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# An Ecology of Learning: Secondary Mathematics Teacher Candidate Learning While Co-Teaching in Early Clinical Practice

Cynthia A. Castro-Minnehan
*University of South Florida*

# An Ecology of Learning: Secondary Mathematics Teacher Candidate Learning While Co-Teaching in Early Clinical Practice

by

Cynthia A. Castro-Minnehan

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of requirements for the degree of
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Department of Teaching and Learning
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University of South Florida

Major Professor: Ruthmae Sears, Ph.D.
Darlene DeMarie, Ph.D.
Mile Krajcevski, Ph.D.
Laura Sabella, Ph.D.

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## DEDICATION

I dedicate this work to my mother, Wilma Johnson.

Thank you for being my exemplar for a lifelong learner.

I also dedicate this work to my children,

John Joseph and Gillian Marie Minnehan.

Thank you for being my first students and my best teachers

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I would like to thank several people who helped me complete this project. First, thank you to Dr. Ruthmae Sears for your mentorship and support throughout this journey. Thank you also to the members of my committee for your support. Thank you to the CPCT Sub-RAC, CERAC, and MTE-P members for creating a collaborative space for this research. Lastly, thank you to all the incredible people in my writing group. Your friendship and peer support has made this accomplishment possible.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| AACTE | American Association of Colleges for Teacher Education |
| APLU | Association of Public and Land-Grant Universities |
| AT | Adaptive Teaching Expertise |
| AT-b | AT-balancing |
| AT-C | AT-contextual demands |
| AT-SC | AT-student cues |
| CE | Collaborative Expertise |
| CE-CO | CE-Co-responsible for Student Learning |
| CE-EIA | CE-Evaluating Instructional Approaches |
| CE-PC | CE-planning curriculum |
| CE-STS | CE-Sharing Teaching Space |
| CERAC | Clinical Experiences Research Action Cluster |
| CHAT | Cultural-Historical Activity Theory |
| CIM | Coaching in the Moment |
| CIM-ASI | CIM-Authentic Student Input |
| CIM-CD | CIM-collaborative dialogue |
| CIM-O | CIM-observation |
| CIM-SC | CIM-student cues |
| CM | Co-mentoring |

| | |
|---|---|
| CPCT | Co-planning and Co-teaching |
| GC | Growth Competence |
| GC-AR | GC-Articulating Rationales |
| GC-DTD | GC-Discuss teaching decisions |
| GC-JTD | GC-Justify Teaching Decisions |
| IDEA | Individuals with Disabilities Act |
| INTASC | Interstate New Teacher Assessment and Support Consortium |
| IRW | Immersion in Real World |
| IRW-C | IRW-Class |
| IRW-S | IRW-school |
| JIT | Just in Time |
| KP | Key Practices |
| MCOP2 | Mathematics Classroom Observation Protocol for Practices |
| MTE-P | Mathematics Teacher Educator Partnership |
| MTPs | Mathematics Teaching Practices |
| NCTM | National Council for the Teachers of Mathematics |
| ND | Negotiating Differences |
| ShA | Sharing Authority |
| ShA-I | ShA-Interactional |
| ShA-L | ShA-Linguistic |
| ShA-P | ShA-Physical |
| Sub-RAC | Sub-research action cluster |
| TC | Teacher Candidate |

| | |
|---|---|
| WHO | World Health Organization |

## ABSTRACT

Researchers have called for more empirical research exploring better ways to organize clinical practice around teacher candidate (TC) learning and the coursework-fieldwork gap. This study responds to their call by exploring secondary mathematics TC learning in early clinical placements that use co-teaching. Further, this study views co-teaching in clinical practice through the lens of an activity system. An activity system conceptualizes co-teaching in clinical practice as a complex learning environment or a learning ecology. This study uses a convergent mixed methods design. Findings reveal evidence of TC learning of eight key practices associated with co-teaching in their early clinical placements. Further, correlational analysis suggests a strong positive association between the number of instances of the key practice of *Adaptive Teaching* coded in TC reflections and observations and the MCOP2 construct of *Student Engagement* in observations of their teaching. Additionally, TCs who report more instances of the key practice of *Adaptive Teaching* also perceive their mentors as being more collaborative and feel more comfortable communicating their ideas to their mentors.

This study illuminates TC learning of key practices in early clinical placements when TCs co-teach for only 60 hours. The implication of this study for teacher preparation programs is that by cultivating early learning of these key practices in a co-teaching practicum, teacher preparation programs may ensure TCs are collaborative-practice ready or co-teaching practice-ready for learning of these key practices in their final field or clinical internship.

# CHAPTER ONE INTRODUCTION

## Background

This study explores secondary mathematics teacher candidate (TC) learning while co-teaching in early clinical practice. To do so, this study views co-teaching in early clinical practice as a complex learning environment or a learning ecology (Cobb et al., 2003). Co-teaching can be described as a complex learning environment because it enables new ways of learning for students, TCs, and their mentors in the situated and authentic environment of the classroom (Drewes et al., 2020; Roth et al., 2002; Soslau et al., 2015; Thompson & Schademan, 2019).

Co-teaching is a model for collaborative work in the clinical practice portion of teacher preparation. As an alternative to traditional models of clinical practice, co-teaching supports more collaborative work arrangements between a mentor teacher (mentor) and TC and has been shown to positively impact student learning (Bacharach et al., 2010). However, traditional models for clinical practice have been the norm in teacher preparation for the last 100 years. In traditional models of clinical practice, the TC takes a more passive role in their training and spends time observing before gradually assuming responsibility for tasks in the classroom. Yet, classrooms are becoming more diverse and teacher accountability more prevalent. Consequently, there is a need to transform clinical practice to better prepare TCs for these more diverse and accountable spaces. More collaborative models of the clinical practice, such as co-teaching, establish the TC as a teacher from the outset of the clinical experience and encourage active collaboration between the TC and mentor as the co-teaching pair focuses on student learning.

Because co-teaching is highly collaborative in nature, it encourages new ways of thinking and learning for all the participants in clinical practice, including the mentor, the TC, the university supervisor, and the student (Drewes et al., 2020). Therefore, more teacher preparation programs are replacing traditional clinical practice models with more collaborative approaches such as the co-teaching model (Heck et al., 2008).

Recent research into co-teaching during clinical practice has found that co-teaching provides TCs opportunities to learn several key practices as they co-teach. For example, Soslau et al. (2015) studied TC learning in secondary science clinical practice and found that co-teaching facilitates TCs' learning of *Adaptive Teaching Expertise* and *Collaborative Expertise. Adaptive Teaching Expertise* refers to the ability of teachers to adjust instruction based on students' learning needs, while *Collaborative Expertise* refers to TCs' ability to advocate for themselves and enact collaborative skills (Gallo-Fox & Scantlebury, 2015; Soslau et al., 2019; Thompson & Schademan, 2019). Thompson and Schademan (2019) studied secondary science, mathematics, history, and English TCs while they co-taught during their clinical practice placements. These researchers noted that as TCs gained fluency with co-teaching, they developed professionally through the learning of several key practices. These key practices collectively developed TCs' ability to be equitable collaborators with their mentors as they worked collectively to better meet the needs of students. In both studies, the researchers studied TCs in prolonged and primarily full-time clinical internships.

Since 2013, the Mathematics Teacher Educator Partnership (MTE-P), which is organized under the Association of Public and Land-Grant Universities (APLU), has led research efforts into transforming secondary mathematics teacher preparation (APLU, 2021). MTE-P is comprised of research action clusters that have adopted several innovative models for clinical

practice. One of these models is the Co-planning and Co-teaching (CPCT) model. The CPCT sub-research action cluster (sub-RAC), which is part of the Clinical Experiences Research Action Cluster (CERAC), has been researching how the CPCT model impacts TCs' implementation of mathematics teaching practices (MTPs). The MTPs are described in the National Council of the Teachers of Mathematics (NCTM), *Principles to Action*s (2014). There are eight MTPs. These practices are: establish mathematics goals to focus learning; implement tasks that promote reasoning and problem solving and connect mathematical representations; facilitate meaningful mathematical discourse; pose purposeful questions; build procedural fluency from conceptual understanding; support productive struggle in learning mathematics; and elicit and use evidence of student thinking (NCTM, 2014). The CPCT sub-RAC has specifically been researching how the CPCT model impacts TCs' learning to implement these MTPs (Martin et al., 2020; NCTM, 2014).

Besides studying collaborative models for clinical experiences, the MTE-P and the CPCT Sub-RAC also study co-teaching enactment through the CPCT model at several points across a continuum of clinical practice from methods and practicum classes to full-time clinical internships. Specifically, at one university in the southeastern United States, TCs start co-teaching with mentors in classrooms during their methods classes, where they are required to spend 10 hours co-teaching in the classroom. This brief foray into clinical practice is followed by 60 hours of clinical practice in the classroom during their practicum classes before their final semester-long clinical internship. In these practicum hours, TCs typically co-teach with their mentors for the first time. Although co-teaching researchers have studied how co-teaching facilitates learning of key practices in full-time clinical internships (Soslau et al., 2019; Thompson & Schademan, 2019), less is known about TC learning of key practices in these

earlier clinical placements that use co-teaching. Moreover, Caprano et al. (2010) asserted that it might not be the amount of time but rather how the time is spent in clinical practice which determines the effectiveness of the clinical practice. Therefore, research studies into early clinical practice may offer useful insights into how TCs learn key practices as the co-teach for the first time.

**Statement Of Problem**

Several empirical studies of co-teaching implementation suggest that co-teaching facilitates TC learning of several key practices in the clinical internship (Soslau et al., 2019; Thompson & Schademan, 2019). However, we know less about the extent co-teaching also facilitates similar TC learning opportunities in early clinical practice for secondary mathematics TCs. We also do not know whether evidence of TC learning of these key practices impacts TCs' ability to implement MTPs. Suppose the mathematics education community knew more about TC learning while co-teaching in early clinical practice. Then, we might possibly understand how to develop TC co-teaching readiness or their ability to be ready for these learning opportunities in their final clinical internship, where they spend much more time co-teaching with their mentor.

**Why Exploring Co-teaching in Early Clinical Practice Matters**

Exploring co-teaching in early clinical practice is important because researchers are calling for more empirical research into TC learning in these authentic classroom spaces and over a range of clinical practice hours. For example, Darling-Hammond (2006) challenged teacher education programs to organize their programs around promoting TC learning. Further, Cochran-Smith et al. (2015) called for more empirical evidence to address the coursework–fieldwork gap to better link what TCs learn in universities to what they learn in authentic

classroom experiences during their clinical practice. Additionally, Cochran-Smith et al. (2015) noted that policymakers have advocated increasing the amount of time TCs spend in authentic classroom environments and starting classroom-based clinical practice sooner. Recent empirical studies show that TCs learn key practices while they co-teach in their clinical internships (Soslau et al., 2019; Thompson & Schademan, 2019). Yet, my literature review found very few studies that specifically explore secondary mathematics TCs' learning of these key practices in early clinical placements such as the practicum classes that employ co-teaching. However, we know TCs learn these key practices in longer clinical internships. Therefore, this gap in the literature indicates that we need to explore more about secondary mathematics TC learning of these same key practices early in clinical practice placements, such as the practicum when TCs and their mentors co-teach for the first time.

**Purpose Of This Study**

This study aims to determine if TC learning opportunities that have been shown to occur in longer clinical practice placements that use co-teaching are evident in early clinical practice, such as the practicum class. If so, does the evidence of this learning impact TCs' implementation MTPs? By exploring co-teaching in early clinical practice, this study aims to add to the research on co-teaching in early clinical practice and, specifically the practicum.

This study uses a convergent mixed methods design. TC participant data sources from early clinical placements that employed co-teaching were analyzed to glean evidence of TC learning and to discern the impact of co-teaching on TCs' implementation of MTPs.

**Conceptual And Theoretical Frameworks for Studying Complex Learning**

This study uses an activity systems conceptual framework to explore TC learning while co-teaching in early clinical placements. This study views clinical practice that uses co-teaching

as a specific situated and contextualized complex learning environment (Campbell & Dunleavy, 2016). Complex learning environments are defined as situated authentic settings where several people are engaged in shared activities (Yamagata-Lynch, 2010). Further, this study explores TC learning in this co-teaching space through the theoretical perspective of cultural-historical activity theory (CHAT), which is also more broadly described as activity theory (Sannino et al., 2009). Through the lens of CHAT or activity theory, the context of the learning activity is not separate from the activity. The context is instead used to mediate the learning activity. Further, studying the relationship between the context and the subject of the learning activity can help address empirical questions related to the subject and the object of the learning activity (Sannino et al., 2009).

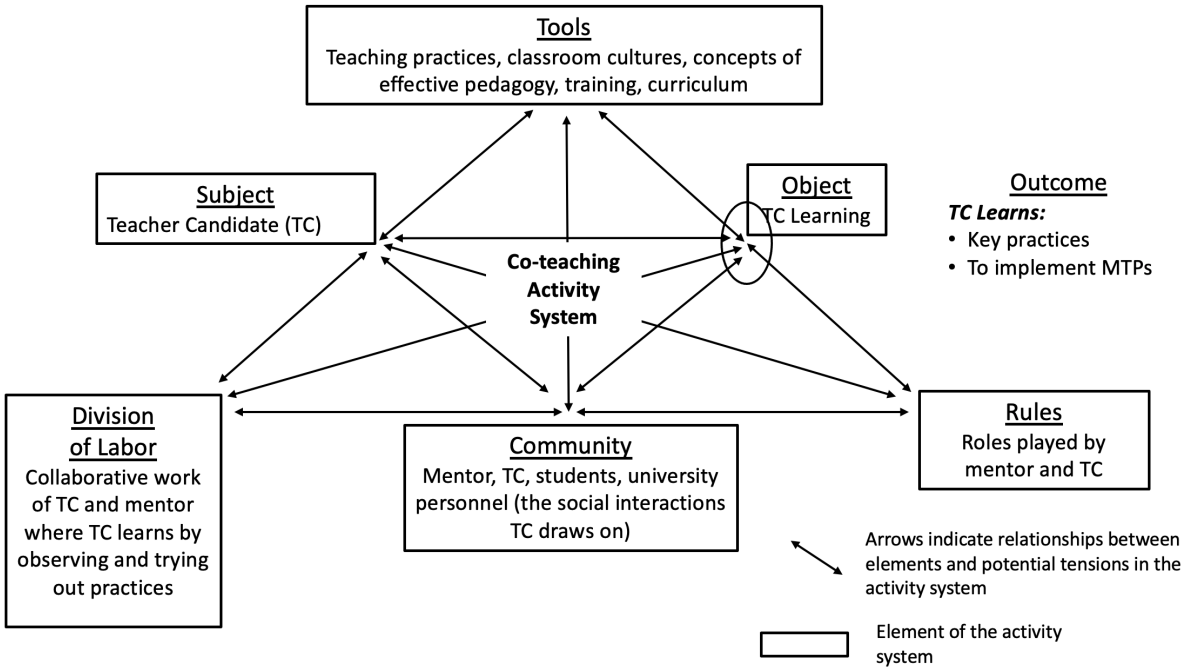
**Activity Systems and Co-Teaching**

An activity systems model conceptualizes CHAT as a triangular model. This triangular model graphically represents the development of some form of human consciousness, such as learning, while being mediated through elements such as the community in which the learning occurs and the training that supports the learning (Yamagata-Lynch, 2010). Campbell and Dunleavy (2016) used an activity systems triangular model to conceptualize their research on mediated field experiences. I adapted Campbell and Dunleavy's illustration of an activity systems triangular model to co-teaching in clinical practice for this study. This adaptation is shown in Figure 1. In this illustration, clinical practice modeled on co-teaching is conceptualized as an activity system consisting of seven interacting elements (more generally referred to as tools), including the object, outcome, subject, tools, rules, community, and division of labor. The top portion of the triangle represents the individual learner within the system. The individual learner within a co-teaching context represents the TC, and the object or outcome represents the

TC learning. The object represents activities that Engeström (2001) describes as "... always, explicitly or implicitly, characterized by ambiguity, surprise, interpretation, sense-making, and potential for change..." (p. 134). More broadly, the activity system depicted in Figure 1 graphically conceptualizes TC learning while co-teaching in clinical practice.

