learn through implementation of strategies and technologies in the classroom. She described herself as a "hands-on" learner. She noted that she built knowledge related to technology integration through trial-and-error in the classroom. Kelly needed to experiment to learn new practices. She shared, "I have to do it myself . . . I wouldn't understand it if you just explained it to me…I would just rather do it myself." Teachers learn through experimenting with new strategies and making adjustments based upon those experiences (Keane et al., 2016).

Patty spent time looking for new technologies on the Internet. She also talked with other educators to discover technologies that had been effective in their classrooms. Patty and Kelly shared what they've learned through individual professional learning with each other in the co-taught classroom. Teachers need to be active in their own learning through collaboration with other teachers and through implementation of new strategies in their own classrooms (Hanover Research, 2016).

Patty and Kelly both reported that more planning and classroom time and better connectivity could allow for further technology integration. Regardless of these challenges, they continued to strive to build their knowledge and shared it with other teachers in the school and across the state. The knowledge, beliefs, and values Patty and

Kelly held influenced their professional practices and how they built and shared knowledge related to technology integration.

Summary

The school context in which Patty and Kelly worked included access to technology resources and colleagues with knowledge of technology integration. They communicated, collaborated, and engaged in professional learning within their co-teaching context. This context included the individual knowledge, beliefs, and values each teacher brought to the partnership.

Co-teaching partners from the next case, Karen and Amy, worked in the same school as Patty and Kelly and also had access to technologies and other educators in the building. They did not have longevity in their partnership, as was the case with Julie, Laura, Chris and Emily. Although their school context differed from the first two cases, they had similarities within their co-teaching context with all three of the cases described thus far.

Karen and Amy

Karen and Amy co-taught at Lake View Middle School along with Patty and Kelly. Their English 8 classroom was a model site in the statewide co-teaching initiative described above. Their school and classroom contexts influenced how they held, built, and shared knowledge related to technology integration.

Lake View Middle School

As noted previously, this suburban middle school is located in a mid-Atlantic state and has a population of over 900 students with more diversity than the other two schools in this study. Lake View Middle School was fully accredited according to the state accountability system for the 2016-17 school year. The bell schedule included seven periods of 45 to 60 minutes each.

Co-Teachers

Amy and Karen were in their first year as co-teaching partners and were assigned to teach together. They participated in the English grade-level planning team and co-planned through this process. They planned as partners when they were able to find time to connect throughout the day and by sharing lesson plans electronically. Amy and Karen belonged to two PLCs—one with other English 8 teachers and one with the grade-level cross-curricular team. Additionally, Karen participated in the special education PLC.

Karen. Karen, the special education teacher, was in her ninth year of teaching at the time of the study. She began her career as a general education English teacher, but spent the last six years teaching sixth and eighth grade special education. She participated in co-teaching partnerships in every year she taught. Karen learned how to co-teach in the classes that she completed for her Master's degree in special education.

Karen taught with Amy one period a day, with another English 8 teacher for two periods, and alone in reading remediation and academic support for one period each. She brought expertise in content, specially designed instruction, and technology integration to her partnership with Amy. Karen noted that she always integrated technology into

instruction, learning to do so through college courses and in collaboration with other teachers.

Amy. Amy, the general education teacher, was in her 20th year, having taught various levels of eighth grade English throughout her career. She had been co-teaching for ten years, but noted that this was her first year of a "true co-teaching" partnership. She attributed this to Karen's level of expertise with the content, as Karen was previously an English teacher. Amy learned to co-teach by attending a two-day seminar and reviewing related literature.

Amy's schedule included two periods of gifted/honors English and two periods of general English 8—one as a solo teacher and one with Karen. She also facilitated remediation and enrichment in an intervention period for English and mathematics. Amy had content, pedagogical, and technological expertise. Amy noted that Karen had greater knowledge of technology integration and often took the lead with this in planning.

Karen and Amy integrated technology into the classroom daily, using an electronic white board, document camera, laptops, and tablets. They employed a variety of software and had recently implemented a flipped classroom approach to instruction (described below) to better meet the needs of students.

Holding, Building, and Sharing Knowledge of Technology Integration

The school and classroom contexts in which they taught influenced how Karen and Amy developed knowledge and expertise related to technology integration. Both teachers held knowledge, beliefs, and values that informed their professional practices. The school in which Amy and Karen taught had a culture of collaboration and provided

access to technology resources and knowledgeable educators. As co-teachers, Karen and Amy had a collaborative relationship that enhanced knowledge-building and sharing.

School context. As noted previously, Karen and Amy co-taught in the same school as Patty and Kelly. They, therefore, shared the same school context. This context differed from that of the first two cases described. These differences included limited time together and access to an educational technology specialist. Also, Karen and Amy did not teach in a computer lab as Chris and Emily did, and they had more difficulty with Internet connectivity. They did, however have access to hardware and software to support student learning.

Access to technology resources. Karen and Amy had an interactive white board and document camera in their classroom. They had one computer in the back of the room and access to a computer lab and laptop carts. Karen and Amy used a variety of software programs that allowed students to take online assessments, read digital articles, and view videos outside of the classroom. Access to these resources allowed them to integrate technology into instruction.

Karen and Amy used the technologies available to them and engaged in professional learning that enhanced their skills to do so. Amy noted, "What I don't know, I'm willing to learn and use." Karen and Amy collaborated with other teachers in their PLC planning to discover avenues through which to integrate technology effectively into their classroom.

Access to knowledgeable teachers. There was a culture of collaboration throughout the school in which Karen and Amy taught. They both participated in the grade-level PLC and the English PLC. Karen stated, "We're always collaborating,

working with other teachers, finding out what went well." Amy noted that she and Karen shared what they discovered through their individual exploration when they were together in the PLC. Professional Learning Communities provide an avenue for collaboration among teachers that fosters growth and professional development (Hanover Research, 2016). As the teachers within the PLC learn from one another, they are then better able to collaborate and co-create lessons (Hanover Research, 2016). The culture of collaboration within Lake View Middle School provided an avenue for professional learning beyond that which occurs in the co-taught classroom.

Amy noted that Karen often takes the lead with technology integration and shared ideas in the PLC planning session. I saw this in one of the co-planning sessions I observed. Karen had another commitment and could not attend the first part of the meeting. The English 8 teachers were planning for upcoming lessons. When Karen arrived, she immediately joined the group and initiated discussion about how technology could be incorporated into these lessons. She shared her expertise, not just with Amy as her co-teaching partner, but with other teachers in the school as well.

The school context in which Karen and Amy taught provided technology resources and access to a PLC, where they collaborated with other teachers. They also worked with the educational technology specialist as Patty and Kelly described.

Access to educational technology specialist. Lake View Middle School employed an educational technology specialist who met regularly with PLCs throughout the building to provide support for teachers in technology integration. Karen and Amy learned from this support. Amy noted, "He meets with us frequently . . . to show us how we can do tests online . . . he even set up our first test. We didn't have to do a thing.

[He] showed us how to do it." Karen noted that she was then able to use this software to create additional online tests.

Their school context provided Karen and Amy with resources and supports that enhanced their knowledge building and sharing. Their co-teaching context further influenced how they increased their expertise related to technology integration.

Co-teaching context. Karen and Amy brought individual knowledge, beliefs, and values to their co-teaching partnership. They shared their knowledge with one another and with other teachers through collaboration both in their shared classroom and through PLC planning that took place on a weekly basis. They communicated when they were able even though they had limited structured time for planning as partners. They built their knowledge of technology integration through their own exploration. Karen and Amy implemented their new discoveries in the classroom, sharing knowledge with one another in the process. They were very similar to the co-teachers in the previous three cases in terms of their knowledge, beliefs, and values as described below.

Teacher knowledge. Karen and Amy both held knowledge of content, pedagogy and technology and the blend of these within their context to ensure student learning (TPACK). They had knowledge of English content and how best to deliver it (PCK), as both had experience as general education teachers for this subject. Karen and Amy knew how to effectively integrate technology into the content (TCK) and selected technologies that supported active engagement in classroom activities (TPK). Although they both had content knowledge and the ability to integrate technology into instruction, each teacher had specific areas of strength. They relied upon one another to take the lead in these areas.

Amy's individually-held knowledge. Although both teachers had knowledge about how to teach English, Amy had more years of experience and greater expertise in certain concepts, such as grammar and writing. She had knowledge of pedagogical practices to support student learning, but felt better equipped to teach students who were gifted. Amy noted that she relied upon Karen for support in teaching struggling learners.

Amy had knowledge of technology that supported learning and had been integrating technology into her classroom for several years. However, she believed she had learned more as a result of working with Karen. Although Karen noted that Amy was competent with technology integration as well. She shared, "[Amy] holds a pretty good degree of technology knowledge . . . she certainly knows how to use all the technologies we have in the classroom."