**Figure 1**

*Co-teaching Activity System*




Note: Adapted with permission from Campbell and Dunleavy (2016)

**Research Questions**

By exploring co-teaching in early clinical practice, this study aims to add to the research on co-teaching in clinical practice by looking at TC learning while co-teaching in the practicum and by conceptualizing TC learning through a co-teaching activity system. This study also endeavors to better understand how co-teaching in early clinical placements impacts TCs implementation of MTPs. Towards that end, this study addressed the following questions:

1. Is there evidence of TC learning of co-teaching key practices in practicum placements?
2. Does TC learning of key practices impact their implementation of equitable MTPs in observations of TC teaching?
3. How does the community of co-teachers in a co-teaching-modeled practicum support TC learning?
4. What roles (rules) impact learning for TCs in practicum placements?
5. How Do CPCT strategies (Division of Labor) in co-teaching modeled practicum support TC learning?
6. What contradictions impact TC learning?

## Definition of Terms

For clarity, I define several terms. Some terms aid in brevity, while others draw on the research literature to advance clarity.

### *Adaptive Teaching Expertise*

*Adaptive Teaching Expertise* (AT) refers to developing the flexibility in one's practice to adjust instruction based on students' learning needs (Gallo-Fox & Scantlebury, 2015; Soslau et al., 2015).

### *Clinical Experiences*

The term *Clinical Experiences* is used in this study to refer to the intentional placement of TCs that supports specific practices and experiences with some degree of feedback and coaching. Clinical experiences refer to a type of field experience (L. Sabella, personal communication, May 15, 2021).

***Clinical Internship***

*Clinical Internship* is defined by the American Association of College of Teacher Education (AACTE) and is used in this study to refer to what has traditionally known as student teaching or final field placements (AACTE, 2018).

***Clinical Practice***

*Clinical Practice* is a term defined by AACTE to describe work in authentic classroom spaces that have been traditionally known as fieldwork (AACTE, 2018). In certain contexts, I alternately refer to instances of clinical practice as a clinical placement(s) or clinical experience(s), especially in the context of the practicum.

***Collaborative Expertise***

*Collaborative Expertise* (CE) refers to TCs' ability to advocate for themselves, enact collaborative skills, seek help, contribute to lesson planning, and integrate into professional learning communities while engaging in peer-based coaching in support of theirs and their colleague's professional development (Soslau et al., 2015).

***Collaborative Practice-Ready.***

This term originated in the healthcare field and specifically in a World Health Organization (WHO) framework for interprofessional education and collaborative practice (WHO, 2010). In this context, this term refers to a workforce in which all parties work together to provide comprehensive services in various settings as they collectively strive to strengthen the system. I propose adopting and adapting this term to refer to a co-teaching community where all parties have been prepared to work together to promote learning.

### *Co-teaching*

In this study, I use the term *co-teaching* to refer to a pedagogical practice that encourages collaboration and communication between a TC and a mentor in an authentic shared classroom space (either face-to-face or virtual). In this space, they work together to co-plan, coteach, and co-assess for student learning (Bacharach et al., 2010; Brosnan, Jaede, et al., 2014; Tobin & Roth, 2005). Therefore, I use the term *co-teaching* to refer to co-planning, co-teaching, and co-assessing activities in authentic classroom spaces for this study.

### *Co-planning and Co-teaching (CPCT) Model*

The CPCT model refers to a specific kind of co-teaching clinical practice model first described by Brosnan et al. (2014). They described the CPCT model as a type of co-teaching model. The co-teaching model was originally adapted from special education to clinical practice by Bacharach et al. (2010). The CPCT model was described by Brosnan et al. (2014) as one that facilitates the development of strong working relationships between TCs and mentors through co-planning and co-teaching with a focus on student learning.

### *Co-teaching Readiness*

*Co-teaching Readiness* is a phrase I am using to refer to a state where co-teachers are ready to engage in learning opportunities facilitated by the co-teaching. This term assumes that that to be ready for co-teaching, co-teachers have been prepared to embrace their dual agency as learners and teachers of learners (Soslau et al., 2018).

### *Early Clinical Practice*

This term refers to fieldwork TCs do while in their practicum. I adapt the definition of *Clinical Practice* described by the AACTE to early forays teacher preparation programs afford their TCs in clinical practice, such as during methods and practicum classes (AACTE, 2018).

### *Field Experiences*

For this study, the term *Field Experiences* is used to refer to the spectrum of fieldwork from traditional, unsupervised general experience to more tailored and selective experiences and to include and clinical experiences (placed with intentionality, supporting specific practices and experiences, with some or much feedback and coaching). Clinical practice is a specific kind of field experience (L. Sabella, personal communication, May 15, 2021).

### *Growth Competence*

*Growth Competence* (GC) is the ability of the TC to continue to grow professionally based on an internal locus of control (Soslau et al., 2019).

### *Key Practices*

In this study, *Key Practices* collectively refer to TC learning opportunities reported in the empirical research on co-teaching (Soslau et al., 2015; Thompson & Schademan, 2019). These include Soslau et al. (2015)'s *Adaptive Teaching Expertise* (AT), *Growth Competence* (GC), *Collaborative Expertise* (CE), and Thompson and Schademan (2019)'s related co-teaching key practices of *Coaching in the Moment* (CIM), *Negotiating Differences* (ND), *Sharing Authority* (ShA), *Co-mentoring* (CM), and *Immersion in Real World* (IRW). Notably, Soslau et al., (2019) describe TC learning opportunities rather than using the term, *Key Practice*. For the sake of clarity however, this study identifies all these TC learning activities as "key practices" using the definition proposed by (Grudnoff et al., 2017) which described key practices as "..complex practices that are predictable and stable across contexts.." (p. 307). Further, this study did not distinguish key practices from *High-Leverage Practices* (AACTE, 2018; Ball & Forzani, 2011) or *Core Practices* (Grossman et al., 2009). *High-Leverage Practices* have been described by Ball and Forzani (2011) as "... those practices at the heart of the work of teaching and most likely to

affect student learning...” (p. 41). Similarly, Grossman et al. (2009) described *Core Practices* as those that are high leverage, occur with high frequency, and can be applied in multiple curricula contexts and with different instructional approaches, can be mastered by new teachers, allow new teachers to learn about students and teaching, maintain the integrity and complex nature of teaching, and are based on research and may improve student achievement.

### *Learning*

There is no accepted definition for learning (Illeris, 2009). However, for the purpose of this study I adopt Illeris’ (2018) description of learning as “...any process that in living organisms leads to permanent capacity change and which is not solely due to biological maturation or ageing...” (Illeris, 2018, p. 3).

### *Mentor Teacher (Mentor)*

*Mentor Teacher* is a term defined by AACTE as “...a teacher who serves as the primary school-based teacher educator for teacher candidates completing clinical practice or an internship.” (AACTE, 2018, p. 11).

### *Teacher Candidate (TC)*

*Teacher Candidate* is a term defined by AACTE as “...an individual enrolled in a teacher preparation program that leads to a recommendation for initial-level state licensure and who is also engaged in clinical practice...” (AACTE, 2018, p. 11).

## Limitations and Delimitations of the Study

This study draws on data collected as part of a larger study already in progress. Therefore, I had limited influence on the design of data collection instruments and surveys. This study is also based on observations and data collected from one teacher preparation program included in the larger study. The findings, therefore, may not be generalizable given that there is

no external validity to other studies. However, there may be some population generalizability based on similar participants in similar contexts.

This study explores data collected from TCs and therefore reflects only their perceptions of their co-teaching experiences. This study does not consider other important voices such as mentors, university supervisors, and students in the classrooms. Further, the data collected required TCs to self-report their perceptions. Self-reported data impacts the ability of a researcher to verify the accuracy of the responses (Fowler Jr, 2013). However, two researchers observed TCs in their practicum placements on at least two occasions, and these observations serve to triangulate claims TCs made in their self-reported data sources. Lastly, given my role as the researcher and investigator in this study and my interest in supporting and developing teachers, I realize bias is possible. To guard against this bias, I maintained a non-participant observer stance while conducting fieldwork. I also draw on several empirical studies for coding to enhance the trustworthiness of my analysis.

**Organization of the Study**

Chapter two provides a review of relevant literature. Chapter three presents the methods used in this study. Chapter four highlights the results of this study. Chapter five discusses the implications of this study.

# CHAPTER TWO LITERATURE REVIEW

My review of the literature review first considers the origins of co-teaching and its promise for clinical practice. Second, I discuss the various ways researchers describe co-teaching in their studies that point to co-teaching in clinical practice as a complex learning environment. Third, I summarize several issues related to effective co-teaching and co-teaching implementation evident in these empirical studies. Finally, because I use activity theory to frame my study, I review CHAT and the activity systems framework.

## Co-Teaching, its Origins, and its Promise for Clinical Practice

A review of the literature on co-teaching establishes its origins in the field of special education. In response to the Individuals with Disabilities Act (IDEA) of 2004, schools began to embrace greater collaborative working arrangements between general education and special education teachers. Co-teaching became the model for these collaborative work arrangements (Murawski & Lochner, 2011). In the context of teacher preparation, co-teaching is seen as an alternative to traditional models of clinical practice because it is more collaborative. Traditional models of student teaching, which have been the norm in teacher preparation for the last 100 years, place TCs in a more passive role as they spend time observing before gradually assuming responsibility for tasks in the classroom (Bacharach et al., 2010). Co-teaching, on the other hand, establishes TCs as teachers alongside their mentors on the first day of their clinical practice. Further, through several strategies, TCs collaboratively teach and plan with their mentors as they actively focus on student learning (Tschida et al., 2015). Co-teaching improves student learning

because it facilitates differentiated and collaborative instructional and communications practices, which TCs correspondingly need for their own professional growth long term (Darragh et al., 2011; Soslau et al., 2015).

## How Co-Teaching Is Described

The research literature exhibits variability in its descriptions of co-teaching. Descriptions range from co-teaching as collaborative teaching, and co-teaching as a set of strategies to co-teaching as a complex learning environment.

### *Original Descriptions*

Originally, Cook and Friend (1995) defined co-teaching in a special education context as two or more professionals who deliver instruction to diverse or blended groups of students in a single space. However, Bacharach and Team (2007), who first studied co-teaching in clinical practice, defined co-teaching as a mentor and TC working together in a classroom with groups of students while sharing in the planning, organization, delivery, and assessment of instruction, as well as the physical space.

### *Co-teaching as Collaborative Teaching*

Because co-teaching is collaborative in nature researchers have incorporated collaborative terms in their descriptions of co-teaching. For example, defining co-teaching in terms of collaboration is evident in Dieker and Murawski (2003)'s definition of co-teaching as a general education and special education teacher who can be described as "…sometimes known [also] as collaborative or cooperative teaching, team teaching, or even teaming…" (p. 1). Dieker and Murawski (2003) specifically considered co-teaching in a secondary education inclusive classroom context. Heck et al. (2008) further articulated co-teaching in a clinical practice context as an experience where the mentor and TC "…collaboratively plan and deliver instruction from

the very beginning of the experience…" (p. 1). Further, Tobin and Roth (2005) captured the collaborative nature of co-teaching in an urban science classroom when they contrasted co-teaching with traditional student teaching as "…the difference between traditional assignments and coteaching was the expectation that the two would teach together, at the elbow of the other … they would plan and teach together with the intention of improving the science learning of the students…" (p. 316).

***Co-teaching as Co-planning, Co-instructing, and Co-assessing***

Because co-teaching involves several activities, such as collective planning, teaching, and assessing, some researchers align their descriptions of co-teaching with the collaborative efforts the co-teachers engage in. For example, Guise, Habib, et al. (2017) broadly defined co-teaching as when "… both the pre-service and cooperating teacher are engaged in student learning at all times through daily co-planning, co- instructing and co-assessing…". (p. 370). Soslau et al. (2019) further stated that "…coteaching is when two or more teachers share responsibility for pupils' learning. When used as a model for student teaching, one or more of the co-teachers are experienced teachers who work with one or more teacher candidates to coplan, coinstruct, and coevaluate…" (p.1). Thompson and Schademan (2019) described co-teaching as "..the pairing of a mentor teacher and teacher candidate in a teacher preparation program who partner in the planning of lessons, instructional decision-making, and assessment of student learning.. " (p. 2)

***Co-teaching as Strategies***

Characterizing co-teaching as a set of specific strategies or tools is also a notable trend in how researchers describe co-teaching in the literature. For example, Scruggs et al. (2007), in their meta-synthesis of research on co-teaching, summarized five co-teaching variations evident in Cook and Friend (1995)'s earlier work: one-teach, one-assist, station teaching, parallel

teaching, alternative teaching, and team teaching. Bacharach et al. (2010) further described co-teaching strategies which they modified from Cook and Friend (1995) for use in teacher preparation contexts. They articulated the following strategies: one-teach one observe, one-teach, one assist, station teaching, parallel teaching, supplemental teaching, alternative teaching, team teaching. Grady et al. (2019) defined six co-planning strategies that complement and support co-teaching strategies. They defined these strategies based on feedback from their TCs and mentors. They indicated that while they found the co-teaching strategies beneficial, they felt they needed more support to incorporate co-planning effectively. These six co-planning strategies are one-plans, one assists, partner planning, one reflects one plans, one plans one reacts, parallel planning, team planning.

***Co-teaching as Benefiting Several Learners***

There are several learners who benefit from co-teaching during clinical practice. For example, co-teaching has been shown to support student learning because with co-teaching, mentors can remain actively engaged in their classrooms (Heck et al., 2008). Two teachers essentially interact in the classroom to support the students' learning needs, which decreases the student-teacher ratio. In their four-year study of co-taught students, Bacharach et al. (2010) found that co-teaching impacted students' academic performance positively on achievement tests for mathematics and reading.

Further, co-teaching has also been shown to support learning of both co-teachers. For example, Roth et al. (2002) studied co-teaching in a secondary science context. They noted that co-teaching combined with cogenerative dialoguing built deep learning of content and of pedagogy for TCs and their mentors. They also noted that co-teaching combined with cogenerative dialogue allowed co-teachers to learn regardless of "… whether they are new

teachers, 30-year veterans, or students …" (p. 254). Scantlebury et al. (2008) conducted an ethnographic study of co-teaching over three years in a secondary science teacher education context. They characterized co-teaching by how TCs and mentors effectively created learning communities based on collective teaching, co-respect, and co-responsibility. More recently, Thompson and Schademan (2019) studied four years of data on co-teaching pairs and how they enacted effective co-teaching. They noted that as co-teaching pairs gained fluency in co-teaching, they reported increases in professional understanding and their abilities to meet student needs in diverse, rural classrooms.

In addition, these co-teaching learning communities are professional development for the mentor teacher. For example, Gallo-Fox and Scantlebury (2016) conducted a four-year ethnographic design-based study implementing the co-teaching model in secondary science suburban classrooms. They found that co-teaching served as professional development for the mentors. The co-teaching experience provided mentors with "… renewed energy toward practice, opportunities to develop and implement curriculum, reflection as a catalyst for changing practice, and an expansion of professional roles into new arenas..." (p. 191). Guise et al. (2016) noted in their case study of co-teaching that both the mentor and TC felt co-teaching provided them an opportunity to learn and grow as teachers and, for the mentor in particular, co-teaching allowed him to broaden and hone his practice. Both mentor and TC participated in reflective conversations, especially when they were co-planning, and the mentor felt his practice was made better because of co-teaching.

Other empirical research looks specifically at TC learning opportunities in the context of co-teaching. For example, Soslau et al. (2015) conducted a qualitative cross-case comparison drawn from three teacher preparation programs including one secondary science education

program. They studied how co-teaching benefited TCs in these programs. They described co-teaching as affording opportunities for learning for TCs. Later, Soslau et al. (2018) further studied four secondary science TCs in their clinical internships who co-taught. In this study they defined co-teaching as.. "…a model used to support teacher learning during the student teaching practicum…" (p. 99). These studies considered the TC as the learner in the co-teaching clinical experience and revealed TCs' gaining several learning outcomes. Soslau et al. (2018) found that TCs engaged in adaptive help-seeking to learn *Adaptive Teaching Expertise*. They described adaptive help-seeking as the TCs taking responsibility for their learning by initiating a request for help. They asserted that adaptive help-seeking precedes developing the skill of *Adaptive Teaching Expertise,* which refers to the TC's ability to modify planned instruction based on student cues in real-time. TCs become learners of teaching who engage in adaptive help-seeking to develop *Adaptive Teaching Expertise*. Soslau et al. (2019) also found that co-teaching provided opportunities for these TCs to not only learn *Adaptive Teaching Expertise* but also *Growth Competence* and *Collaborative Expertise.* Yet, they also asserted that several factors needed to be addressed for these learning opportunities to be realized. These factors include issues of power, agency building, and the co-teachers assuming both teacher and learner roles. They noted that TCs did not consistently perceive themselves as agents in their own learning despite having clear opportunities for learning afforded by co-teaching during the clinical practice experience.

### *Co-teaching as a Complex Learning Environment*

Because co-teaching creates an environment where several members of the co-teaching community are engaged in learning, researchers have suggested co-teaching fits the description of a complex learning environment. A complex learning environment is defined as "...situations

in natural settings where multiple individuals are involved in shared activities within a single or multi-organizational context..."(Yamagata-Lynch, 2010, p. vii). Activity theory is one perspective researchers use to conceptualize complex learning environments. These situations are characterized by human activity that occurs in a collective context such as a classroom or school (Yamagata-Lynch, 2010). For example, Roth et al. (2002) adopted activity theory and an activity systems approach to frame their model of collective teaching and learning for secondary science TCs in clinical practice, which they called co-teaching/co-generative dialoguing. They described this co-teaching model as facilitating

> ... deep learning of science concepts while learning about alternative ways to teach the same subject matter. As praxis, coteaching brings about a unity between teaching and learning to teach; cogenerative dialoguing brings about a unity between teaching and researching. Both are potential sites for deep learning.. (p. 253).

Additionally, Thompson and Schademan (2019), who studied four years of qualitative data involving 21 TCs and 12 mentors in multiple content areas, framed their co-teaching research through activity theory to better understand effective co-teaching. They described the co-teaching space as the interplay of five primary practices: *Negotiating Difference*, *Sharing Authority*, *Co-Mentoring, Coaching In The Moment,* and deep *Immersion In Real World Teaching*. More generally, Hackett et al. (2019) and Grady et al. (2016) asserted that research into co-teaching demanded a paradigm shift away from a "…reductive checklist or procedure-based…" (p. 2) approach and towards studying co-teaching in a way that accounts for its complexities.

However, researchers who study co-teaching in clinical practice do not always frame their studies with activity theory. For example, Soslau et al. (2019) claimed that co-teaching and

learning during co-teaching are bounded by a "micro-community of learners where learning takes place in the same authentic context as it is applied.. " (p. 266). They describe co-teaching as affording TCs' learning opportunities through the notions of communities of practice and situated learning theory (Lave & Wenger, 1991). Similarly, although Roth et al. (2002) associated co-teaching with "deep learning" but framed their study using activity theory, Darling-Hammond and Oakes (2021) defined *Teaching For Deeper Learning* in teacher preparation as consisting of learning that occurs in productive communities of practice that is "supported by the use of coteaching models as a means for learning to teach..." (p. 258). A community of practice describes a well-defined group of people who form relationships and address recurring problems as practitioners. Yet when used to frame co-teaching research, these communities of practice define the unit of analysis in the investigation of learning (Horn, 2007; Wenger, 1998). Studies investigating learning outcomes may alternatively frame co-teaching research using activity theory because the learning activity is the unit of analysis (Yamagata-Lynch, 2010).

Interestingly, Hackett et al. (2019), who studied a co-teaching team in a special education context, suggested that co-teaching is a *Learning Ecology.* Cobb et al. (2003) define a learning ecology as a complex, interacting system of activities that function together to support learning. Toward that end, several studies have asserted that co-teaching creates a complex learning community in clinical practice (Roth et al., 1999; Soslau et al., 2015; Thompson & Schademan, 2019). Yet, these communities have also been characterized by interactions between community members that create power and role negotiation issues that must be thoughtfully navigated for co-teaching to be effectively implemented (Gallo-Fox & Scantlebury, 2015; Hackett et al., 2019; Soslau et al., 2015).

In summary, the empirical research on co-teaching describes co-teaching in several ways. These descriptions range from characterizing co-teaching as a set of strategies co-teachers can use to co-teaching as a complex learning environment or a learning ecology.

**Co-Teaching as Supporting More Equity in Teacher Preparation**

Although several studies suggest that co-teaching provides unique learning opportunities for TCs, some researchers suggest that these learning opportunities raise issues of equity in the preparation of TCs. Darling-Hammond and Oakes (2021) studied seven pioneering teacher education programs and found that effective teacher preparation programs teach and support their candidates in the same ways they want the candidates to teach and support children. Towards that end, learning certain pedagogical strategies such as *Adaptive Teaching Expertise* (Soslau et al., 2018), for example, helps TCs learn to make in-the-moment instructional decisions. These instructional decisions are responsive to their students' thinking which positions students as key players in the instruction. By offering valuable insight, students can shape interactions in the classroom (Sandoval et al., 2020). Towards that end, Sandoval et al. (2020) studied TCs' conceptualizations of equity. They specifically described equity in teacher preparation as having two broad dimensions: the first focusing on developing the TC's awareness of attention to broader sociopolitical context of schooling and the second dimension being the kinds of practices TCs must begin to develop to advance equity in their own practice. Further, Olmstead et al. (2020) studied 107 TCs who co-taught and identified those who struggled in their semester-long clinical practice. They noted that mentors needed to provide TCs with more immediate feedback, which in turn benefits the students in the classrooms. They further noted that effective co-teaching depends on equity in the co-teacher relationship. These findings suggest there is a complement around equity as it relates to co-teaching. More

specifically, attending to the more equitable access of TC learning opportunities such as *Adaptive Teaching Expertise* through co-teaching and, specifically responsive in-the-moment feedback ensures more equitable learning opportunities for students. In other words, equitable teacher preparation through co-teaching for TCs ensures equitable learning through co-teaching for students.

**Importance Of Dialogue in Co-Teaching**

The nature of dialogue inherent in co-teaching has been found to be key to facilitating learning. For example, Roth et al. (2002), coined the phrase, *coteaching/cogenerative dialoguing* to refer to learning of content knowledge concepts while also learning pedagogical content skills. They clarified that co-teaching brought about a union between teaching and learning to teach by relating co-teaching with cogenerative dialoguing and asserting that both these activities created "...sites for deep learning..." (p. 253). They concluded that cogenerative dialogue facilitated a key idea that all participants in co-teaching have a shared and collective responsibility for each other's learning. Similarly, Scantlebury et al. (2008) conducted a three-year longitudinal study on co-teaching implementation among secondary science TCs that included their first-year teaching. They found that when they conceptualized co-teaching as a dialogue with associated coteaching/co-generative dialogue strategies, co-teachers could create effective learning communities based on collective teaching, co-respect, and co-responsibility. Guise et al. (2016) noted in their case study of co-teaching that both the mentor and TC felt co-teaching provided the co-teachers with opportunities to engage in reflective conversations when they co-planned together. Further, Guise and Thiessen (2016) studied eight co-teaching pairs in science and english. They found that "…co-teaching during the clinical experience provided an opportunity

to shape pre-service teachers to be collaborative, reflective practitioners who seek out opportunities to collaborate and position themselves as lifelong learners...” (p. 37).

They asserted, however, that teacher education programs that implement co-teaching during the clinical practice must be prepared to ensure co-teaching is implemented with fidelity and ensure that TCs who co-teach during their clinical practice also are prepared to assume full-time employment where co-teaching opportunities may be less pervasive.

**Challenges of Co-teaching in Clinical Practice.**

Clinical experiences that use co-teaching may transform the clinical practice into a rich ecology of learning for all participants (Hackett et al., 2019). However, the empirical research asserts that there are challenges associated with co-teaching. These challenges include establishing trust, addressing issues of power and TC agency and positioning, and mentors’ and TCs’ ability to embrace their dual roles as teachers and learners of teaching. Morton and Birky (2015) conducted a three-year study on co-teaching effectiveness. Participants included 40 co-teaching pairs. They noted that trust is important to collaboration and to co-teaching being effective. Although Cochran-Smith et al. (2015) asserted that in general, fieldwork results in a sense of agency for TCs, TCs need to be agents of their own learning, and TC agency is a wildcard with co-teaching. Further, Soslau et al. (2019) studied 12 co-teaching pairs and found that positioning, power, and agency building in co-teaching placements are vital because TCs do not consistently perceive themselves as agents in their own learning. They also noted that there could be a lack of focus on student learning because TCs can sometimes perceive that a lesson has gone well, but the mentor does not push the TC to self-evaluate based on evidence of student learning. Soslau et al. (2019) also noted TCs’ and mentors’ ability to embrace the dual role as teachers and learners of teaching as an obstacle to effective co-teaching. They concluded that a

lack of conversations around teacher learning weakens the effectiveness of co-teaching. Yet, Tschida et al. (2015) studied various co-teaching models and noted that as the relationship between co-teaching teams strengthened, a level of trust grew that gave mentors confidence to jump in and correct mistakes TCs might make during their lessons. Similarly, Guise, Thiessen, et al. (2017), who studied eight co-teaching pairs, found that co-teaching implementation must be framed around teacher learning. Further, Guise, Habib, et al. (2017) asserted that ".. to successfully support co-teaching implementation, attention to framing the field experience around notions of teacher learning and communities of practice is necessary..." (p. 379).

**Implementing Co-teaching in Clinical Practice**

The empirical literature reveals studies that explore implementing co-teaching effectively and with fidelity so that all participants in the co-teaching enterprise realize opportunities to learn. Researchers refer to effective co-teaching implementation in terms of co-teaching fluency, mentor collaborative traits, and evaluation of co-teachers' co-teaching. Thompson and Schademan (2019) studied four years of qualitative data involving 21 TCs and 12 mentors in multiple content areas who co-taught and they described the importance of co-teachers gaining fluency in their co-teaching practice. As co-teachers gain fluency, they engage in professional development as they learn to negotiate their differences, share authority, mentor and coach each other, and immerse themselves in real-world teaching experiences. Guise, Habib, et al. (2017) asserted that eight co-teaching pairs they studied fell on a co-teaching continuum based on mentor dispositions evident in their collaborative work together. More recently, Drewes et al. (2020) studied 12 co-teaching pairs and their ability to co-evaluate, which they described as the simultaneous assessment of student learning and collective examination of their co-teaching practice. They asserted that teacher educators need a better way to balance evaluating TC

learning in clinical experiences with the enhanced TC learning and student learning and mentor professional development apparent in clinical experiences transformed by co-teaching. They concluded that as clinical experiences are transformed through co-teaching, how TCs' teaching is evaluated in these co-teaching spaces must also be transformed. One way to do this is to move away from a TC-based competency or checklist approach and toward a TC and student learning-focused approach, so that enhanced learning is illuminated (Drewes et al., 2020).

**Assessing TC Performance While Co-Teaching**

Studies that considered assessing TC performance when co-teaching involved using indicators of teacher preparedness and surveying perspectives from the students. Bacharach and Team (2007) studied how TCs (n=370) who engaged in co-teaching performed when evaluated. These researchers used standards set for beginning teachers by the Interstate New Teacher Assessment and Support Consortium (INTASC) when they assessed elementary-level TCs who used co-teaching. They found that the TCs who used co-teaching in their student teaching outperformed those in traditional student teaching based on a summative assessment consisting of eleven indicators of teacher preparedness from the INTASC. Further, Morton and Birky (2015) studied 40 co-teaching pairs in high classrooms and surveyed students in these classrooms. Students in classrooms where TCs co-taught reported a positive classroom climate, increased engagement, individualized instruction, and feedback. More broadly, this study attributed enhanced student learning and growth in the TC and the mentor to co-teaching.