Karen's individually-held knowledge. Amy appreciated Karen's background and knowledge in English. She noted that Karen was able to fully share in content instruction, allowing for "true co-teaching" to take place without having to provide a "mini-lesson" in English for Karen first. Karen held knowledge of general pedagogical practices, as well as specially designed instruction, to support students with disabilities in the classroom. She was also able to differentiate instruction to meet the needs of all students. Amy described Karen as her "differentiation coach."

Although both teachers had knowledge of technology integration, Karen was stronger in this area. Amy stated,

> I think [Karen] is very comfortable with it and definitely more knowledgeable than me. So I'm happy to let her do what she's good at and not struggle, because she does it a lot faster than I would do it.

Karen had extensive formal learning related to technology. She noted that her undergraduate degree was in communications, and she once worked as a technology support specialist for the cable company in her area. She had become certified as an educational technology specialist.

Karen and Amy were aware of each other's strengths. Effective co-teachers understand each other's areas of expertise (Friend et al., 2010), and value the skills their partner brings to the team (Walther-Thomas et al., 2000). Karen and Amy capitalized on the strengths each brought to the partnership as they blended their areas of expertise in the classroom.

Shared knowledge. Similar to Chris and Emily, Karen and Amy demonstrated shared knowledge that allowed them to best meet the needs of their students. Both teams noted that they complemented one another with their differing areas of strength and weakness. Co-teaching partners often blend their knowledge and expertise in the classroom to better meet the needs of their students (Scruggs et al., 2007; Sileo & van Garderen, 2010; Walsh, 2012). They are able to collaborate more effectively when they understand their differences and value their strengths (Pratt, 2014).

Karen and Amy blended their areas of expertise to provide a richer classroom environment. Karen stated, "We use our skills together to kind of take technology and blend that into instruction to meet the students' needs." Amy added, "And I think where one lacks the other picks up. I think we blend nicely with our strengths and weaknesses. We're not . . . both weak in the same areas it seems." They recognized where each could better support student learning and planned their lessons accordingly.

This blending of knowledge and expertise allowed for parity, seamless co-teaching in the classroom, and the opportunity to incorporate a variety of technologies into instruction. Karen and Amy held and blended knowledge within their shared classroom. They had similar beliefs and values that drove their professional practices and supported further learning related to technology integration.

Teacher beliefs. Karen and Amy believed that technology supported student engagement and provided for more effective instruction, as did teachers in the other three cases. They selected technologies that would ensure full participation of all students in the classroom, effective use of instructional time, and assessment of student learning.

Karen and Amy both believed technology added variety to their lessons. Karen shared that technology allowed them to differentiate instruction in order to address students' unique needs. Amy noted that technology integration added "a different flair so that kids don't always have to learn something the same way." She added,

> It's a great visual. They *like* being more interactive with technology, because it's a part of their daily lives. I think they enjoy it more, and I think they'll learn more if they enjoy it more. So, I try to use it whenever I can.

These teachers believed that the possibilities were "endless" with technology integration and chose to build their knowledge and expertise in this area. They did so because they valued learning for both themselves and their students.

Teacher values. As in the other three cases Karen and Amy valued learning. Amy noted, "It's important for the teacher to be very flexible and want to, as much as possible, know what's out there so we're well-informed, and we know what children are interested in to increase learning."

Karen and Amy valued time with their students and wanted to make the best of the limited class time that they had. They incorporated a flipped classroom approach into their instruction in order to do so. This approach to instruction involves the use of technology outside of the classroom, allowing the teacher more time to interact with students in the classroom (Bull, Ferster, & Kjellstrom, 2012; Overmyer, 2012). Homework may involve watching videos created by teachers or available from free online resources to replace the lecture time in the classroom (Overmyer, 2012). Classwork emphasizes activity-based learning with opportunity to receive direct support from the classroom teacher.

Karen and Amy used this approach because they wanted to better assist students in the writing process. Amy shared that they needed more time to conference individually with students about an upcoming writing assignment. Based upon Karen's suggestion, they decided to provide their instruction through video to be completed for homework. They then had class time to talk with students one-on-one. Karen further explained,

> Well, it's really an issue of time . . .. We were spending so much time instructing that we were not getting to adequately conference with them about their writing. So, it seemed to me that the logical thing to do is that the passive part, where the student is just kind of getting the information, that would be the better part to do at home versus them actually writing at home where I can't give them feedback; I can't help.

Karen and Amy made the effort to learn this approach in order to support student learning. They engaged in professional learning to enhance their own skills as well. Amy stated, "I think we're both motivated people. We're not satisfied to just do what

we've always done and not always search for something better." Their value of learning, along with their knowledge and beliefs, informed professional practices within their co-teaching context.

Professional practices. Similar to the co-teachers in the other three cases, Karen and Amy communicated regularly, collaborated effectively, and engaged in professional learning practices to expand their knowledge and skills. They built a cohesive relationship that allowed for learning with and from each other.

Communication. Although Karen and Amy had limited structured time together, they made an effort to find time to communicate through various avenues and throughout the day. They emailed, texted, and talked between classes and during class. Amy stated, "We still find ways to communicate even if it's not in person, and we're pretty open to the idea of communicating with each other at any time." This communication is important for effective co-teaching (Friend, 2014). Their communication fostered collaboration.

Collaboration. Karen and Amy shared in all aspects of planning and delivery of instruction just as the other co-teaching partners in this study. Teachers often feel better supported with another teacher to share in the responsibilities of the classroom (Fenty & McDuffie-Landrum, 2011). Karen noted that she and Amy learned about technology from each other through lesson planning and instructional delivery.

Karen and Amy often collaborated on lesson planning electronically. Teachers in Lake View Middle School had access to a shared drive. Their English department used this drive to share lesson plans, and Karen and Amy used it as a means of co-planning. Although Patty and Kelly taught in the same school, they did not indicate that they used

the shared drive for this purpose. Karen noted that the shared drive "makes it easier . . . to go in, look at plans, know what's going on, and then make modifications for special education—add information about specially-designed instruction for each lesson."

Karen and Amy's relationship provided for effective collaboration. Amy stated, "We both kind of blend our input when it's necessary and useful, and it's not a competition between the two of us. We just help each other out in whatever areas we need." Karen and Amy learned about new technologies through their collaborative relationship and through their professional learning practices.

Professional learning. Karen and Amy held knowledge, beliefs, and values that informed the professional practices in which they engaged. These practices included communication and collaboration as partners and the professional learning experiences in which they participated.

Many of the co-teachers in this study engaged in informal professional learning practices that included exploration followed by trial-and-error implementation in the classroom. All of the partners engaged in this practice to some extent, but Patty, Kelly, Chris, and Emily participated in this type of learning most often. Julie and Laura were more likely to attend conferences and then implement technologies, adjusting them to fit their own classroom context.

Teachers must be able to experiment in a risk-free environment where failure is accepted in order to create progressive learning environments for their students (Keane et al., 2016). Teachers who are provided with opportunities for this trial-and-error approach to professional learning will continually develop and refine their instructional practices. This is the type of learning in which Karen and Amy engaged.

Karen and Amy built their knowledge related to technology integration mainly through exploration on their own time. When they found new technologies they believed would work well in the classroom, they shared with one another and implemented them. Amy stated,

> When I research things I try to implement them. If they're successful, I'll continue to go deeper into it with my classes. But if glitches come up with technology . . . then I'll put it aside and probably not use it again . . . I go looking for something else.

Karen noted, "You know, trying something new and if it works great, if it doesn't, trying something new the next time." Both teachers built their knowledge related to technology integration by investing time in professional learning experiences.

Summary

The school and co-teaching contexts in which Karen and Amy worked influenced how they held, built, and shared knowledge related to technology integration, as was found in the other three cases. They accessed resources within their school, collaborated as co-teaching partners, and engaged in professional learning to enhance their knowledge and skills. They valued learning and believed technology was an avenue that supported it.

The co-teachers in this study may not be representative of the typical co-teaching context. These differences are described next.

Atypical Characteristics

It is important to remember that the co-teachers in this study may not be representative of the typical co-teaching collaboration. As noted previously, these partners were all participants in a state co-teaching initiative. They were identified as

successful co-teaching partners and their classrooms were selected as model sites. As such, they had received additional professional development related to effective co-teaching and co-planning practices.

Another less typical characteristic of these partnerships was the degree of content knowledge each special educator brought to the classroom. All special education teachers in this study were qualified to teach in the content area in which they were assigned. Each teacher brings a specific area of expertise to the co-teaching partnership (Murawski, 2012) and may not have similar knowledge and skills (Linz et al., 2008; Mastropieri et al., 2005; Sileo & van Garderen, 2010) as co-teachers in this study did with their content knowledge.