**TC Perceptions of Co-Teaching**

The literature is slim on TCs' perceptions of their co-teaching, but one study reported TCs' favorable perception of co-teaching. Darragh et al. (2011) specifically looked at TC perceptions of co-teaching. Researchers trained TCs and their mentors in co-teaching strategies

and provided additional training for the TCs in their coursework. Their TCs consisted of students in their undergraduate, graduate masters, and alternate teacher certification programs. They surveyed 156 students across these three programs to determine their perceptions of the co-teaching model and perceived benefits for student learning. They reported that 59.4% of TCs surveyed strongly agreed that co-teaching is a valuable professional practice to benefit student learning, 48.6% strongly agreed that co-teaching is a valuable professional practice to benefit the TCs' professional training, while 47.8% felt adequately prepared to co-teach. Lessons learned from their study included the necessity of TCs and mentors being properly matched and grounded in trust, mutual respect, and clear communication with their mentor.

**Time Spent Co-Teaching**

Darragh et al. (2011) also asserted that the co-teaching model could be effectively used in early clinical practice such as the practicum to

> …gradually introduce teacher candidates into teaching responsibilities and to teach the strategies. Each co-teaching strategy can be introduced into coursework early on in the teacher preparation program. Then, by the time the teacher candidate enters the student-teaching internship, all strategies are understood and can be incorporated into the planning, utilizing, as survey respondents indicated, a wider variety of teaching strategies, perspectives, and styles within the classroom… (p. 101).

Yet, the empirical literature around co-teaching considers primarily semester-long or year-long clinical practice experiences and TC opportunities to learn during these longer clinical practices. For example, Soslau et al. (2015) looked for evidence of TC learning in a full-time 16-week practicum in secondary science (biology, chemistry, earth science, or physics). Similarly, Guise, Habib, et al. (2017) studied co-teaching of eight co-teaching pairs in secondary English and

science. The TCs completed a year-long clinical practice experience that progressed from practicum to part and then full-time co-teaching. Thompson and Schademan (2019) notably studied TCs in secondary Science, Mathematics, History, and English who completed a year-long co-teaching practicum. Yet Eick et al. (2003) found that even when TCs were provided the opportunity to co-teach once per week as part of methods classes, they realized positive outcomes. In their study, Eick et al. (2003) found that ten secondary science TCs in methods courses who co-taught experienced four favorable outcomes: (a) comfort in learning to teach, (b) critical reflection in modeling the teacher's lesson, (c) development of confidence in teaching and managing students, and (d) positive effect of seeing and doing inquiry in practice. They concluded that although TCs experience positive outcomes from co-teaching, the limited time in the classroom was a drawback. Instead of being in schools once per week, greater exposure through co-teaching to the teaching process would be more desirable in situated learning models like co-teaching. They concluded that the TCs "learned in practice" but that this added "learning in practice" needed to be studied further to determine if co-teaching and specifically if learning in practice can improve teaching performance and that extending the co-teaching experience would be a first step.

**Secondary Mathematics TCs Learning While Co-teaching in Clinical Practice**

Although my review of the literature revealed empirical studies related to TC learning while co-teaching, these studies do not primarily consider secondary mathematics TCs. For example, Soslau et al. (2015) studied TCs in secondary science classrooms that use co-teaching and noted that these TCs have the opportunity to learn *Collaborative Expertise*, *Adaptive Expertise*, and *Growth Competence* while co-teaching in clinical practice. Thompson and Schademan (2019) studied TCs in science, mathematics, history, and English. They investigated

how the co-teaching pairs gained fluency with co-teaching by developing expertise in five key practices: *Negotiating Difference*, *Sharing Authority, Co-mentoring*, *Coaching in the Moment*, and *Immersion in Real World* teaching experiences.

One research initiative that is researching secondary mathematics TCs is the research initiative led by the APLU MTE-P. One aim of the MTE-P is to determine the extent to which co-teaching facilitates secondary mathematics TCs' implementation of the MTPs. These practices focus on students' conceptual understanding of mathematics. These practices have been articulated in several standards set out by national organizations. The MTE-P measures TCs' implementation of these practices using the Mathematics Classroom Observation Protocol for Practices (MCOP2). This protocol is a K-16 mathematics classroom instrument designed to measure the degree of alignment of the mathematics classroom with these standards (Gleason et al., 2015).

**Cultural-historical Activity Theory (CHAT)**

Because I am choosing to frame my study using CHAT and an activity systems model, I provide a brief review of the literature on this perspective. Studies around co-teaching show that some researchers choose to conceptualize co-teaching through more complex lenses to account for the complexity of the co-teaching model. One theoretical perspective researchers use in these studies is CHAT which is sometimes more commonly referred to as activity theory (Nussbaumer, 2012). Activity theory has its origins in psychology and the work of Vygotsky in Russia in the early 20$^{th}$ century. Vygotsky was interested in identifying methods that would objectively study and explain human activities and the development of human consciousness through participation in human activities through mediated action with artifacts such as tools and social others. This view countered the ideas of Pavlov and the behaviorist movement prevalent at

the time in the study of psychology. Instead of accepting the ideas of Pavlov, Vygotsky countered that psychology should be the study of relationships of the human being and their environment and how these enabled the development of human consciousness. Later, Leontiev further developed Vygotsky's concept of activity theory by defining object-oriented activities in a system with structure and events that can transform the participants and the activity itself. (Yamagata-Lynch, 2010). This association with a system gave rise to the theoretical perspective known as cultural-historical activity theory, CHAT. This perspective basically expands on an individual's association within a society proposed by Vygotsky (Campbell & Dunleavy, 2016). Engeström (2001) built on this perspective and developed the notion of an activity system and represented this system as a triangle diagram which is shown in Figure 2. This illustration essentially operationalizes the CHAT theoretical perspective into what Yamagata-Lynch (2010) refers to as activity systems analysis. The graphic shown in Figure 2 represents Vygotsky's original notions of mediated action through artifacts that comprise the socio-historical aspects of the activity under analysis. This triangular model is referred to as the second-generation model of activity systems analysis. The first model is a simple triangle proposed by Vygotsky (Yamagata-Lynch, 2010). Nussbaumer (2012) described this more elaborate second-generation model this way:

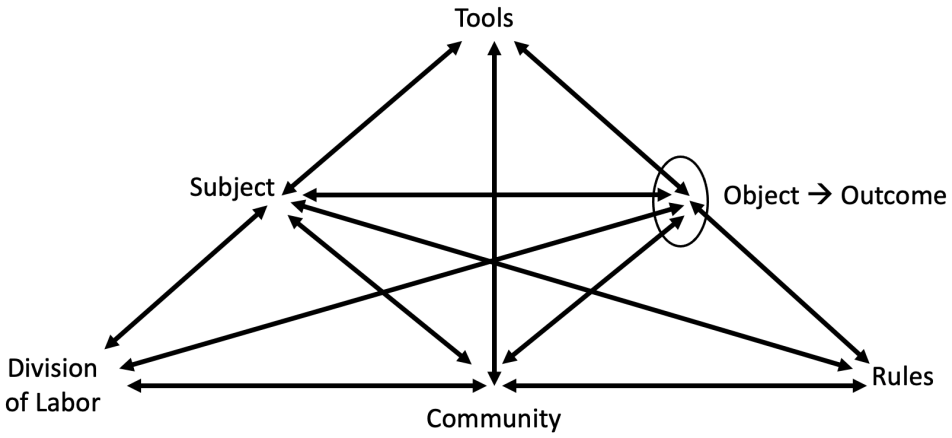
> The subject is a person or group working to achieve an object leading to an outcome. Instruments, rules, community, and division of labor mediate or reciprocally influence the achievement of the object and the final outcome, each of which is called a construct (p. 39).

The activity systems triangular model provides a graphical lens for examining the complex relationship between an individual and a collective community who engage in an

activity that is mediated by several elements. Understanding this complex relationship depends on understanding multiple elements of the activity system and how these elements facilitate the activity and relationships as they unfold (Roth & Lee, 2007). In Figure 2, the top triangle represents an individual while the larger triangle represents group activities that occur in a community, and all exist in a collective activity system. The oval on the far right of the diagram represents the object of the actions in the activity system model, which may involve "...ambiguity, surprise, interpretation, sense-making, and potential for change…" (Engeström, 2001, p. 135).

**Figure 2**

*Activity System Triangle Diagram*




Note: Adapted with permission from Engstrom (2001)

***Contradictions***

One noteworthy aspect of a complex learning environment is the inherent tensions that arise from the activity system elements (Yamagata-Lynch, 2010). The arrows in the model represent these tensions and can reveal contradictions inherent in any activity system. These contradictions and tensions can "…affect the subject's ability to attain the object by taking a role

as an obstacle, making it difficult for the subject to attain the object..." (Yamagata-Lynch, 2010, p. 3). These tensions can ultimately lead to dramatic changes in the activity system. For example, in clinical practice that use the co-teaching model, researchers have suggested that issues around how power and identity are negotiated present obstacles to effective co-teaching (Soslau et al., 2015). Engeström (1987) noted that the element of division of labor involves a horizontal division of tasks between community members that involve the vertical division of power and status.

**Summary**

In summary, the empirical research on co-teaching reveals researchers expanding their descriptions of co-teaching to account for its nature as a complex learning environment or learning ecology. My review of the literature points to a gap in what we know about secondary mathematics TC perceptions of their learning while co-teaching in the early phases of their clinical practice. My review of the literature also reveals some inconsistencies in how researchers frame co-teaching as a complex learning environment. Yet, researchers appear to continually expand their descriptions of co-teaching to account for its nature as a complex learning ecology. These descriptions, therefore, point to CHAT and an activity systems model as viable theoretical and conceptual frameworks for this study.

In addition, my review of the literature also points to evidence that TCs learn several key practices while they co-teach; these practices may help them learn how to teach more equitably. For example, *Adaptive Teaching Expertise* has been shown to promote equitable learning of students (Jez, 2020; Soslau et al., 2018). Therefore, TC learning of this critical practice may advance equity in their own practice. Yet, little is known about how secondary mathematics TCs learn key practices such as *Adaptive Teaching* while they co-teach in their early clinical

placements. Therefore, this study attempts to illuminate TC learning of *Adaptive Teaching* and seven other key practices while co-teaching in these early clinical placements.

# CHAPTER THREE METHODS

This chapter discusses the theoretical and analytical lens through which I viewed my study and the methods I used to analyze my data. I strove to better understand TC learning in early clinical practice by viewing TC learning through an activity systems lens. Utilizing an activity system helps conceptualize TC learning in the complex learning environment created by co-teaching in clinical practice.

## Activity Systems Model as Conceptual Framework

I have chosen the second-generation activity system model as a conceptual framework grounded in CHAT or the activity theory perspective. This perspective assumes that the context of an activity is not separate from the activity or from tools that mediate the activity. Tools, in this circumstance, is a general term used to refer to the elements that characterize the context of the learning (Sannino et al., 2009). This perspective is conceptualized through an activity systems model. This model provides researchers with a graphic depiction of a complex learning environment that they can use to communicate their findings (Yamagata-Lynch, 2010). For example, Campbell and Dunleavy (2016) used an activity systems model to describe teacher candidate learning in mediated field experiences. Their work establishes precedence for using the activity systems model in the context of clinical practice.

### *TC as the Subject of a Co-teaching Activity System*

I have chosen to describe TC learning while co-teaching using a co-teaching activity system model graphically depicted in Figure 3 (this figure is the same as the one shown in figure

1). An activity system model may consider three socio-cultural planes for analysis: the personal, the interpersonal, and the community plane (Yamagata-Lynch, 2010). However, Yamagata-Lynch (2010) advised that researchers need to bound the activity system so as not to be overwhelmed with contextual information that may be extraneous to their study. Further, Rogoff (1995) suggested that researchers consider only one plane of analysis and blur out the other planes. In keeping with these recommendations, my study identifies the TC as the subject and the TC's learning as the primary, organizing motive or object of co-teaching clinical placement. This designation is grounded in the empirical evidence that co-teaching modeled clinical practices promote TC learning in secondary settings (Morton & Birky, 2015; Soslau et al., 2019; Soslau et al., 2018; Thompson & Schademan, 2019). Roth et al. (2002) also supported this interpretation of the activity systems model. They used an activity system model to explore co-teaching and cited Lave (1993), who compelled researchers to focus on activity systems from a learner's perspective (Roth et al., 2002). Roth (2002) further stated that the other elements of the activity system essentially mediate the primary association between the subject (TC) and the object (TC learning) through community, tools (a distinct element of the activity system such as training), division of labor, and rules. Roth (2002) took an expansive view of a co-teaching activity system to address three main concerns: learning subject matter, learning to teach subject matter and collective responsibility for teaching and learning. However, I have chosen to frame a co-teaching activity system around TC learning consistent with Campbell and Dunleavy (2016), Lave (1993), and Rogoff (1995) and focus the activity system from a learner's perspective.

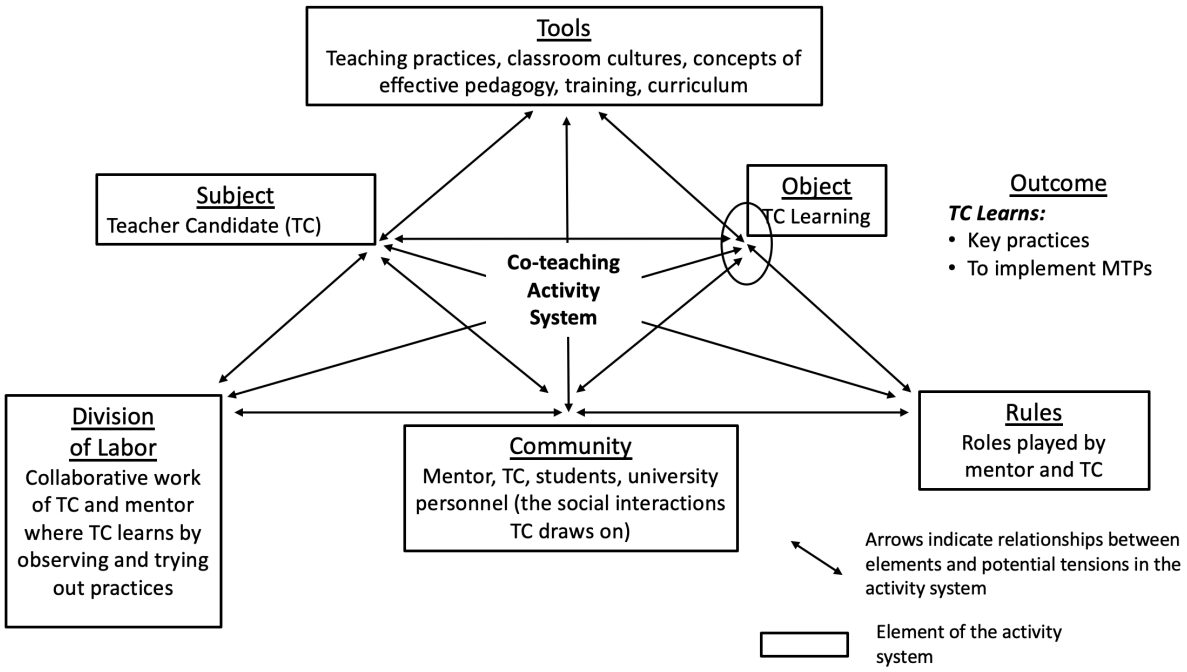
### *Adaptation of the Triangular Model*

Figure 3 is my graphical interpretation of a co-teaching activity system and is based on evidence in the literature that co-teaching in clinical practice creates a complex environment

where there are several learners (Hackett et al., 2019; Roth et al., 1999; Soslau et al., 2019). Consistent with Campbell and Dunleavy (2016), the object of the co-teaching activity system is TC learning. This model, therefore, considers how different elements interact when co-teachers support TC learning in clinical practice while co-teaching and how this interaction may impact TCs' implementation of MTPs in the secondary mathematics classroom. For example, the model conceptualizes how evidence of TC learning (object) of key practices might impact TCs' implementation of MTPs (outcomes) and how this evidence is facilitated by co-teaching and co-planning strategies (division of labor), mediating tools (training and professional development) and in the community of practice (community) established between the mentor and TC.