The cohesive relationships that these teachers described were another less typical feature of co-teaching. Although compatibility—the sharing of instructional beliefs, values, and practices in the co-taught classroom—is an aspect of effective co-teaching, (Scruggs et al., 2007; Walther-Thomas, 1997), it does not always occur within administrator-assigned partnerships (Scruggs et al., 2007). The teachers in this study were assigned as partners, but developed strong relationships early in their co-teaching assignments. They shared beliefs and values related to teaching and learning and engaged in practices that supported the development of a collaborative partnership.

Although co-teachers in this study may not be representative of other co-teaching partnerships that have been studied, due to their unique characteristics and practices, the results of this research illustrate specific meso- and micro-level contextual elements that influence co-teachers' TPACK development, and how they share and enact this

knowledge in their teaching. These elements are noted below and recommendations for how leaders might encourage and support similar partnerships are discussed in Chapter 5.

Conclusion

The macro-, meso-, and micro-contexts referenced earlier in this chapter include conditions that influence teachers' knowledge and practice (Porras-Hernández & Salinas-Amescua, 2013). In this study, meso- and micro-level contexts directly influenced co-teachers' knowledge development and sharing related to technology integration. The meso-level context is defined as "the social, cultural, political, organizational, and economic conditions established in the local community and the educational institution" (Porras-Hernández & Salinas-Amescua, 2013, p. 228). The micro-level context includes resources, classroom norms, student preferences and goals, and teachers' characteristics and philosophies. Teachers experience the most autonomy within this micro-level context.

Teachers' educational philosophies, comprising their beliefs, motives, and values, inform their instructional decisions and influence their development of TPACK (Porras-Hernández & Salinas-Amescua, 2013). The co-teaching partners within each case presented in this chapter had similar educational philosophies that informed their classroom practices. Their shared beliefs regarding integration of technology to support student engagement and similar values about the learning process allowed them to set common goals for instruction. Co-teachers with similar approaches to instruction are better able to understand one another and develop a compatible relationship (Pratt, 2014).

The teachers in this study described strong compatibility in their partnerships, allowing for more effective communication and greater collaboration. Their cohesive relationships allowed these co-teachers to integrate technology within their shared classrooms (micro-level context), despite the challenges of limited resources or supports in some cases (meso-level context).

Supports Needed for Technology Integration

Teachers need knowledge and skills as well as resources to effectively integrate technology into instruction (Mawhinney, 2010). When they have both knowledge and resources, co-teachers incorporate a variety of technologies into the classroom (Kim et al., 2006; H. J. Lee & Herner-Patnode, 2009; McDuffie et al., 2009). The co-teachers in this study had TPACK as described in the cases above, but lacked some meso-level resources that support technology integration. For example, most of the teachers in this study noted that resources were lacking in some areas, making these practices a challenge.

In contrast, Chris and Emily did not name specific challenges to technology integration within their meso-level context. They had computers available to them in their classrooms, software to support math instruction, and other colleagues from whom to learn. They explored and experimented with technology integration within their shared classroom and took advantage of professional development offerings within their school division. They had time together as partners to co-plan lessons. Although Chris and Emily did not specifically express any challenges to technology integration, further study with a focus on that topic may reveal additional information.

Co-planning time. Teachers have reported that the limited time they have to plan technology-enriched instruction creates a challenge to integrate technology effectively (Hechter & Vermette, 2013). Co-teachers note that lack of co-planning makes it difficult to engage in effective co-teaching practices (Bryant-Davis et al., 2012; Solis et al., 2012; Wischnowski et al., 2004). In this study, Karen, Amy, Patty and Kelly planned collaboratively with other content area teachers within the PLC, but lacked shared planning time with each other as co-teaching partners. Both partnerships at this school saw this as a challenge, and wanted to have more time together to explore, experiment, and design technology-enhanced lessons. Patty and Kelly noted that the other teachers within their content-level PLC were less interested in incorporating technologies into the classroom. As such, they often planned approaches to teaching that differed from their grade-level peers.

In contrast, Karen and Amy were able to collaboratively plan for technology integration in English 8 lessons, as the other teachers in their PLC were willing to participate. However, Amy still believed that additional time to plan as partners would have enhanced practices within their co-taught classroom. She stated, "I wish that, as co-teachers, we had protected time together that was stable every week."

Access to technology. Teachers also find it a challenge to integrate technology when they have limited access to hardware and instructional scheduling constraints (Carver, 2016; Hechter & Vermette, 2013). Further, teachers report that the network infrastructures in their schools do not often support their technology-integrated activities (Grant et al., 2015). Similarly, short class times with slow connectivity provided an

additional challenge for Karen, Amy, Patty and Kelly. Patty and Kelly were concerned with loss of class time when computers were slow to connect. Patty noted,

> My only thing, cause I love it—I think it is great stuff. The only thing is that, in this school, we're just not equipped to—or at least, let me take that back—I don't think that I'm equipped to deal with the lack of excellent technology in the 45-minute-time that I have.

Working in the same school, Karen and Amy experienced similar challenges. Amy shared that she would have liked the school division to provide more current technology, "have Wi-Fi systems that are a better grade," and potentially provide devices to students who do not have them for use in the classroom. Karen added that the tablets they purchased with the state co-teaching grant did not connect to the Internet. She and Amy were, therefore, limited to activities that did not require Internet access when using these devices.

Karen worked in a school division that had much greater access to hardware, software, and strong Internet connections before coming to Lake View Middle School. She believed that the "general attitude" of that division leadership supported technology integration. Karen did not see this same "attitude" in the division in which she taught during this study, and noted that the lack of resources "really limits what we can do." Amy explained, "So, we're trying to say the possibilities would be endless if we could work out that [resources] issue." Despite these challenges, Karen, Amy, Patty and Kelly found ways to integrate technology use into their classroom contexts.

Knowledgeable colleagues. Teachers need colleagues who have knowledge of technology integration, such as other knowledgeable teachers or a technology specialist,

who can provide support (Hechter & Vermette, 2013). An additional challenge for teachers in this study included access to knowledgeable colleagues. Julie and Laura, for example, did not have access to teachers within their building who had strong knowledge of technology integration. They supported other teachers in incorporating instructional practices that included technology. Julie explained,

> because we got so excited—you know when you're excited about something, you think everybody should be excited about it—so we were like, everybody should know how to do this, because this would be great for whatever classes.

Julie and Laura offered after-school sessions for other teachers so that, collaboratively, they could learn with one another. They had to discontinue these sessions due to lack of attendance.

Professional learning. Teachers also need access to comprehensive professional learning opportunities as schools add technologies and increase expectations for teachers to integrate them into the classroom (Grant et al., 2015; Hechter & Vermette, 2013). Professional development opportunities varied among participants in this study. For example, Julie and Laura were able to regularly attend conferences and often did so together. Chris and Emily noted that their school division provided professional development as new technologies were added. Karen, Amy, Patty and Kelly learned about new technologies primarily from the educational technology specialist or from their own exploration. These teachers perceived lack of time and connectivity issues to be greater challenges than lack of professional learning opportunities, however.

Despite the challenges noted here, the co-teachers in this study persevered in their efforts to integrate technology into their students' learning. Teachers, who desire to

integrate technology, but work in a culture that does not support these efforts, must find innovative approaches to doing so (Ertmer & Ottenbreit-Leftwich, 2010). Teachers in this study found ways to integrate technology and built and shared their knowledge for doing so through their collaborative relationships. Further detail related to barriers to technology integration and recommendations for leaders about how to address these are discussed in Chapter 5.

Collaboration to Support Technology Integration

Co-teachers in this study established strong collaborative partnerships based upon mutual respect. Teachers who participate in collaborative relationships with their colleagues have opportunities to share concerns, take risks, and encourage one another to think more creatively (Chong & Kong, 2012). When teachers exchange ideas related to technology integration, they are engaging in their own professional development related to these practices (Keane et al., 2016). A notable finding in this study was the collaboration within these partnerships that supported how these co-teachers held, built, and shared knowledge of technology integration, overcoming challenges to effectively do so.

Teacher learning is most effective when it is actively incorporated within the school and classroom context and in community with other teachers (Keane et al., 2016). Teachers need opportunities to connect in meaningful ways to share quality practices with one another. In doing so, they are better prepared to support students in doing the same as they engage in their learning. The co-teachers in this study collaborated in all aspects of teaching to support student engagement and learning. As Julie described in regard to her relationship with Laura, “I do think it all boils down to just communication

with each other and just the openness that we have with each other and sharing stuff and being willing to listen, and accept it, and take it in."

Putting teachers in the same classroom does not always result in collaboration (Levine & Marcus, 2007). They need time to engage in meaningful dialogue, reflect upon practices, and identify common goals through structured co-planning time. Co-planning provides opportunities to build trust and enhances collaboration. Co-teachers may participate in content- or grade-level planning, but will still need structured time together as partners to establish a cohesive relationship and set common goals (Pugach & Winn, 2011).