**Figure 3**

*Co-teaching Activity System*




Note: Adapted with permission from Campbell and Dunleavy (2016)

### *Elements of the Co-teaching Activity System*

Table 1 further articulates the co-teaching activity system elements. This table shows how I have aligned the co-teaching activity system elements with descriptions of these elements from sources in the literature. In keeping with Campbell and Dunleavy (2016), the object of the co-teaching activity system for this study is TC learning which is oriented toward a particular goal and is transformed to produce outcomes in the TC's clinical experience (Campbell & Dunleavy, 2016). When co-teaching is used in early clinical practice, outcomes are the practices the TC acquires in the course of their fieldwork (Campbell & Dunleavy, 2016). For my study, outcomes are evidence of TC learning of key practices described in the empirical literature and evidence of TC implementation of the MCOP2 constructs of *Student Engagement* and *Teacher Facilitation* in their observed teaching. These constructs measure of the degree to which TCs' teaching aligns with MTPs recommended by national organizations (Gleason et al., 2017).

**Table 1**

*Co-teaching Activity System Element Descriptions*

| Activity System Element | Description of Element from Literature | Description of the Co-teaching Activity System Element |
|---|---|---|
| Subject | The *subject* is the individual or groups of individuals involved in the activity (Yamagata-Lynch, 2010) | TC as the subject of the co-teaching activity system |
| Object | The *object* is the goal of the activity (Yamagata-Lynch, 2010) | TC Learning as the object or goal of the co-teaching activity system. |
| Tools | The *tool* includes social others and artifacts that can act as resources for the subject in the activity (Yamagata-Lynch, 2010). Anything used in the transformation process, including both material tools and tools for thinking (Kuutti, 1996) | Coursework and training materials that act as resources for the TC in the activity system |

**Table 1 (Continued)**

| Activity System Element | Description of Element from Literature | Description of the Co-teaching Activity System Element |
|---|---|---|
| Rules | The *rules* are any formal or informal regulations that, in varying degrees, can affect how the activity takes place activity (Yamagata-Lynch, 2010). The community establishes norms, conventions, or social traditions to govern its members (Engeström, 1999). | Roles that govern the community of the TC and mentor as the community in the activity system |
| Community | The *community* is the social group the subject belongs to while engaged in an activity (Yamagata-Lynch, 2010).<br><br>Campbell and Dunleavy (2016) describe this social group as those in the classroom. | TC and mentor as a collaborative community aimed at TC learning/growth |
| Division of labor | The *division of labor* refers to how the community shares tasks. The horizontal division of tasks is between the community members, and the vertical division of tasks addresses power and status issues (Engeström, 1987). | Co-teaching strategies that reveal how co-teachers divide labor amongst themselves. |
| Outcome | The *outcome* of an activity system is the result of the activity (Yamagata-Lynch, 2010). | Evidence of TC learning in the field such as key practices and observed teaching of MTPs |

## Purpose of the Study and Research Questions

This research study responds to the call for empirical research that explores better ways to organize clinical practice and addresses the coursework–fieldwork gap (Cochran-Smith et al., 2015; Weinberg et al., 2020). This study conceptualizes TC learning graphically through an activity systems model to explore how co-teaching in early clinical practice impacts TC learning of key practices and TCs' implementation of MTPs. Specifically,

1. Is there evidence of TC learning of co-teaching key practices in practicum placements?
2. Does TC learning of key practices impact their implementation of equitable MTPs in observations of TC teaching?

3. How does the community of co-teachers in a co-teaching-modeled practicum support TC learning?
4. What roles (rules) impact learning for TCs in practicum placements?
5. How Do co-teaching strategies (division of labor) in co-teaching modeled practicum support TC learning?
6. What contradictions impact TC learning?

## Philosophical Orientation

This study takes the theoretical perspective of activity theory which deals with the complex situational, social, and cultural dimensions of learning. This study explores TC s' perceptions of their learning in the context of their co-teaching experience during early clinical placements. Therefore, my epistemological approach to knowledge leans toward an interpretivist approach. The interpretivist researcher aims to focus their social inquiry on a perspective of persons and the subjective meaning of a complex action to provide insight into how an individual or group of people might make sense of a situation or phenomena they confront. (Crotty & Crotty, 1998).

## Research Design and Rationale

### *Research Design*

I used a convergent mixed-methods approach to my research design. Fetters et al. (2013) describe a convergent mixed methods approach as,

> … the qualitative and quantitative data are collected and analyzed during a similar timeframe. …qualitative and quantitative data collection occurs in parallel, and analysis for integration begins well after the data collection process has proceeded or has been

> completed. Frequently, the two forms of data are analyzed separately and then merged … (p. 2137).

Creswell and Guetterman (2019) also noted that researchers collect quantitative and qualitative data in a convergent design. Analysis of the data sets occurs separately, and then the researcher compares the results of the analysis of each set before interpreting the results. The strength of this method is that by integrating qualitative and quantitative data, the researcher can access knowledge and understanding less evident in either one or the other data sets (Moseholm & Fetters, 2017).

***Rationale***

My rationale in using a convergent mixed-methods approach is its suitability for studying complex learning environments. Specifically, Fetters et al. (2013) noted that mixed methods research provides a useful way of investigating complex systems. Clinical practices that use co-teaching have been described as complex learning environments (Roth et al., 1999; Soslau et al., 2019; Thompson & Schademan, 2019). Fetters et al. (2013) also advised that the convergent mixed methods approach uses different data sources to provide complementary results. In my study, the quantitative data provided a discrete picture of TCs learning while co-teaching through their knowledge of co-teaching, relationship with their mentor, and implementation of MTPs in terms of *Student Engagement* and *Teacher Facilitation*. The qualitative data provided evidence of TC learning, and quotations from TC reflections and observations which help to illuminate TC learning of key practices in their co-teaching in early clinical practice.

## Study Context

### *Practicum Class in Early Clinical Practice*

In cooperation with the university instructor, I participated as a teaching assistant and co-researcher for a secondary mathematics practicum class in the Fall of 2019 at a large research university in the Southeast. In this role, I observed TCs as they engaged in co-teaching with their assigned mentors in their practicum class. My role in these spaces was as a nonparticipant observer.

### *Participants and Selection Criteria*

Participants were selected based on their enrollment in the university instructor's practicum class. The practicum class required students to spend 60 hours in classrooms with a mentor, co-teaching, and co-planning. While not representative of the population, these participants provided helpful information about TC learning in early clinical practices that use co-teaching (Creswell & Guetterman, 2019).

### *Coursework of Participants*

All participants successfully completed their middle school or high school methods classes before their practicum class. In their methods courses, they were introduced to clinical practice with a mentor through an initial 10 hours of clinical practice.

### *Clinical Placement*

TC placements in the practicum required the candidates to demonstrate specific proficiencies and progress toward mathematics teaching practices. TCs placements in the practicum also required the candidates to work with mentors who were certified in mathematics and could model intentional mathematics practices for TCs. Additionally, mentors provided

some feedback to TCs about their performance. Therefore, practicum placements were considered clinical placements (L. Sabella, personal communication, May 15, 2021).

### *Mentor Selection*

Mentors were selected based on the state requirements that mentors have three or more years of successful teaching experience, are certified in the content area the TC is pursuing (middle school or high school mathematics), have completed clinical educator training, and have received a principal's recommendation as to effective or highly effective. The university at which this study occurred also requested mentors who understood Adult Learning Theory. In addition, mentors selected for this study completed a one-day CPCT training provided to them as part of the more extensive research study.

In addition, mentors who participated in this study had several program-specific characteristics. Mentors had prior experience as mentors with the university, expertise in mathematics education and, in some cases, co-teaching experiences. Several mentors had experience working specifically as mentors with the university instructor and her students in past practicum placements. When assigning mentors and TCs, the university instructor drew on her knowledge of these prior student placements to place participants with mentors while also considering geographic preferences of the participants.

### *Sample Size*

Eleven students enrolled in the practicum class used in this study. These TCs belonged to a homogeneous sample of individuals because all sought the same college degree and certification to teach mathematics. Of the 11 participants, eight completed the same number of observations (2) and reflections (7). These eight participants were assigned pseudonyms and

comprised the sample for this study. Names used in this study, therefore, do not reflect actual participant names in any way.

### *Sample Characteristics*

All eight participants were studying to earn a bachelor's in mathematics education in grades 6-12. Of the eight participants, five were female, and three were male. Towards their bachelor's in mathematics education, participants had to complete 70 hours of coursework consisting of professional education coursework (20 hours), specialization coursework (21 hours), and additional specialization coursework (24 hours). Participants enrolled in the practicum were in the additional specialization or final phase of their coursework immediately prior to their internship or final field placement. The demographics garnered were approximate age, gender, and education. Individual participants were all undergraduates in their early 20s. Five of the participants were female and three were male. Although the participants in this study differed by gender, they were also homogeneous because they were all undergraduate students pursuing their bachelor's degree in mathematics education.

### *Sampling*

The sampling used for this study was both convenience and purposeful. The sampling was convenience sampling since participants chosen for this study represented a ready and willing pool of TCs but are not representative of a population. The sampling was also purposeful sampling because the participants were all selected using the criteria that the individuals are all practicum students and engaged in field experiences that use co-teaching.

### *Training of Participants*

Participants attended a one-day CPCT training. This training was designed, implemented, and taught by faculty members of mathematics teacher preparation programs who are considered experts in their field.

## Data Collection

### *Timing of Data Collection*

For a convergent mixed methods designed study, qualitative and quantitative data collection occurs in a similar time frame (Moseholm & Fetters, 2017). Therefore, both types of data were collected simultaneously throughout the Fall 2019 semester. Additionally, I collected data from multiple sources to provide complementary sources of evidence of TC learning and the outcome of this learning. Data collection followed the schedule shown in Table 2.

**Table 2**

*Timeframe for Data Collection*

| Week beginning | Survey | Notes |
|---|---|---|
| Week 1 | Presurvey | |
| Week 3 | Reflection 1 | |
| Week 4 | MCOP2, Reflection 2 | First instance of MCOP$^2$ |
| Week 5 | Reflection 3 | |
| Week 8 | Reflection 4 | |
| Week 10 | JIT Survey | |
| Week 11 | Reflection 5 | |
| Week 12 | MCOP2, Reflection 6 | Second instance of MCOP$^2$ |
| Week 13 | Reflection 7 | |
| Week 15 | Post survey | |

### *Data Sources*

**Surveys.** Data garnered through surveys constitute one source of data for this study. Pre and post-survey data and Just-In-Time (JIT) survey data included Likert-scaled questions that generated quantitative data for this study. Pre and post-survey data also included open-ended

questions that generated qualitative data for this study. The schedule for survey administration is shown in Table 2.

**Coursework Materials.** Coursework materials included TC reflections relative to their co-teaching experience. Seven reflections for each TC spanned the semester. The schedule for these assignments is shown in Table 2.

**Observations.** Observations afforded the researchers first-hand experience with TCs in their co-teaching clinical practice activity and provided an alternate viewpoint for contextualizing their learning (Yamagata-Lynch, 2010). Two researchers collected field notes from observations of TCs at different points in time in their practicum. An observation protocol, the MCOP2, was used to measure the extent to which TCs implemented MTPs oriented toward the goal of conceptual understanding of mathematics as articulated in national organizational standards focused on mathematics teaching and learning (Gleason et al., 2017). The MCOP2 effectively examines teaching mathematics through the constructs of *Teacher Facilitation* and *Student Engagement*. Gleason et al. (2017) described these constructs this way:

> In the community of learners' framework, the role of the teacher as a facilitator is one who provides structure for the lesson, targets students' zone of proximal development (Vygotsky, 1978), and gives guidance in the problem-solving process (Polya, 1945, 1957) while promoting positive, productive discourse norms within the classroom (Cobb, Wood, & Yackel, 1993; Nathan & Knuth, 2003). Likewise, the role of student engagement includes actively participating in the lesson content, persisting through the problem-solving process, and productive discourse as an essential element for making the connections necessary for a conceptual understanding of mathematics. Neither of these roles and responsibilities thrives without the support of the other. Therefore, for a

mathematics classroom to fit strongly within this design framework, both teacher and students must fulfill their roles and responsibilities (p. 113).

## Data Quality

### *Qualitative Data Quality*

**Validity.** I selected data from different sources and used various methods to converge conclusions to ensure data collection and analysis accuracy. These data sources were linked to complementary elements of the activity systems model (Miles et al., 2014) and reflected constructs at work in early clinical placements that used co-teaching. Although this approach has been referred to as triangulation, Fetters et al. (2013) and Morgan (2019) advised eliminating triangulation as a term from research design due to its multiple meanings and lack of clarity and precision**.**

**Credibility.** I included peer debriefings as a credibility technique for this study. Frequent meetings with my peer allowed me to engage in discussions and interpretations and collaborative work, which provided external evaluation of my research (Liao & Hitchcock, 2018).

### *Quantitative Data Quality*

**Reliability**. Issues of reliability include the reliability of the observation protocol data and instrument or scale reliability. Concerning the scoring of the observation protocol, two researchers conducted several observations together and calculated their inter-rater reliability between .60 - .80. Additionally, sources of scale reliability of validated instruments are shown in Table 3. Further, when completing the MCOP2 form, the researchers used the descriptors outlined in the MCOP2 descriptors manual to maintain the instrument's reliability and the validity of the constructs (Gleason et al., 2015).

**Table 3**

*Data Sources and Reliability*

| Variable/Construct | Data Source | Reliability |
|---|---|---|
| Relationship & Communication | JIT survey | The single survey has a Cronbach's alpha of .96. |
| Teacher Facilitation | MCOP2 | The Teacher Facilitation subscale has a Cronbach's alpha of .85 (Gleason et al., 2017). |
| Student Engagement | MCOP2 | The Student Engagement subscale has a Cronbach's alpha of .90 (Gleason et al., 2017). |

**Validity.** Evidence of validity comes from two sources: internal validity and content validity. Concerning internal validity, the sample used in this study is a homogeneous group of TCs who enrolled in the university instructor's practicum class. There is no random assignment. Concerning content validity**,** a multi-institutional team of secondary mathematics education researchers who represent an expert panel developed the pre/post surveys and the JIT survey (Grady et al., 2020). Further, the MCOP2 is a validated instrument that aligns with two constructs: *Student Engagement* and *Teacher Facilitation* (Gleason et al., 2017).

## Data Analysis

### *Software Used for Analysis*

The software tools I used for data analysis were NVivo, Excel, and SPSS. First, I imported qualitative data into NVivo software and coded the data based on coding schemes articulated in Table 4. Subsequently, I used Nvivo, Excel, and SPSS to perform quantitative analysis of qualitative codes and quantitative analysis of constructs. I also used Excel to merge the data sets.

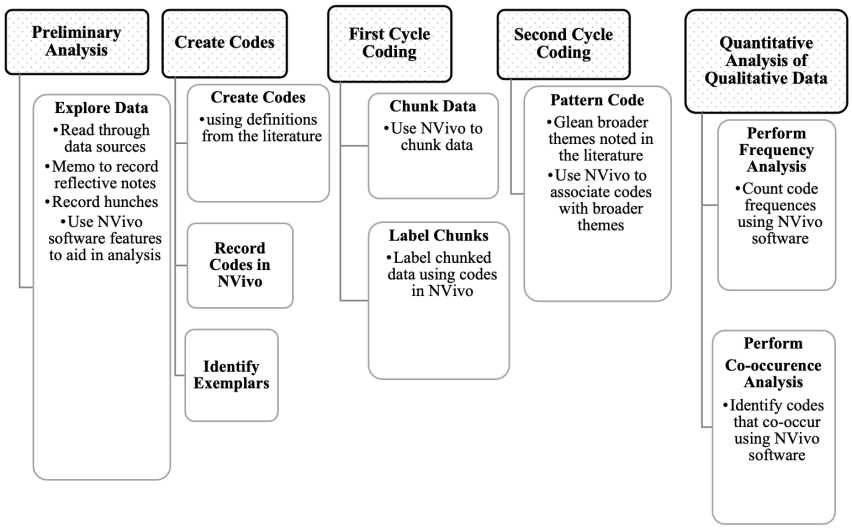
### *Data Analytic Details*

Data analysis is the process the researcher uses to make sense of the data collected by taking the data apart, looking at individual responses, and putting it back together to summarize the data (Creswell, 2002). Because this is a mixed-methods design, I used quantitative and qualitative analytic techniques to analyze my data (Creswell & Guetterman, 2019).

**Qualitative Data Analysis.** My overall approach to analyzing my qualitative data sources is summarized graphically in Figure 4. My approach consisted of five steps. These steps were first to conduct a preliminary analysis of my data sources to captures hunches and make notes. Second, I created codes and a codebook. Third I chunked data and labeled data using codes. Fourth, I looked for patterns in these codes and aligned subcodes with broader themes evident in the literature. Finally, I conducted frequency analysis and co-occurrence analysis on the codes to reduce the data and to capture the prevalence of patterns and themes (Namey et al., 2008). I detail these steps in the following sections.

**Figure 4**

*Qualitative Data Analysis Approach*



***Preliminary Data Analysis.*** To ascertain overall trends and patterns in qualitative data sources, I first conducted a preliminary exploratory analysis to establish an overall sense of the data. In conducting the initial exploratory analysis, I read through all qualitative sources and used memoing to record ideas and hunches that occurred to me as I explored the data (Creswell & Guetterman, 2019). I used NVivo software and its searching and memoing features to assist in this preliminary exploratory analysis process.

***Code Creation.*** Coding qualitative data is a process of segmenting or labeling the data to glean broad themes (Creswell & Guetterman, 2019). Saldaña (2021) advises that articulating a coding scheme before coding helps synchronize your study with your conceptual framework and aids in analyzing my research questions. Therefore, after exploring the data, I coded the data based on *a priori* coding schemes, which I derived from the literature (Grbich, 2012). These coding schemes are shown in Table 4 and align with elements of the co-teaching activity system. My coding, therefore, constituted a deductive approach to coding.

***First-cycle Coding Methods.*** In the first-cycle coding phase, codes are attached to "chunks" of data to detect recurring patterns (Miles et al., 2014). My first-cycle coding of the qualitative data followed descriptive coding methods because I assigned descriptive codes to chunks of the data to indicate the meaning in relation to my research namely TC learning while co-teaching (Linneberg & Korsgaard, 2019). Miles et al. (2014) further described descriptive coding as assigning "...labels to the data to summarize in a word or phrase the basic topic of the passage…" (p. 74). Miles et al. (2014) asserted that descriptive coding is appropriate for social environments, keeping with my study of a community of learners in a co-teaching clinical experience. These descriptive codes are words or phrases sourced from the literature which describe the bulleted themes in Table 4 (Miles et al., 2014; Saldaña, 2021)..

**Table 4**

*Alignment of the Activity System Element with the Data Source, Type, and Data Analytic Approach*

| Activity system element | Co-teaching Activity System Model | Data source | Type of data | Data analysis |
|---|---|---|---|---|
| Object | Evidence of TC learning | Short-answer survey responses and participant reflections, and field notes | Qualitative | Analyze short-answer survey responses, reflections, and field notes. Coding scheme based on TC learning described in (Soslau et al., 2015; Thompson & Schademan, 2019). These studies describe key practices mediated by CPCT include but are not limited to:<br>• Adaptive expertise<br>• Collaborative expertise<br>• Growth momentum<br>• Negotiating power |
| Tools* | Evidence transformed thinking | Pre/post survey responses indicating knowledge of CPCT | Quantitative | Descriptive and inferential statistics of Likert-scaled responses Knowledge of Co-planning (KCP) Knowledge of Co-teaching (KCT) constructs |
| Rules | Roles | Short-answer survey responses and participant reflections, and field notes | Qualitative | Analyze survey responses to roles perceived by TC that mentor plays. Coding scheme based on (Guise, Habib, et al., 2017). Mentor traits fall on a continuum described by the following categories:<br>• Traditional<br>• Blended<br>• Forward momentum<br>• Scaffold & grow |

**Table 4 (Continued)**

| Activity system element | Co-teaching Activity System Model | Data source | Type of data | Data analysis |
|---|---|---|---|---|
| Community | TC and mentor collaborative relationship aimed at TC learning/growth | Likert scaled survey responses on relationship and communication | Quantitative - Just-in-time (JIT) survey data indicating Relationship/Communication between TC and mentor | Descriptive and inferential statistics of *Relationship*/*Communication* construct from JIT survey |
| Division of labor | CPCT strategies used and preferred | Open-ended survey questions on CPCT strategies preferred by TC and why from pre/post surveys and reflections | Qualitative | Analyze survey responses to roles perceived by TC that mentor plays. Coding scheme based on (Guise, Habib, et al., 2017). Mentor traits fall on a continuum described by the following categories:<br>• Traditional<br>• Blended<br>• Forward momentum<br>• Scaffold & grow |
| Outcome | Implementation of Mathematics Teaching Practices | MCOP2 scoring of constructs *Teacher Facilitation, Student Engagement,* and Observation notes | Quantitative and Qualitative | • Descriptive and inferential statistics of *Teacher Facilitation* and *Student Engagement* constructs.<br>• Coding of field notes for evidence of TC learning (see Object) |
| Contradictions | Tensions | Reflections | Qualitative | Coding is based on Yamagata-Lynch and Haudenschild (2009), who cited Engestrom's (1987) four levels of inner contradictions in activity systems.<br>• Primary<br>• Secondary<br>• Tertiary<br>• Quaternary |

*Note: Element not addressed in this stud

***Second Cycle Coding Methods.*** In second-cycle coding, I used pattern coding by combining first-cycle codes to glean a sense of the patterns evident in the data (Saldaña, 2021). Pattern coding is a specific process by which first cycle codes are used to reveal patterns, categories, or constructs and has the important function of helping the researcher form a more integrated schema (Miles et al., 2014; Saldaña, 2021). These categories are the broader themes in the literature, such as the type of learning that was evident, the roles the mentor played, and the category of co-teaching a TC's perception might be indicating.

***Quantitative Analysis of Qualitative Data.*** In addition to pattern coding, I conducted quantitative analyses of the coded qualitative data to further expose patterns in the data. To discern these patterns, I performed two types of data analyses on the qualitative data: frequency analysis and co-occurrence analysis (Namey et al., 2008). Frequency analysis involves counting the frequency of words or phrases to identify larger patterns in the qualitative data. Code frequencies revealed how codes were distributed in the data set. Besides code frequencies, I also calculated the relative percentages of codes. Namey et al. (2008) also suggest calculating the presence of a theme. Presence refers to how many participants mention a theme out of total participants. Namey et al. (2008) assert that the presence of the theme is a better gauge of the importance of a theme rather than how frequently the theme is coded. Applying two or more codes to a data segment also describes co-occurrence (Namey et al., 2008). Codes that are grouped or co-occur at higher frequencies suggest co-occurrence of themes and may be evidence of inter-relationships between the themes or codes (Namey et al., 2008). Where appropriate, I also analyzed co-occurrence patterns.

***Contradictions.*** One noteworthy aspect of a complex learning environment is the inherent tensions that arise from the elements of the activity system (Yamagata-Lynch, 2010).

The arrows in Figure 3 represent these tensions and can reveal contradictions inherent in an activity system. These contradictions and tensions can "…affect the subject's ability to attain the object by taking a role as an obstacle, making it difficult for the subject to attain the object..." (Yamagata-Lynch, 2010, p. 3). These tensions can ultimately lead to dramatic changes in the activity system. Primary contradictions, for example, refer to instances when the participants in an activity such as co-teaching encounter multiple value systems within an element of the system that generates conflict and cause tension (Yamagata-Lynch & Haudenschild, 2009). In clinical practices that use co-teaching, researchers have suggested that how power and identity are negotiated may present obstacles to effective co-teaching (Soslau et al., 2015). These issues could be evident in the form of tensions in TC reflections. Therefore, to capture evidence of tensions, I coded TC reflections for tensions to explore further how contradictions impacted the co-teaching activity system.

### Quantitative Data Analysis

***Cleaning the Data.*** Sources of quantitative data included surveys and observational protocols that employed Likert scales for scoring responses. I inspected the data for structural issues and missing values. Of the 11 participants, three were missing either reflections or observations and were deleted from the dataset.

***Descriptive Statistics.*** I used descriptive statistics to summarize the overall trends or tendencies in the data. These summaries revealed how varied constructs and variables were in terms of normality of the data set and indicated where data points stood relative to others (Creswell, 2002). Therefore I used these descriptive statistical summaries to determine central tendency (mean, median, mode) and variability (variance, standard deviation, range) of quantitative data sets.

***Inferential Statistics.*** Inferential statistics allowed for the comparison of variables or groups of a single variable in an element of the activity system. Consequently, I used inferential statistics to compare variables and groups within the elements of the co-teaching activity system. For example, by comparing sets of variables or groups of TCs on a single variable within an element, I attempted to illuminate trends in the data and characterize further the elements of the activity system and the activity system as a whole.

### *Data Integration*

The process by which the quantitative and qualitative data come together characterizes mixed methods research (Creswell & Guetterman, 2019; Moseholm & Fetters, 2017). Therefore, in this section, I discuss the data integration techniques I used as part of the data analysis phase of my research.

**Data Integration by Merging.** In a convergent design, the researcher collects, analyzes, and compares the quantitative and qualitative data during a similar timeframe. One way of linking the quantitative and qualitative data is by merging. Merging refers to how the two data sets are brought together for analysis and comparison (Fetters et al., 2013). I merged my quantitative and qualitative data using an approach described as a simultaneous bidirectional approach. Moseholm and Fetters (2017) define this approach as framing simultaneously the quantitative and qualitative data to direct the final interpretation of the data. The bidirectional process is an integration method that employs a "two-way" lens where the researcher can frame or provide a detailed sketch of the data using both the quantitative and qualitative perspectives. The researcher may go from the quantitative elements to the qualitative aspects and back to the quantitative elements of the data (Moseholm & Fetters, 2017). Moseholm & Fetters further recommend displaying the data in matrix form so that quantitative survey categories can be

compared with qualitative themes. According to Miles & Huberman (2014), a matrix helps researchers organize their data in a condensed "at-a-glance" form for reflection and interpretation (Miles & Huberman, 2014, p. 91).

***Merging Matrix.*** Table 5 is an example of the merging matrix I used in data analysis. A merging matrix was instrumental in detecting patterns in the data because it allowed me to order data cases or constructs to note patterns and themes. Miles & Huberman (2014) describe matrices as a tool for ordering data by cases or constructs, which permits a "good look" in analyzing influences and effects. When used to order cases (cases represent TCs), a merging matrix helped me detect differences in high, medium, and low cases, make contrasts and comparisons, note patterns, and identify extreme cases. A case-ordered matrix therefore, was fundamental to discerning my next step in understanding what was occurring across the cases. I used Excel software to build several merging matrices and order cases by variables or constructs.

**Table 5**

*Merging Matrix Data Analysis Table*

| Subject | Rules | Community | Outcome | Outcome |
|---|---|---|---|---|
| TC1<br><br><br><br>TC1<br>TC2.... | Continuum Category | Relationship with Mentor | Frequencies of Key Practices and Co-occurrences of Key Practices | Teacher Facilitation (TF) and Student Engagement (SE) Scores |

## Limitations

This study has several limitations. These limitations constrain the generalizability of the results of this study. However, findings may inform future studies with similar participant populations.

### *Data sources*

The data I used for this study came from a more extensive research study that was already underway when I joined the effort. The more extensive research study had already designed the method of data collection. Although I participated as a researcher in this more extensive research study, I did not participate in its initial design. Therefore, the data sources were, for the most part, predetermined.

### *Positionality*

I position myself as a nonparticipant observer. However, I acknowledge that my earlier experiences as a novice teacher influence my ability to be objective and may present the possibility of bias. As a new mathematics teacher in a rural public school in Arizona, I found identity and support in a vibrant community of practice within my district and within a broader professional community that included the University of Arizona. This community encouraged several collaborative experiences in their novice teacher training that set me up for success in subsequent years. I often reflect on my experiences from Arizona and the exciting possibilities of universities and school districts working collaboratively together.

### *Limited Observations*

This study is based on observations and data collection from one teacher preparation program and therefore the sample size is small and is not generalizable given that there is no external validity to other studies. However, there may be some population generalizability based on similar participants in similar contexts.

### *Mentor selection*

Districts primarily controlled the selection of mentors who worked with TCs. Thus, the researchers had limited control over this aspect of the study.