Blend of expertise. Co-teachers need time to plan, but also to communicate regarding each other's strengths and needs (H. J. Lee & Herner-Patnode, 2009). When co-teachers understand one another's skills, they are better able to establish a strong partnership and address student needs, as they capitalize on their individual strengths. Collaboration provides an avenue through which the "strengths of each teacher [are] applied to maximum advantage, while their limitations are ameliorated by the presence of a trained teaching partner whose skills complement their own" (McDuffie et al., 2009, p. 495). Neither teacher has to be an expert in every aspect of instruction in this setting. This was illustrated in this study as Chris, Emily, Karen and Amy described how they shared knowledge in the classroom, each teacher having strengths in specific areas. Chris shared,

> We both typically talk through it if we're making a problem—I think it's funny to watch—she'll have an idea and I'll add to it, or I'll have an idea and she'll add to

it. Or we'll point out things that we would have overlooked. So, it's all together when we create or change something.

Co-teachers establish parity by recognizing the expertise each brings to the partnership and considering how they can complement one another in the sharing of this expertise (Pratt, 2014). They then can engage equally in planning, delivery, and assessment of instruction. All of the co-teachers in this study shared responsibility for teaching and learning in these aspects of instruction. Chris, Emily, Karen and Amy noted how their individual strengths allowed them to complement one another in the classroom. Emily summarized, "I think we have our strong points, but neither one of us is solely responsible for any one part of the classroom or of a lesson."

Co-teaching relationship. Pratt (2014) noted that co-teachers are able to overcome challenges within their school and classroom settings through their supportive relationships with one another. They are better able to do so when they have learned how to effectively co-teach, have established co-planning time, and share similar educational philosophies (Pratt, 2014; Pugach & Winn, 2011). Patty and Kelly, for example, expressed that they were often "on the same page" when it came to ideas about how to support student learning. They shared their ideas with one another and were open to innovative practices. Kelly said that she and Patty are, "bouncing ideas off one another on a daily basis."

Co-teachers must have mutual respect and an attitude of equality in order to be successful collaborators (Keefe & Moore, 2004). Their relationship is the most critical element of success in the shared classroom. These partners must work cohesively as a team to reap the benefits of sharing the responsibility of teaching (H. J. Lee & Herner-

Patnode, 2009). Teachers' perceived benefits include sharing ideas, learning more effective instructional practices, and addressing student needs. Participants in this study expressed respect for one another. For example, Karen and Amy shared that they respected one another's opinions on student and classroom matters. Kelly noted that Patty taught her what co-teaching should be. Kelly stated, "She just made me see a different side of it . . . by showing me we could both be just as valuable in the classroom as the other."

Professional learning. Participating in collaborative professional learning helps to build relationships among teachers, encourages risk taking, provides an avenue for inquiry, and creates opportunity for teachers to engage in dialogue about their own practices (Steeg & Lambson, 2015). It is through their collaborative partnerships that co-teachers plan for instructional practices that provide greater support to their diverse student populations (Friend et al., 2010). Teachers in this study engaged in professional learning as partners. For example, Chris described the shared learning in which she and Emily participated. She stated,

> with the co-teaching initiative project . . . and as far as professional development we do a lot of it as a team. So, we learn new things, and we kind of bring our own point of view and discuss it, and Emily had ideas that I didn't think of, and I have ideas that she didn't think of.

Co-teachers mentor one another through their strong partnerships (Pratt, 2014). Special educators build content knowledge and general educators learn how to differentiate instruction. Communication and open sharing allow for both partners to grow as professionals. Co-teachers in this study also learned during their classroom

teaching experiences. For example, Kelly noted that she learned through observing Patty in the classroom. Emily also learned from watching Chris as she integrated technology into lessons. She said, "Sometimes it's easier to learn like that in the classroom setting."

As evidenced by the results of this study, co-teachers share ideas with one another, and then build upon those ideas to establish more effective instructional practices. Through this process, they build a shared repertoire of teaching activities. As these co-teachers participated in shaping practices, and experimenting in the classroom, they engaged in professional learning. Collaboration provided an avenue through which they built, and shared knowledge related to technology integration. Co-teaching partnerships that are based upon collaboration, communication, and respect for each other's expertise can provide an avenue through which teachers can overcome the challenges they face in their school and classroom contexts (Keefe & Moore, 2004).

Summary

The co-teachers in this study experienced some challenges in incorporating technology educationally, as shared above, but they integrated it in curriculum-based and student-focused ways, regardless of these challenges. They did so because of their shared beliefs and values, as well as the collaborative relationships that they established. The meso- and micro-level contexts in which the participants in this study taught influenced how they held, built, and shared knowledge related to technology integration.

School and division leaders must provide structures and supports within these contexts to ensure that teachers have the knowledge and skills necessary to effectively integrate technology within the co-taught classroom (Mawhinney, 2010). School and district leaders are able to impact both teacher knowledge and resources, which influence

both meso- and micro-contexts in large measure. School and division leadership that champions efforts for technology integration ensures integration of new technologies and continued use in the classroom (Grant et al., 2015). Leaders need to create school cultures that foster collaboration among teachers to support professional learning and increase innovation (Keane et al., 2016). They can address barriers to technology integration, as well as strategically pair teaching partners, fostering professional collaboration, as described in Chapter 5.

CHAPTER 5: IMPLICATIONS

The results of this study illustrate that meso- and micro-level contexts can influence how secondary school co-teachers hold, build, and share knowledge related to technology integration when engaging in effective co-teaching practices. Within these partnerships, the co-teachers in this study collaborated effectively, building and using distributed knowledge. School leaders can provide time and create opportunities for collaboration among teachers that allow for the sharing of knowledge and expertise (Vatanartiran & Karadeniz, 2015). In this chapter, I provide recommendations for how school, division and state leaders can support effective co-teaching that can enhance teachers' professional learning, encourage distributed knowledge, and incorporate technology to support student learning.

Co-Teaching

Effective co-teaching provides supports for students with disabilities in the general curriculum (Tremblay, 2013), may increase achievement for these students (McDuffie et al., 2009), and offers opportunities for the development of students' social skills (Strogilos & Stefanidis, 2015; Walther-Thomas, 1997). Co-teaching may benefit students and the teachers who engage in this partnership (Walther-Thomas, 1997). Benefits for teachers can include learning from one another, the opportunity to collaborate with another professional in a shared classroom (Fenty & McDuffie-Landrum, 2011; Walther-Thomas, 1997), and increased opportunities to differentiate instruction (Fenty & McDuffie-Landrum, 2011).

Effective co-teaching flourishes with supportive leadership and structures (Scruggs et al., 2007; Walsh, 2012), shared planning time (Friend et al., 2010; Pratt, 2014; Wischnowski et al., 2004), and professional learning opportunities (Sileo & van Garderen, 2010; Van Hover et al., 2012; Walsh, 2012). These supports for co-teaching enable partners to share in planning and delivery of instruction that incorporates the specially designed instruction that students with disabilities need to access the general education curriculum (Walsh, 2012). Technology, when integrated effectively into instruction, can enhance learning for these students (Anderson et al., 2009; Boon et al., 2006; Thomas et al., 2012).

Technology Integration

As described in Chapter 2, IDEA (2004) and ESSA (2015) mandate expectations for technology use that supports students with disabilities. Students with learning disabilities may be more motivated to learn when educational technologies are incorporated into lessons (Bagon & Vodopivec, 2016). Integration of technology may support their understanding of content, allow for more peer interaction, and provide autonomy in the learning process. Effective integration of technology can support transformation of complex content into meaning for students (Koehler et al., 2013). Although teachers in this study believed that integrating technology into instruction supported students in their classrooms, in some cases, there were challenges to doing so.

Supports for Technology Integration

As described in Chapter 4, the teachers in this study noted some issues with technology integration, such as limited access to computers, slow connectivity, and lack of time for planning and exploration. Lack of time, equipment, and training may make

technology integration challenging for teachers (Keengwe, Onchwari, & Wachira, 2008). Lack of computer availability can be a significant obstacle for teachers (Carver, 2016), particularly lacking access directly within their classrooms (Pittman & Gaines, 2015). Teachers can also struggle with slow connections to Internet sites and strict filters limiting access to certain technologies (Vatanartiran & Karadeniz, 2015).

Regardless of the challenges noted by most of the teachers in this study, they regularly incorporated technology into instruction. Karen, Amy, Patty, and Kelly, in particular, believed that they could provide more technology-enhanced instruction if they had better access and more time to do so. Julie and Laura expressed a desire for leadership support to encourage increased technology integration throughout their school.

Even when rich resources are available, some teachers do not incorporate technology into instruction (Lim & Pannen, 2012). Their lack of knowledge and expertise in technology integration may make them reluctant to engage in this practice (Copriady, 2014). Technology use in isolation does not support quality instruction; rather, teachers' effective integration of technology may ensure educational practices that support student learning (Copriady, 2014; Sang et al., 2010).

The TPACK framework, as explained in Chapter 2, describes the expertise teachers need to effectively integrate technology (Koehler et al., 2013). When considering assignment of co-teaching partners and the supports teachers need to develop TPACK, it may be helpful for leaders to be aware of how this knowledge may be distributed across teachers and settings.

Distributed Knowledge

Co-teaching is based upon the premise that each teacher brings differing, but equal expertise to the partnership (Murawski, 2012). The blend of differing skills allows co-teachers to support one another in the classroom (Murawski & Hughes, 2009). Knowledge may be distributed across teachers, with each employing his or her expertise and the resources available to ensure effective instruction (Di Blas & Paolini, 2016; Di Blas, Paolini, Sawaya, & Mishra, 2016).

The co-teachers in this study brought individually-held knowledge to their partnerships that they shared with one another in their co-teaching contexts. As they shared their expertise, they learned from one another and expanded their individually-held knowledge. The distinct strengths each teacher held allowed their knowledge to be distributed across the partnerships.

Chris and Emily, for example, both possessed content knowledge, yet Chris noted that they each had strengths related to specific concepts within Algebra 1. They relied upon one another to take the lead in teaching those concepts for which they had stronger pedagogical content knowledge (PCK). Karen and Amy described similar blending of knowledge within the English 8 classroom. Karen had deeper knowledge of grammar and writing, and Amy was stronger in provision of specially designed instruction to students with disabilities. They felt that they were able to develop lessons to meet the needs of all students in their classroom as they blended these unique areas of expertise.

These teachers were able to address the needs of their students with the distributed knowledge that occurred as a result of their collaboration. Julie and Laura had been co-teaching for such a long time that they said they could each plan for and deliver

all parts of all lessons. However, Julie did not have expertise in specially designed instruction, and relied upon Laura's knowledge in this area as they planned their co-taught lessons.

Although she was the general education teacher, Patty was also certified in special education and, as such, brought this knowledge to the classroom she shared with Kelly. Kelly was not yet certified in special education, but was able to support students with disabilities and co-teach effectively as a result of her partnership with Patty. The individual expertise of Patty and Kelly was distributed across their partnership, allowing Kelly's classroom management skills to blend with Patty's instructional knowledge to ensure students were engaged and learning. These examples illustrate how co-teachers in this study distributed PCK across the partnership. They also demonstrated distributed TPACK, which will be described in the next section.

Distributed knowledge occurs when teachers with varying levels of knowledge engage in communication around teaching and learning (Haberman, 2006; Putnam & Borko, 2000). As partners or groups of teachers engage in this dialogue, their knowledge is spread across classrooms, enhancing instructional practices that support students throughout the school (Putnam & Borko, 2000). Development of support systems and structures for collaboration enhances distributed knowledge that encompasses each teacher's areas of expertise (Haberman, 2006). The co-teachers in this study described distributed knowledge in more general areas of expertise, as well as distributed TPACK.

Distributed TPACK. As noted above, the teachers in this study described distributed TPACK within their shared classrooms. For example, Amy often deferred to Karen to "take the lead" with planning technology-enhanced lessons, as "[Karen's] very

comfortable with it." Their description of the flipped classroom approach, as detailed in Chapter 4, illustrated how this knowledge was distributed between Karen and Amy. Amy noted that she addressed the technical aspects of writing, while Karen incorporated the needed technology.

Patty and Kelly each brought differing experiences with technology integration to their shared classroom. Kelly noted that she had experience with "newer technologies," but Patty was better able to design lessons that supported the integration of them. In a similar way, Emily brought new ideas for technology-enhanced activities to Chris, who then "[made] them happen" with her knowledge of how many technologies work. Although Julie had limited experience with technology integration when she began her partnership with Laura, these teachers were able to effectively engage in these practices as a result of Laura's expertise that blended with Julie's knowledge of the content.

TPACK scholarship is in its early stages related to how it sees TPACK as distributed across teachers (Di Blas et al., 2016). TPACK has typically been considered to be individually-held knowledge; yet teachers rarely work alone, as they regularly interact with students and other teachers. Distributed TPACK is defined as knowledge of technology integration that "does not reside in just the teacher's head but is rather distributed within a complex system of resources that includes students, colleagues, relatives, experts, the Internet, etc., well beyond the classroom's walls" (Di Blas, 2016, p. 67). Teachers interact with these resources to implement technology-enhanced instruction effectively.

Teachers employing practices about which they do not have full knowledge rely upon resources within their schools, including other professionals and technologies, to

ensure successful implementation (Di Blas, 2016). Results from a large mixed-methods study, as described by Di Blas (2016), support the "distributed nature of TPACK" (p. 72). These data illustrate how veteran teachers, with limited knowledge of technology integration, coordinate resources within their school and classroom contexts to plan and deliver technology-supported lessons. Di Blas et al. (2016) refer to this coordination of resources as distributed and dynamic TPACK.

Distributed and dynamic TPACK. The teachers in this study coordinated resources in their schools and classrooms as they planned for technology-integrated lessons. As described in Chapter 4, these resources included hardware and software, colleagues, and formal and informal learning experiences. These teachers further noted that students in their classrooms were another resource for discovering more about technology and how to use it effectively.

Teachers can employ the resources available to them to ensure effective integration of technology that supports meaningful teaching and learning (Di Blas et al., 2016). The teacher's role becomes that of navigator of the resources within the micro-context of a classroom. Within dynamic TPACK, teachers work "within a broader system of knowledge and with elements that possess varying kinds and degrees of expertise" (Di Blas et al., 2016, p. 7). They facilitate classroom activities that incorporate technology by accessing the supports and resources within that broader system. Further, knowledge does not belong to an individual teacher, but is distributed across teachers, and each builds knowledge within this dynamic process (Di Blas & Paolini, 2016).

The co-teachers in this study demonstrated distributed TPACK within their co-taught classrooms. This knowledge was cultivated by their consistent communication and

collaborative relationships. They built and shared knowledge related to technology integration from and with one another within their school and classroom contexts. The supports provided within these contexts fostered their ability to do so.

Supportive Leadership

Teachers can benefit from strong leadership that supports technology integration (Keengwe et al., 2008). They require support for learning new technologies and strategies, and opportunities to do so. They need time for exploration, experimentation, and collaboration. As noted earlier, co-teaching requires leadership that specifically supports co-teaching (Scruggs et al., 2007; Walsh, 2012), such as co-planning time and opportunities for professional development (Walsh, 2012). These contextual structures at the micro- and meso-levels can support effective co-teaching and technology integration.

Context. Co-teaching contexts for the teachers in this study incorporated components of effective co-teaching, including parity, compatibility, communication and trust. The teachers were provided with resources and supports that facilitated the development of distributed TPACK. For the most part, these teachers had access to hardware and software, knowledgeable colleagues with whom to collaborate, and opportunities to engage in exploration and experimentation.

Context influences teachers' adoption of technologies in the classroom (Angeli & Valanides, 2013) and influences the practices of teachers within their unique environments (Porter & Brophy, 1988). Teachers' knowledge and practices in this study were indeed influenced by the contexts in which they taught, as described in the previous chapter. Teachers both influence and are influenced by the resources that they have

available and the colleagues with whom they work (Hewitt & Scardmalia, 1998; Phillips & Koehler, 2016).

Components of co-teaching. The components of effective co-teaching (Friend, 2014) allowed teachers in this study to collaborate effectively and learn from and with each other. These teachers developed and shared TPACK through their collaboration and common planning time—both as individual partners (Chris, Emily, Julie and Laura) and in the PLC (Patty, Kelly, Karen and Amy). They shared ideas, strategies, and technologies that supported student learning, as described in Chapter 4.

It is important for school leaders to have an understanding of co-teaching in order to support co-teachers in implementing it effectively (Reynolds, Murrill, &Whitt, 2006). Leaders who provide structures, at both the meso- and micro-levels, that allow teachers to collaborate around instruction and specific student issues, support effective co-teaching (Tichnor-Wagner, Harrison, & Cohen-Vogel, 2016). These structures include strategic partnering of teachers, scheduled co-planning time, and professional learning related to co-teaching (Friend et al., 2010).

One of the most crucial supports for effective co-teaching is the provision of planning time (Friend et al., 2010). Time to collaborate as partners provides co-teachers with opportunities to discuss student progress, to give and receive feedback from fellow teachers, and to share strategies (Hanover Research, 2016). Teachers have indicated this to be the most critical factor in navigating the distribution of co-teaching responsibilities, noting that time to plan together at least once a week ensures quality co-teaching (Friend, et al., 2010).

Leaders who support these structures help to ensure quality co-teaching that benefits both students and teachers, as described earlier in this chapter and, in greater depth, in Chapter 2. Although the results of this study are not generalizable considering the size of the study's participant sample, its methods, and the characteristics of the co-teachers as noted in the previous chapter, the recommendations below are based upon the study's results and the extant literature that supports these findings.