## Delimitations

### *Voices*

Due to my methods and design, which explores the perceptions of TCs, I have left out essential voices, namely the mentor and the university supervisors of the co-teaching community.

### *Self-reported Data*

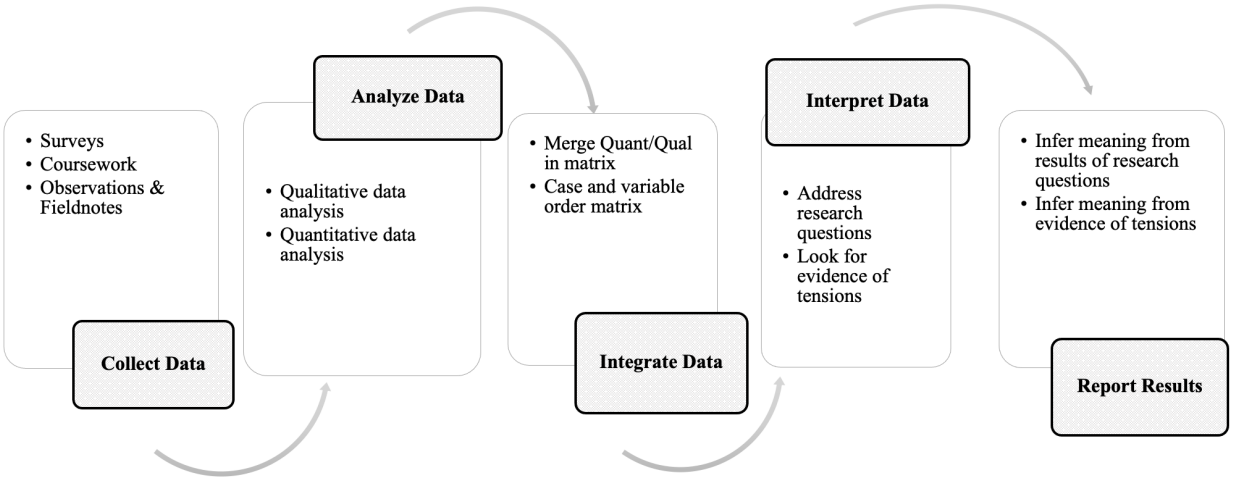
Data collection involved collection using surveys administered via Qualtrics. One drawback of using surveys is that they involve self-report data. Self-report data impacts the ability of a researcher to verify the accuracy of the responses (Fowler Jr, 2013).

## Overall Systemic Approach

Figure 5 illustrates this study's systematic approach to data collection, analysis, and reporting. This study uses a convergent mixed-methods approach to analyze quantitative and qualitative data collected during a semester-long practicum class.

**Figure 5**

*Systemic Approach to Data Collection, Analysis, and Reporting*



## Summary

This chapter presents the theoretical and conceptual perspectives and methods I used to study TC learning while co-teaching in early clinical practice. I aimed to better understand TC learning in early clinical practice by viewing TC learning through a co-teaching activity systems lens. Using a co-teaching activity system helped conceptualize TC learning in the complex learning environment created by co-teaching in clinical practice. This study used a convergent mixed methods approach whereby both quantitative and qualitative data were collected, analyzed separately, and then merged graphically using a merging matrix for interpretation and reporting.

# CHAPTER FOUR RESULTS

This study analyzed data collected from TC practicum placements modeled on co-teaching. The data were framed through the conceptual lens of a co-teaching activity system and analyzed using a mixed-methods approach. Findings reveal evidence of TC learning of all eight key practices associated with co-teaching during clinical experiences for teacher preparation. Additionally, correlational analysis suggests a strong positive association between the number of instances of the key practice of *Adaptive Teaching* (AT) coded in TC reflections and observations and the MCOP2 construct of *Student Engagement*. Further, TCs who report more instances of the key practice of AT also perceive their mentors as being more collaborative and feel more comfortable communicating their ideas to their mentors.

The following sections address each of the research questions. For each question, I first present the quantitative analysis of qualitative data (i.e., codes) to sharpen and focus any patterns in the data. Then, I present qualitative data to corroborate these patterns (Miles et al., 2014; Namey et al., 2008).

## Research question One. Is There Evidence of TC Learning of Co-Teaching Key Practices in Practicum Placements?

### *Summary of Findings*

Coding of data sources for key practices revealed evidence of TC learning of all eight key practices associated with co-teaching during the practicum placements. *Sharing Authority* (ShA) and *Collaborative Expertise* (CE) were the most frequently coded key practices. Additionally,

several key practices co-occur. Notably, ShA often co-occurs with *Growth Competence* (GC), CE, and AT.

### *Quantitative Analysis of Qualitative Data*

Quantitative analysis of qualitative data revealed patterns in the data that suggest TCs reporting higher instances of certain key practices. I conducted two types of data analyses on the qualitative data to discern these patterns: frequency analysis and co-occurrence analysis (Namey et al., 2008). I present the frequency analysis first. Following frequency analysis, I show the exemplars of key practices from the data set and descriptions of each key practice from the literature. Similarly, I present the co-occurrence analysis second. Following co-occurrence analysis, I show the exemplars from the data set.

**Frequency Analysis.** I used code frequencies to discern patterns in the data relative to key practices. For example, code frequencies revealed how codes appeared in the data set. Table 6 displays percentages by key practice of code frequencies that occurred in my analysis of reflections and researcher field notes.

**Table 6**

*Frequency of Codes by Key Practice*

| Key Practice | Total Codes Assigned | Percent of Total Codes |
|---|---|---|
| Co-mentoring (CM) | 3 | 1% |
| Negotiating Difference (ND) | 7 | 1% |
| Coaching In The Moment (CIM) | 46 | 8% |
| Growth Competence (GC) | 55 | 10% |
| Adaptive Teaching (AT) | 63 | 11% |
| Immersion in Real World (IRW) | 79 | 14% |
| Collaborative Expertise (CE) | 139 | 25% |
| Sharing Authority (ShA) | 168 | 30% |
| Total | 560 | 100% |

Table 6 reveals that all key practices appeared in the data set; ShA and CE were the most frequently coded key practices, while CM and ND were the least frequently coded key practices.

Namey et al. (2008) suggest calculating the presence of a theme. Presence refers to how many participants mention a theme out of total participants. Namey et al. (2008) add that presence of the theme is a better gauge of the importance of the theme rather than the frequency the theme is coded. Table 7 displays the presence of the key practices and reveals that all participants reported 75% of the key practices described in the empirical literature. Presence analysis of key practices further suggests that CM and ND were less present in the practicum than the other six.

**Table 7**

*Presence of Key Practices*

| Key Practice | Percent of participants (n=8) coded for key practice | Fraction of participants (n=8) coded for key practice |
|---|---|---|
| Co-mentoring (CM) | 25% | 2/8 |
| Negotiating Difference | 50% | 4/8 |
| Adaptive Teaching (AT) | 100% | 8/8 |
| Collaborative Expertise (CE) | 100% | 8/8 |
| Coaching in the Moment (CIM) | 100% | 8/8 |
| Growth Competence | 100% | 8/8 |
| Immersion in Real World (IRW) | 100% | 8/8 |
| Sharing Authority (ShA) | 100% | 8/8 |

Code frequencies also help determine differences in the distribution of key practices among participants (Namey et al., 2008). Table 8 displays the raw counts of coded phrases associated with each key practice and participant. For example, Table 8 shows that 560 segments emerged from the data set.

**Table 8**

*Frequency of Code References for Key Practices by the Participant*

| Key Practice / Cases | AT | CE | CIM | CM | GC | IRW | ND | ShA | Total |
|---|---|---|---|---|---|---|---|---|---|
| Fiona | 13 | 19 | 4 | 1 | 10 | 14 | 1 | 23 | 85 |
| Brianne | 8 | 24 | 3 | 0 | 5 | 12 | 0 | 24 | 76 |
| Carl | 8 | 20 | 7 | 0 | 6 | 4 | 0 | 21 | 66 |
| Carla | 5 | 16 | 3 | 0 | 8 | 17 | 2 | 15 | 66 |
| Cesar | 7 | 18 | 13 | 0 | 6 | 5 | 0 | 13 | 62 |
| Ellen | 10 | 11 | 7 | 0 | 6 | 9 | 1 | 31 | 75 |
| Gary | 8 | 14 | 6 | 0 | 6 | 5 | 3 | 20 | 62 |
| Jamie | 4 | 17 | 3 | 2 | 8 | 13 | 0 | 21 | 68 |
| Total | 63 | 139 | 46 | 3 | 55 | 79 | 7 | 168 | 560 |

To help discern patterns, Table 9 presents the frequency as a proportion of total codes. This presentation helps to compare the relative frequency of key practices within the dataset. Percentages in Table 9 reveal how evidence key practices appeared among the participants and across the data set. For example, Fiona's data sources generated the most codes while Cesar and Gary generated the least codes. Also, ShA and CE were the most frequently coded key practices, while CM and ND were the least coded.

**Table 9**

*Frequencies as Proportions of Total Codes*

| Key Practice / Cases | AT | CE | CIM | CM | GC | IRW | ND | ShA | Total |
|---|---|---|---|---|---|---|---|---|---|
| Fiona | 2.3% | 3.4% | 0.7% | 0.2% | 1.8% | 2.5% | 0.2% | 4.1% | 15.2% |
| Brianne | 1.4% | 4.3% | 0.5% | 0.0% | 0.9% | 2.1% | 0.0% | 4.3% | 13.6% |
| Carl | 1.4% | 3.6% | 1.3% | 0.0% | 1.1% | 0.7% | 0.0% | 3.8% | 11.8% |
| Carla | 0.9% | 2.9% | 0.5% | 0.0% | 1.4% | 3.0% | 0.4% | 2.7% | 11.8% |

**Table 9 (Continued)**

| Key Practice / Cases | AT | CE | CIM | CM | GC | IRW | ND | ShA | Total |
|---|---|---|---|---|---|---|---|---|---|
| Cesar | 1.3% | 3.2% | 2.3% | 0.0% | 1.1% | 0.9% | 0.0% | 2.3% | 11.1% |
| Ellen | 1.8% | 2.0% | 1.3% | 0.0% | 1.1% | 1.6% | 0.2% | 5.5% | 13.4% |
| Gary | 1.4% | 2.5% | 1.1% | 0.0% | 1.1% | 0.9% | 0.5% | 3.6% | 11.1% |
| Jamie | 0.7% | 3.0% | 0.5% | 0.4% | 1.4% | 2.3% | 0.0% | 3.8% | 12.1% |
| Total | 11.3% | 24.8% | 8.2% | 0.5% | 9.8% | 14.1% | 1.3% | 30.0% | 100.0% |

In Table 10, row percentages reveal the distribution of codes for each participant across the eight key practices. Noteworthy is that Brianne, Carl, Ellen, and Gary had higher instances of ShA.

**Table 10**

*Row Distribution of Codes by Key Practice for Each Participant*

| Key Practice / Cases | AT | CE | CIM | CM | GC | IRW | ND | ShA | Total |
|---|---|---|---|---|---|---|---|---|---|
| Fiona | 15.3% | 22.4% | 4.7% | 1.2% | 11.8% | 16.5% | 1.2% | 27.1% | 100.0% |
| Brianne | 10.5% | 31.6% | 4.0% | 0.0% | 6.6% | 15.8% | 0.0% | 31.6% | 100.0% |
| Carl | 12.1% | 30.3% | 10.6% | 0.0% | 9.1% | 6.1% | 0.0% | 31.8% | 100.0% |
| Carla | 7.6% | 24.2% | 4.6% | 0.0% | 12.1% | 25.8% | 3.0% | 22.7% | 100.0% |
| Cesar | 11.3% | 29.0% | 21.0% | 0.0% | 9.7% | 8.1% | 0.0% | 21.0% | 100.0% |
| Ellen | 13.3% | 14.7% | 9.3% | 0.0% | 8.0% | 12.0% | 1.3% | 41.3% | 100.0% |
| Gary | 12.9% | 22.6% | 9.7% | 0.0% | 9.7% | 8.1% | 4.8% | 32.3% | 100.0% |
| Jamie | 5.9% | 25.0% | 4.4% | 2.9% | 11.8% | 19.1% | 0.0% | 30.9% | 100.0% |
| Total | 11.3% | 24.8% | 8.2% | 0.5% | 9.8% | 14.1% | 1.3% | 30.0% | 100.0% |

Quantitative analysis of qualitative data revealed interesting patterns. For example, the data indicates higher instances of certain key practices in the data set. For instance, ShA and CE

appeared most frequently. Similarly, some participants were coded higher for certain key practices; for example, Brianne, Carl, Ellen, and Gary reported higher instances of ShA than the other participants. To better discern these patterns in the qualitative data, a definition of each key practice follows along with exemplars by subcode for each key practice.

**Exemplars.** Following are descriptions of each key practice, their presence, and exemplars by each subcode as they appeared in the data set. The exemplars from TC reflections and researcher observations demonstrate how codes aligned with the empirical literature (Soslau et al., 2015; Thompson & Schademan, 2019).

***Adaptive Teaching (AT).*** The key practice of AT involves TCs learning adaptive teaching expertise, which "enables a teacher to modify their planned instruction based on pupil cues in real-time, adjust scripted curriculum guides to serve contextual demands, and balance experimental teaching approaches with risks to pupil learning and well-being" (Soslau, 2012)**.** Table 11 shows the presence of the key practice AT by subcodes identified in the literature. Results show that AT in response to student cues is the most prevalent form of AT.

**Table 11**

*Presence of AT*

| Key Practice Sub-coding | Percent of participants coded for key practice (n=8) | Fraction of participants coded for key practice |
|---|---|---|
| AT-balancing | 63% | 5/8 |
| AT-other | 13% | 1/8 |
| AT-contextual demands | 75% | 6/8 |
| AT-student cues | 100% | 8/8 |

AT-balancing (AT-b) refers to TCs learning to balance experimental teaching approaches, such as allowing a TC to teach for the first time, with perceived risks to student learning. For example, Ellen noted the following:

> I noticed that a lot of the same students were participating. Therefore, [my mentor] helped me call on students when the participants started to slow down. I am still learning names so I was happy for [my mentor's] help… (Ellen)

In this excerpt, Ellen reflects on how her mentor adapts their plan of instruction by helping Ellen call on students whose names she had not learned. This form of adaptive teaching balances Ellen's need to gain valuable solo teaching experience with the risks to students whose names she had not yet learned and therefore could not easily call on. As a result, Ellen learns to prioritize student learning over her learning as she teaches for the first time.