Recommendations

In this study, teachers learned from and with each other, both formally and informally. Although the purpose of co-teaching is to provide special education services to students with disabilities eligible under IDEA (Friend, 2014), an unintended benefit is the opportunity for the professional learning it provides to participating teachers (Walther-Thomas, 1997). Effective professional learning can occur when teachers work collaboratively with others who have differing knowledge and skills.

School leaders support teachers' quality instruction when they encourage collaboration among teachers (Thoonen, Sleegers, Oort, Peetsma, & Geijsel, 2011). The supports that they provide for effective co-teaching may enhance student achievement as well as teacher learning (Walther-Thomas, 1997). However, it is not recommended that leaders support co-teaching primarily for the purpose of providing professional learning or to compensate for a teacher's weak instructional skills (Friend, 2014). Co-teaching is, first and foremost, a service delivery model for specially designed instruction for students with disabilities that requires parity between teachers. Still, based upon this study's results, co-teaching, when implemented effectively, can support the development of distributed TPACK within co-teachers' classrooms. It is, therefore, recommended that

school leaders provide the infrastructures needed at the micro- and meso-levels to support effective co-teaching, as will be shared next.

Fostering collaboration. One of the most salient aspects of the findings in this study was the specific nature of the collaborations these teachers described. Effective co-teaching occurs as a result of teachers sharing the responsibilities of the classroom, respecting the expertise of one another (Friend et al., 2010), and committing to the partnership (Friend, 2014). In all four cases examined within this study, the teachers engaged in informal professional learning through their strong co-teaching relationships. Teachers from two separate cases in this study described this learning from one another as "organic" and a natural part of their partnership.

The relationship between co-teachers is the most important determinant of successful co-teaching (Keefe & Moore, 2004). When they collaborate effectively in planning and delivering instruction, teachers can become more effective and increase student achievement (Sun et al., 2017). By working collaboratively, they can share their rich knowledge and expertise with one another. Co-teachers who share knowledge can employ instructional strategies and activities that best match the subject area taught (Van Hover et al., 2012) and the students they are teaching (Pratt, 2014).

Requiring teachers to work together does not guarantee collaboration, however (Levine & Marcus, 2007). Scruggs et al. (2007) note that co-teaching is most effective when teachers volunteer to become partners. It is not always feasible to provide this option to teachers, due to scheduling and personnel constraints, but it is possible to support and encourage collaboration between them once partnered (Keefe & Moore, 2004). When leaders provide opportunities for professional learning related to co-

teaching, teachers can significantly improve collaboration skills and practices (Tzivinikou, 2015).

Teachers in this study were assigned as partners and learned how to co-teach through the state co-teaching initiative described earlier, and in some cases, through other experienced co-teachers. Based upon the results of this study and extant literature, it is recommended that leaders foster collaboration and effective co-teaching by ensuring access to professional learning. Further, ensuring time for, and fostering professional communication can also enhance collaboration between co-teaching partners.

Fostering communication. Every teacher in this study noted that, as partners, they regularly communicated with one another. Their frequent dialogue fostered learning together, learning from each other, and the distribution of knowledge between partners.

Regular communication and dialogue supports a strong partnership (Walther-Thomas et al., 2000) and fosters opportunity for distributed knowledge (Di Blas et al., 2016). Effective co-teaching results from continuous discussion about how best to collaborate in the shared classroom (Bouck, 2007; Friend, 2014). When teachers engage in dialogue around technology integration they can develop further knowledge of these practices (Dakers, 2005). They derive meaning through discussion related to affordances and constraints of such practices in the classroom.

When school leaders ensure structured co-planning time, they provide opportunities for shared dialogue and reflection (Van Hover et al., 2012). Through discussions about how best to instruct students, teachers can develop shared knowledge of pedagogical practices that support student learning. The co-teachers in this study demonstrated how dialogue and communication can foster a collaborative partnership and

distributed knowledge. As such, it is strongly recommended that school leaders provide at least weekly structured co-planning time to ensure that co-teachers have opportunities to engage in dialogue, build trust, and establish partnerships that support effective co-teaching that incorporates technology well. Electronic and on-the-spot co-planning may complement, but should not take the place of face-to-face co-planning (Friend, 2014). These efforts can support fine-tuning of lessons in between the weekly face-to-face sessions. Consideration of strategic pairing of teachers may further enhance distributed knowledge and professional learning as explained in the next section.

Strategic pairing. Co-teachers in all cases noted that they learned from the expertise of their partners. It is unclear whether these partners were strategically assigned, as school leaders were not interviewed for this study; however, the partnerships allowed for blending knowledge within classrooms, as previously described.

The blend of equivalent but differing areas of expertise in the co-taught classroom provides support for each teacher in meeting the instructional demands of this diverse setting (Murawski & Hughes, 2009). As described in detail in Chapter 2, the general education teacher is the content expert (Austin, 2001; Murawski, 2009; Pratt, 2014), and the special education teacher has knowledge of specially designed instruction to support students with disabilities (Walther-Thomas et al., 2000). By combining their respective areas of expertise, co-teachers are able to address the challenges of the classroom, meet the needs of their students, and ensure quality instruction (Pratt, 2014). As such, school leaders might consider partnering teachers with little knowledge of technology integration with a teacher with a greater degree of TPACK, to support effective technology integration in the co-taught classroom.

Further study on the strategic partnering of co-teachers to support distributed TPACK, as well as distributed knowledge in general, would be helpful to the field. There is a dearth of literature directly related to this topic. Research in this area would help to inform leaders about how best to support teachers in blending knowledge and skills in the shared classroom.

Based upon the results of this study as just described, it is strongly recommended that leaders look at the individual strengths and knowledge of their teachers as they consider the most effective partnerships to ensure student learning. The blend of differing areas of expertise can help to ensure that the needs of both teachers and students are met in the classroom (Murawski & Hughes, 2009) and provides for distributed knowledge.

Fostering distributed TPACK further. The co-teachers in this study described and demonstrated distributed TPACK within their co-taught classrooms. Because of the meso-level supports provided by their school leaders, including access to technologies, access to other knowledgeable colleagues, and opportunities to engage in formal and informal professional learning, these teachers' TPACK was distributed across teachers within the school settings as well.

By providing collaborative opportunities within Lake View Middle School, for example, school leaders provided Karen, Amy, Patty, and Kelly an avenue through which to share their knowledge of technology integration with other colleagues, and to learn from them. In a similar way, Chris and Emily collaborated with other teachers around technology integration, and Julie and Laura shared their TPACK with other teachers. These teachers accessed school-wide technologies and colleagues to further build their

individually-held knowledge and share it with others. The co-teachers in this study learned through dialogue within their partnerships, with other colleagues, and in some cases, with students. These opportunities provided for distributed and dynamic TPACK.

TPACK may be enhanced through dialogue with other professionals who operate within the same context (D. Jones, Hefferman, & Albion, 2015; Vatanartiran & Karadeniz, 2015). These discussions among colleagues assist with addressing challenges within the school and provide for distributed knowledge across individuals with varying areas of expertise (Di Blas et al., 2016).

Development of teacher learning teams may also support development of TPACK (Phillips, 2015). PLCs can provide opportunities for professional learning and collaboration among teachers (Hanover Research, 2016; Sun et al., 2017). They can allow teachers to share effective instructional practices with one another (Sun et al., 2017). Two of the partnerships in this study participated in PLCs (Patty, Kelly, Karen and Amy). They noted that this participation provided opportunities to learn and share knowledge of technology integration.

Based upon the results of this study, co-teaching can provide an avenue for developing distributed TPACK within the classroom. Therefore, it is recommended that school leaders provide time and avenues for collaboration for co-teachers, as previously noted, and also for other teachers throughout their schools, to encourage and support these opportunities.

Although this study focused on school- and classroom-level practices, the participants were involved in a state-level initiative to support effective co-teaching practices, and they engaged in professional learning opportunities for technology

integration offered at the district level. District and state leaders may also provide supports for co-teaching (Müller, Friend, & Hurley-Chamberlain, 2009) and technology integration (Anthony, 2012) through structures at these levels that encourage and support effective practices. Recommendations for leaders at these levels are described next.

District-level supports. All four partners in this study indicated that they had access to professional learning opportunities related to new technologies that had been adopted in their districts. They also had access to technology resources within their schools. District-level leadership can support efforts for technology integration by establishing a vision that encourages these practices, including technology integration efforts within their strategic plan, providing technology resources at the school level, and offering professional development for teachers (Anthony, 2012). District-level supports for co-teaching may include opportunities for professional learning (Friend, 2014), access to co-teaching partners within the district who are engaging in effective co-teaching practices, and funding to support technology integration within these classrooms (SDOE, 2016). These practices, as described further below, may support school leaders in ensuring effective technology integration within their co-taught classrooms.

District-level professional learning opportunities. Teachers need a voice, sense of control, and a culture of shared learning in order to actively engage in professional learning that is offered by district and school leaders (Reynolds et al., 2006; Thoonen et al., 2011). When they believe that their knowledge and experiences are ignored, teachers may not engage actively in professional development offerings (Reynolds et al., 2006). Providing opportunities to engage with other teachers in the district and share knowledge with one another may help to ensure that teachers are active in their learning experiences.

Teachers in this study learned how to co-teach through other teachers (Chris, Emily, and Patty), classroom experiences (Julie, Laura, Chris and Emily), and professional learning offered through the state co-teaching initiative (all participants). They learned about technology integration through their collaboration with other teachers within the school (all partners), at the district level (Patty, Julie, and Laura), at conferences (Julie and Laura), and across the state (all partners). They chose to engage in these professional learning offerings, selecting those that matched their interests and needs. Much of their learning was collaborative, both within and outside of their classrooms.

Based upon these results and others from extant literature, it can be said that district-level professional learning opportunities that provide teachers with choices, allow for dialogue and collaboration, and include opportunities to share expertise may support teacher learning related to technology integration and effective co-teaching practices (e.g., Reynolds et al., 2006; Thoonen et al., 2011). As such, it is recommended that district-level leaders support a variety of options in professional learning related to technology integration and allot time for collaboration among teachers, both within professional development sessions and throughout the school year.

Access to knowledgeable teachers across the district. Teachers in this study had access to knowledgeable teachers within their buildings (as indicated by Chris, Emily, Patty, Kelly, Karen, and Amy), across their district (as noted by Patty), and at the conferences they attended (as shared by Laura and Julie). They increased their knowledge of technology integration as they interacted and communicated with these colleagues. Teachers with experience and success with technology integration may be

eager to engage in dialogue with colleagues new to these practices (Sun et al., 2017). Continuing opportunities to share ideas and strategies with one another allows teachers to increase their teaching repertoires. Distributed knowledge related to technology integration can be developed through collaborative learning experiences and collaborative planning amongst teachers (Nore et al., 2010). It is therefore recommended that district-level leaders consider avenues through which teachers from different schools across the district may engage in dialogue around effective co-teaching and technology integration practices. As noted in the previous section, these opportunities may be provided through district-level professional learning offerings.

Funding to support technology integration. As noted previously, teachers need access to resources that support integration of technology into the classroom (Thoonen et al., 2011). I have recommended that school leaders provide quality resources and ensure ready access and connectivity. District-level leaders must support access to these technologies and related resources by providing funding and a vision to support effective educational technology use (Anthony, 2012). Through inclusion of technology resources and related professional learning opportunities within the district's strategic plan and the budget, district leaders may ensure that teachers have technologies available for classroom use, and the requisite expertise to teach with them.

Funding must be considered for the long-term, but may be initiated through grant opportunities offered at the state and/or national level (Office of Educational Technology, 2016). Considerations for long-term funding may include re-allocation of resources, partnerships with community organizations or businesses, and sharing technology infrastructures with local government organizations. As district-level leaders provide a

vision, supports, and resources for technology integration, they can ensure that school-level leaders have the structures needed to support teachers' practices related to technology integration within their schools (Anthony, 2012). State-level structures may also support effective co-teaching and technology integration, as described next.

State-level supports. Recommendations for state leaders in support of technology integration are similar to those for district-level leaders, but on a broader scale. Similar to school districts, states develop strategic plans related to technology integration (Office of Educational Technology, 2016). Alignment among plans at the state, district, and school levels may help to support successful implementation of technology integration to support student learning. Although federal-level technology summits have addressed and supported efforts for technology integration, state and community leaders have a better grasp of the strengths and challenges within their educational systems, and may be better able to support efforts to address the challenges through funding, infrastructures, and professional learning opportunities (Office of Educational Technology, 2016).

As with district-level leadership, state leaders must develop a vision for technology integration and include sustained funding within their strategic plan and state budget allocations (Office of Educational Technology, 2016). Establishing a vision and including stakeholders in the visioning process may ensure community support in implementation and greater opportunity for adoption of the broader plan. Planning for, and establishing, fiscal plans that include funds for technology supports and resources can support long-term sustainability of efforts.

The teachers in this study participated in the state co-teaching initiative designed to support effective co-teaching statewide. Support for co-teaching at the state level can include collaboration with institutions of higher education to ensure pre-service preparation for effective co-teaching practices, professional development opportunities at the state and regional levels that include ongoing co-teaching assistance to districts and schools, and policies that encourage collaborative school cultures (Müller et al., 2009). State-level leaders can foster effective co-teaching at the local level through these practices. It is therefore recommended that these leaders consider provision of professional learning and technical assistance, at the state and regional levels that encourage effective co-teaching, so that students with disabilities have access to and make progress in the general education curriculum. Technical assistance may include consultation, coaching, or information services based upon the needs of the school or school district.

Conclusion

In this study, contextual factors influenced how the co-teachers held, built, and shared TPACK. These partners held individual knowledge, values, and beliefs and engaged in classroom practices that supported technology integration. They built and shared knowledge from and with each other through the collaborative relationships they had developed. They had access to knowledgeable colleagues and technologies within their school context to varying degrees and, as such, their knowledge was distributed across their schools and classroom contexts.

The results of this study indicate that the types and depth of learning that can occur within the co-taught classroom may be greater than what is found and developed

within a solo-taught classroom. Co-teaching provides an opportunity for "organic" professional development, as was shared by Julie and Chris, and can be an effective avenue for teacher learning related to technology integration, as well as all other aspects of instruction. Although that is not the primary purpose of co-teaching, it is a benefit of it. Leaders might support this informal professional learning and distributed knowledge within these classrooms and throughout the school by providing micro- and meso-level supports, as was described earlier in this chapter.

Effective teaching practices may be developed and supported through shared planning time for teachers, professional learning opportunities, and professional learning communities (Tichnor-Wagner et al., 2016). When leaders provide time for professional learning and for teachers with knowledge of technology integration to collaborate with those who do not have this expertise, they can be supporting the development of teachers' knowledge and skills related to technology integration (Tay, Lim, Nair, & Lim, 2014; Vatanartiran & Karadeniz, 2015). District-level leaders can provide a vision of technology integration, professional learning for teachers, and funding for technology and professional learning resources to ensure effective technology integration at the classroom level (Anthony, 2012). School leaders can introduce and reinforce these structures in order to develop a culture of learning within the school setting. As teachers become increasingly competent in these practices, they engage in them more often and are more comfortable in doing so (Copriady, 2014).

By providing the supports and resources noted here, leaders can help to ensure that co-teachers are able to blend their individually-held knowledge and further build their TPACK to support effective technology integration in the co-taught classroom. This

can enhance both the academic achievement of students with disabilities, and all students served in co-teaching settings. Providing structures that support co-teachers in holding, building, and sharing knowledge related to technology integration can help to develop co-teachers' expertise so that students with disabilities can achieve according to their highest academic potential.

Appendix A

A Multiple Case Study of Co-Teachers' Technology Integration Knowledge: How It Is Held, Built and Shared
Observation Protocol

Date:

Time:

Location:

Teachers Observed:

Length of Observation:

Study Focus: To discover how co-teachers hold, build, and share knowledge related to technology integration

Behaviors/communication to note:

Co-planning session

- One teacher takes the lead in discussion related to technology integration, but the other is able to join in the discussion
- Only one teacher discussed technology integration while the other communicates on a limited basis in this regard
- Both teachers are actively engaged in discussion related to technology integration

Classroom observation

- One teacher takes the lead in instruction that involves technology integration, but the other is able to support the effort
- Only one teacher leads activities or instruction that involves technology integration while the other teacher has limited to no involvement
- Both teachers are actively engaged in instruction and activities related to technology integration

Descriptive Notes	Reflective Notes

Appendix B

Codes

A Priori Codes (from Theoretical Framework)	
Code	**Definition**
Contextual knowledge	Knowledge of global, national and state pressures stemming from political, societal, and technological factors; district- and school-level initiatives; the financial climate of the school or district; environmental influences; available classroom resources; teachers' and students' skills, beliefs and values, and past experiences that they bring to the classroom; and the classroom norms (Porras-Hernández & Salinas-Amescua, 2013)
Content knowledge	Knowledge of subject matter that will be taught (Harris et al., 2009)
Pedagogical knowledge	Knowledge of effective instructional practices and strategies to support student learning; includes an understanding of student cognition, assessment, instructional planning and delivery, and classroom management (Harris et al., 2009)
Technological knowledge	Knowledge of how technologies support learning (Harris et al., 2009)
Pedagogical content knowledge	Blending of content and pedagogy such that teachers develop an understanding of teaching unique to the subject area taught (Shulman, 1987)
Technological pedagogical knowledge	Knowledge of how technologies will support or enhance student learning through blending of technologies into pedagogical practices in the classroom (Koehler et al., 2013)
Technological content knowledge	Knowledge of how technology can support or deter learning of content and how technology and content influence one another (Koehler et al., 2013)
Technological pedagogical content knowledge	The interrelation of all three bodies of knowledge (PCK, TPK, TCK) within the specific context of the individual classroom (Koehler et al., 2013)
Individually-held knowledge	Knowledge that is held individually by each teacher
Knowledge-building	Any process through which teachers are gaining new knowledge or increasing already existing knowledge

Shared knowledge	Knowledge that is held between both teachers rather than kept individually (Rytivaara & Kershner, 2012)
Emergent Codes	
Code	**Definition**
Dialogue/communication	Knowledge sharing, blending or building through dialogue or discussion
Blended knowledge	Knowledge that each teacher holds, but is blended through collaboration
Reflection	Thinking about instructional practices and student impact with the intent to adjust practices
Collaboration	Working, planning, or learning together
Co-teaching	Teaching together
Co-planning	Planning together at a structured time
Resources	Hardware and software is readily available to teachers
Formal learning	Learning through structured programs or classes
Informal learning	Learning through any avenue that is not consider formal learning
Learning through praxis	Learning through use
Learning from each other	Co-teachers learn from their interactions with one another
Learning from other teachers	Teachers learn from other educators
Learning together	Co-teachers learn as a result of their time together
Learning through exploration	Learning through individual exploration
Learning from students	Technology knowledge developed through interactions with students
Sharing with others	Co-teachers share their knowledge with other teachers
Student-centered	Practices that allow students to be fully engaged in the learning experience
Time together	Co-teachers time spent in planning, teaching, dialogue, and communication with one another as a result of their partnership
Willingness to learn	Teachers expressed and interest and willingness to learn how to integrate technology into instruction

Appendix C

Coded Interview Transcript (Excerpt)

Debbie: In what ways, if any, do you blend your areas of expertise and knowledge?

Teacher 1: Well, like we were talking about, I have a big forte in grammar (Codes: content knowledge; individually-held knowledge).
I got an English degree, I didn't get a teaching degree. So I then went and got a teaching certificate (Codes: content knowledge; individually-held knowledge; PCK).
So, aspects of English and grammar and writing—myself I write well (Codes: content knowledge; individually-held knowledge).
That's my strength and then [Teacher 2] also, of course, has the English background, but she's got the whole special ed background to help me so… (Codes: individually-held knowledge; blended knowledge; shared knowledge; PCK; content knowledge; pedagogical knowledge)

Teacher 2: Yea, I think we complement each other (Code: blended knowledge) because my initial degree actually wasn't even English it was communications and then I went back to school for education and special education (Code: formal learning), so it just um…

Teacher 1: But we complement each other well, because I need help to…maybe use some more kinesthetic activities or um…activities that will help special ed students learn (Codes: blended knowledge, pedagogical knowledge, student-centered).
She's got—she steps in and if we're talking about something technical that we're looking for in a paper I'll step in (Codes: blended knowledge, collaboration). We both kind of blend our input when it's necessary (Teacher 2 indicates agreement) and useful, and it's not a competition between the two of us. We just help each other out in whatever areas we need (Codes: blended knowledge, collaboration).

Teacher 2: Yea.

Teacher 1: I'm not afraid to ask when I need help and she's not afraid to ask what I think (Code: collaboration).

Teacher 2: And that makes a big difference because I've been in teaching situations where it's like, "This is my room and you just go sit in the back" and that just doesn't interest me (Codes: co-teaching; collaboration).

Debbie: And how, if at all, do you learn from and with each other?

Teacher 2: I think it's just trying new things. I mean, you try something— (Codes: knowledge building; informal learning; learning through praxis)

Teacher 1: Sometimes we'll try things together (Codes: learning together; learning through praxis; informal learning), and sometimes we'll try them independently and share with each other (Codes: informal learning; learning through praxis; learning from each other).

Teacher 2: Yea, try it and it doesn't work; try something different the next day (Code: learning through praxis; willingness to learn). I think that's kind of the whole—that's a lot of what education is.

Teacher 1: Trial and error (Code: learning through praxis; informal learning).

Debbie: So, when you discover something that you've done on your own, where do you find the opportunity to share that with one another?

Teacher 1: We don't have a lot—I mean, we share either before class, during class while the kids are working or after class, but we never seem to have the time given to us to have just [Teacher 2 and Teacher 1] time (Codes: time together; learning from each other; dialogue and communication).
We should be, we're supposed to be according to the grant specifications, supposed to be given that time. We are not (Code: time together).

Teacher 2: And I'll say, even this year in comparison is actually better than last year because I'm working just with English. So, going to English PLCs is more beneficial because I'm not trying to plan with both English and math. I felt like I was always 50% in with both, you know what I mean? So, even this year is a step up, which is good, but I don't know if that speaks a lot with what we are doing (Code: time together; co-planning).

Teacher 1: And, um…we have—we're free to text each other. When I have a minute, if I have a question I text her or she texts me (Code: dialogue and communication).
And, unfortunately, sometimes that may be the only way we are able to communicate. (Teacher 2 says yea) (Codes: time together; dialogue and communication)
And because we're on separate hallways, we only see each other for one bell… (Code: time together)

Teacher 2: And like, we've done—if plans or things need to get done over the week-end, we can email each other and things like that (Code: dialogue and communication).

Teacher 1: Yea, like I emailed her plans over the weekend with the English content and she tweaked it for the co-teaching way of planning (Codes: co-planning; dialogue and communication). Cause we had to present in front of observers on Monday. Because, again, that's her strength. I'll plan out our English activities, and of course, she knows—she's there too for part of that planning because she comes to the PLCs. Um…but then, she divides it up teacher one, teacher two; let's do this (Codes: co-planning; dialogue and communication; blended Knowledge; collaboration).
She has all the good ideas to what kind of co-teaching models work the best. I just let—I do it—whatever she tells me will work best. And I'm not afraid to do that (Codes: collaboration; co-planning; blended Knowledge; pedagogical knowledge).

Debbie: So, is some of it learning from one another and sharing with one another through communication; it's just limited time to do that? And you do communicate in those opportunities where you can find them?

Teacher 1: (Indicates agreement) We grab them wherever we can.

Teacher 2: Yea

Debbie: And when you're learning together. You mentioned, through trial-and-error. How are you finding things to try? Where are you finding things to try?

Teacher 1: I think we're both motivated people (Code: willingness to learn).
We're not satisfied to just do what we've always done and not always search for something better (Codes: willingness to learn; learning through exploration).
We both always do that. Even when I have a minute at home I'll get on my computer and I'll just play around and search for cool new things (Teacher 2 says, yea). And she does that too (Codes: willingness to learn; learning through exploration; informal learning; knowledge building).

Teacher 2: Yea, if there's something that I want to try that I—I mean, sometimes it's just a matter of Googling something or seeing what's out there (Codes: willingness to learn; learning through exploration; informal learning; knowledge building).
And then sometimes we'll have in-services or whatever and something will come up that's new or interesting (Codes: willingness to learn; informal learning; resources). And the other day—was it yesterday? I was doing a Nearpod with my [intervention] group and the kids were like, "Did you know you could hit this button and do that?" and I was

like, “No, I didn’t.” (laughs) So, sometimes they’re teaching me (Codes: learning from students; learning through praxis; informal learning; resources).

Teacher 1: Sometimes the kids will teach us (Codes: learning from students; informal learning).
Sometimes we’ll find things through word-of-mouth. Other teachers will be talking and they’ll say, “Hey! I just used this new program. It’s free.” (Codes: learning from other teachers; informal learning; knowledge building).
That always jumps out at us, cause we don’t want to spend our own money if it’s expensive, of course. And then we’ll go and investigate it on our own and get back with each other. (Codes: willingness to learn; informal learning; knowledge-building; learning from each other; learning through exploration)
I wish we could sit down together and look at them, but we never have time (Code: time together).

Debbie: So, you learn from other teachers a little bit, from students it sounds like, and then your own exploration?

Teacher 1: Self-exploration (Codes: informal learning; learning through exploration).

Debbie: And then I think you mentioned earlier the TIS, also?

Teacher 1: He’s really good at introducing things too. (Teacher 2 indicates agreement) We’ll say, “We would like to do this, do you know of anything?” And he’ll even go and look too (Codes: learning from other teachers; informal learning).

Debbie: And then come back and share?

They both say yes

Debbie: So, does he meet with you all? Your…

Teacher 1: PLCs. He’ll make the rounds, so he’ll go to all the subject areas, so we don’t see him every single Thursday, but um…

Teacher 2: Maybe once a month

Teacher 1: Once a month at the minimum, sometimes more than that, but once a month at the minimum (Codes: learning from other teachers; resources).