AT-contextual demands (AT-C) refer to TCs learning to adapt scripted instruction based on contextual demands. For example, Fiona states:

> …this class period started off a little shaky because [my mentor] got mad at her students because when they came into her classroom they were going crazy. They kept shouting and saying inappropriate things and running around the classroom instead of taking their seats and getting all of their supplies out and being prepared when [my mentor] walked into the classroom. So since they didn't do this [my mentor] spent the first 5 to 10 minutes lecturing them and then I started the lesson… (Fiona)

In this excerpt, Fiona reflects on how she learns how her mentor responds to the contextual demand of an unruly class and how she adapts their planned teaching by "lecturing" her students. Further, this move demonstrates to Fiona how her mentor changes the classroom climate by giving students time to settle down and prepare for instruction. Brianne also reflected on how she learns how her mentor responds to an unruly class by changing his scripted instruction to include a pop quiz :

> ….I don’t know if it was because of lunch or what, but these students were non-stop talkative the entire time. [My mentor] even sent one of his students to the classroom next door because he was being so disruptive. [My mentor] did a good job of getting their attention most of the time, but as soon as he gave them time to work alone or figure out a problem by themselves they were right back at it. Right after the [bellwork], [my mentor] looked at me and said watch this. He stood up and said, “Okay class take out a sheet of paper were going to take a quiz.” The whole class went silent. He said again, “Come on now, you guys want to talk through the whole period we’ll just take a quiz.” They all sat up straight and a couple students started begging to not take a quiz. If he didn’t have the student’s attention before he did now… (Brianne)

In this excerpt, Brianne learns how her mentor uses humor and the offer to take a quiz to change the climate in his classroom. In these reflections, Brianne and Fiona observed their mentors managing demanding classroom situations and the adaptive strategies they employed to change the climate so that student learning could progress.

AT-student cues (AT-SC) refer to TCs learning to adapt teaching in response to their students’ cues. For example, Cesar stated:

> …my last lesson was on scatter plots. The lesson was very simply, only adding one new step to what the students already have learned. This new step was drawing a trend line through the scatter plot. After explaining and demonstrating a trend line we used examples on the board and had students walk up to the board and draw the trendline themselves. Everything in the lesson was going great until we had to write an equation of the trendline. The students showed confusion when no one wanted to volunteer or answer any of my guiding questions. At this point, my teacher told me to explain to the students

> how to write [an] equation for a line on a completely different example. I started a different example from scratch and made sure that by the end of class the students were not lost anymore… (Cesar)

In this excerpt, Cesar reflects on how he learns that the instructional step from drawing a line through a scatterplot to writing the equation of that line requires more scaffolding for his students. With his mentor's help, he learns to quickly adapt his teaching to include a mini-lesson on how to write the equation of a line. By making this quick adaptation, he ensures student learning in real time by responding to student cues -- namely their silence and unwillingness to participate on the heels of what he perceives to be an otherwise very engaging lesson.

Several TCs reflected more generally how they witnessed how their mentors adapted lessons throughout the day as they learned what worked and what they needed to change from class to class to meet the needs of their students. For example, Carla reflected,

> It was nice to see the same lecture back-to-back because if something didn't work for the previous period, then [my mentor] would change it for the next one. I think it's interesting how teachers have to stay on top of things in their classroom and think of different strategies very quickly. (Carla)

This excerpt reveals how Carla notices how her mentor changes her instruction based on what worked for each period. Carla learns that instead of teaching the same lecture to each period, she must be willing to "change it" in response to the needs of her students.

Evidence of TC learning of AT in their practicum spanned four subthemes. These subthemes were adaptive teaching based on balancing their learning with student learning, contextual situations such as an unruly classroom, and student cues such as adapting teaching by incorporating a mini-lesson to scaffold student learning. Additionally, evidence revealed TCs

valued learning how their mentors adapted their teaching from period to period based on different groups of students' needs.

***Collaborative Expertise (CE).*** CE is a key practice associated with co-teaching that involves TCs learning productive collaboration that results in sharing expertise or learning to share teaching space and recognizing their co-responsibility for student learning (Soslau et al., 2015). CE is also associated with what Soslau et al. (2019) noted as participation in professional development communities. Soslau et al. (2019) caution TCs who struggle to learn competencies associated with collaborative expertise may find it challenging to participate in future professional learning communities. Table 12 shows the presence of the key practice CE by subcodes. Results show that all TCs engaged in CE while practicing co-responsibility for student learning, sharing teaching space, and planning curriculum but only half engaged in CE while evaluating instructional approaches.

**Table 12**

*Presence of CE*

| Key Practice Sub-coding | Percent of participants coded for key practice (n=8) | Fraction of participants coded for key practice |
|---|---|---|
| CE-Evaluate Instructional Approaches | 50% | 4/8 |
| CE-Share Teaching Space | 100% | 8/8 |
| CE-Planning Curriculum | 100% | 8/8 |
| CE-Co-responsible for Student Learning | 100% | 8/8 |

CE-Evaluating Instructional Approaches (CE-EIA) refers to TCs learning to evaluate their or their mentor's instructional approaches. For example, Fiona reflected on one of her first teaching experiences and wrote:

> The lesson I taught yesterday was on Inequalities. I was a little nervous to teach for the first time because I had never taught students who didn't even know the basics of algebra

> so I wanted to make sure I taught them the new material in a way that they would understand it. [My mentor] and I talked about the best way to teach the lesson and came up with a foldable… (Fiona)

In this excerpt, Fiona reflects on the challenging dilemma she perceives of teaching algebraic concepts to students who are just learning algebra. First, she shares her concern with her mentor about teaching inequalities in a way her students would understand. Then, Fiona describes how she collaborates with her mentor and learns how to present new ideas so that her students can "understand it" by using graphical organizers and specifically a "foldable." This excerpt shows how Fiona learns to use student-centered instructional approaches while teaching algebra to students new to the subject.

CE-Sharing Teaching Space (CE-STS) refers to the TC leaning to share teaching space with another teacher. Instances of CE-STS in TC reflections capture the co-teachers implicitly bouncing the instructional ball back and forth while co-teaching and making in-the-moment instructional decisions in response to student cues for clarification. For example, in the following excerpt from one of Brianne's (TC) observations, she and her mentor (mentor) were captured collaboratively assisting each other in setting up the lesson and making sure students have adequate time:

> ...TC hands out white boards and tissues to clean white boards. Students and mentor continue to hand out graded papers....TC addresses the class and [mentor] is at the Elmo and TC explains they are going to play Jeopardy... The first group picks a question and TC explains that she is just looking for the coordinates. ... Groups proceed to work on the problem using their whiteboards. Mentor and TC walk about the room. Mentor calls time [but] only 2 groups have completed it. TC asks if they had enough time and group says

> no... mentor gives the groups 2 minutes and asks for just the coordinates. All groups are working on the problem. (Brianne's observation field notes)

This excerpt from Brianne's observation shows the co-teachers using an electronic Jeopardy game to review for an assessment. The mentor is keeping a timer, but Brianne checks with groups to see if more time is needed. When students reply they need more time, the mentor responds to this cue and provides an extra two minutes, and all groups refocus on tackling the problem. The simple affordance of more time comes about because Brianne elicits authentic student feedback on time constraints. This example of sharing the teaching space by the co-teachers demonstrates how Brianne is learning to share equitably in the duties of teaching while also eliciting critical feedback from students about the time they need to complete a problem.

CE-planning curriculum (CE-PC) refers to TC learning to collaboratively plan curriculum in a way that allows co-teachers to share ideas, advice, and support. For example, Fiona stated,

> …[My mentor] and I met this past Sunday to plan for this upcoming week and this is when she told me she was going to let me teach her 3rd period class on Monday. I was the lead teacher for the lesson and [my mentor] was going to throw in things when she felt she needed to. (Fiona)

In this excerpt, Fiona reflects on co-planning with her mentor. She notes how she learns that her mentor will be letting her be the "lead teacher for the lesson," but she also learns how her mentor will not be forcing her to teach solo but will "throw things in when she felt she needed to." This exchange shows the mentor assuring support while in an assist role even though Fiona is the "lead teacher." This excerpt captures Fiona's learning that collaborative expertise involves sharing ideas and supporting one another by supporting one another during co-teaching.

CE-Co-responsible for Student Learning (CE-CO) refers to TC learning to be co-responsible for student learning. For example, Fiona explicitly reflects on one instance of how she and her mentor share in being co-responsible for their students' learning:

> There were three things that happened when a student did not understand the subject matter. The first thing that would happen is, depending on the period, their classmate sitting next to them would often times lean over and show them how to do the problem or further explain what the teacher was teaching. Another thing that would happen is [my mentor] would ask the student what they were having trouble with and then go into detail about that particular part or give examples of that particular part that would help the student understand. The last thing that would happen if a student didn't understand part of the material is that I would go over to that student and explain and help them with the problem while [my mentor] would continue teaching. This allowed [my mentor] to continue on with the lesson and make sure she got everything done that she wanted to get done while I helped the student (Fiona)

In this quote, Fiona reflects on how she and her mentor share responsibility for their students' learning. She learns that she can provide individualized support to a student who is struggling as a co-teacher. In contrast, Brianne reflects on what occurs when her mentor offers individualized support for a student in the middle of instruction:

> …the second problem was a little more tedious and involved multiple steps and factoring. The class was hesitant at first to raise hands to solve, [my mentor] put the class at ease saying he would help them through it if someone volunteered. A young girl in the back picked up her notebook and walked to the front to solve the second problem. [My

mentor] helped the young girl fight through each step while I walked around the classroom to ensure the rest of the class understood and was on task. (Brianne)

In these two reflections, Brianne and Fiona describe learning how to take co-responsibility for student learning by collaboratively assuming responsibility for students individually or as a whole class.

Evidence of TC learning of CE reveals TCs working with their mentors to evaluate appropriate instructional approaches for students, sharing teaching space with others, planning curriculum, and assuming co-responsibility for student learning as a co-teacher in the classroom space.

***Coaching In The Moment (CIM).*** CIM is a key practice associated with co-teaching that involves TC learning through what Tobin (2006) described as an instance of "ad hoc co-generative dialogue" (p. 139). When engaged in CIM, TCs learn to respond to and offer a "quick fix" to an imminent issue related to student learning. I found instances of CIM primarily in observation field notes where the researchers had the opportunities to observe co-teachers as they worked collaboratively in the classroom. CIM instances are characterized as being carried out in public and in the moment where the co-teachers model for students how to work collaboratively together (Thompson & Schademan, 2019). Table 13 shows the presence of the key practice CIM. Results show that all TCs engaged in CIM through collaborative dialogue, but fewer engaged in CIM through student cues, observation, or in response to authentic student input.

**Table 13**

*Presence of CIM*

| Key Practice Sub-coding | Percent of participants coded for key practice (n=8) | Fraction of participants coded for key practice |
|---|---|---|
| CIM-Authentic student input | 50% | 4/8 |
| CIM-Observation | 62.5% | 5/8 |
| CIM-Student cues | 87.5% | 6/8 |
| CIM-Collaborative Dialogue | 100% | 8/8 |

CIM-student cues (CIM-SC) refers to TCs learning from coaching moments that occur in front of students and involve the co-teachers assessing formatively student needs based on student cues. For example, I observed Jamie teaching a lesson on determining the constant of proportionality from a table of values. In the following excerpt, Jamie (TC) is the lead teacher and guiding students through several example problems consisting of tables of values:

> … TC goes on to the next one … and asks if this one is proportional? Some students say yes some say no.. TC says why do you say that? Can we multiply by fractions? One student yells out 1/3.. Another student offered to divide y by x.. student says he got lots of 6s.. students continue to struggle to understand how find the constant … mentor suggests that they try another ordered pair and TC says let's do that and multiply 9 *(2/3).. several students participate in this discussion proving that the constant is 2/3. mentor offers how do we set this up equation wise? Students offer y=2/3*x .. TC asks if this is the same as y=2x/3? And students say yes... (Jamie's observation field notes)

This excerpt from observing Jamie's first teaching experience shows that Jamie uses questioning to encourage student thinking, but students seem to struggle. In the moment, her mentor suggests she try "another ordered pair," and Jamie responds, "let's do that." Her mentor continues to offer coaching by modeling questioning and then returns control to Jamie. By engaging in these

coaching moments, Jamie learns to be responsive to her mentor's suggestions which are grounded in cues from students who struggle with the first ordered pair Jamie uses.

CIM-collaborative dialogue (CIM-CD) refers to TCs learning through collaborative dialogue between the TC and the mentor and sometimes students to understand and improve student learning. For example, one of Ellen's observations captures an in-the-moment collaborative dialogue while Ellen was leading the instruction:

> … TC explains that because the discriminant is 0… and student offers that there must be only 1 solution. TC confirms. TC asks mentor for direction on the next problem and mentor suggests that students do the next one on their own.. she sets a timer.. both circulate and help students … mentor asks student to guide them through how to solve the problem [because] [one] is different than the others and points how this problem is different than the others .. student continues.. uses the formula to solve given that there b = 0.. student continues to work through the calculations … mentor asks what error could be easily be made while you are solving this? Students offer two possible errors.... (Ellen's observation field notes)

This excerpt from Ellen's observation field notes shows Ellen asking her mentor for help on the next problem. Her mentor suggests she have the students try the problem "on their own." Subsequently, the co-teachers engage a student in collaborative dialogue while tackling a problem that is "different than the others." Ellen has the opportunity to learn in this moment that she can collaboratively create consensus on how to approach a slightly different problem by eliciting help from her mentor but also her students (Tobin, 2006).

CIM-Authentic Student Input (CIM-ASI) refers to TC learning to garner student input in the moment. For example, Cesar reflects on eliciting student input on homework and how it is sometimes scary for the student:

> When solving a homework problem on the board …we asked for students to come up to the board and show us what they did so far. In particular a female student who asked about problem 17 (graphing) did not want to go to the board. The teacher insisted and told the student to bring a buddy at the board with her. I saw how the student was more willing to participate with a buddy on her side…. students showing their own work on the board allows me to see where some students' minds are and allows feedback. All the other students are able to see different viewpoints of the problem as well and not just their own work. Because of this I will now want to get students to show their work more often with a buddy (Cesar)

This excerpt from Cesar's reflection captures how his mentor elicits student input by asking a female student to "show us what they did so far..". Cesar reflects what he learns by noting that "students showing their work .. allows me to see where some students' minds are…".

CIM-observation (CIM-O) reveals instances where the co-teachers provide each other with non-evaluative corrections in their practice. For example, Ellen struggles to use her mentor's iPad and then makes an error while a student is guiding her through working on a problem. Her mentor jumps in to offer her non-evaluative corrections:

> …TC works from the iPad and displays the discriminant worksheet and fumbles to find the highlighter but mentor jumps in to direct her where it is (from the back of the room). TC asks what is the axis of symmetry? Students says it is the x of the vertex… and TC says wonderful.... TC continues to run the class and asks who can help me with #3? A

> student raises her hand and TC lets student guide her through the problem. TC makes an error and mentor jumps in to correct her.. TC makes the change and keeps moving (Ellen's observation field notes)

In this excerpt, Ellen is learning to be responsive to coaching moments that are instructive such as a correction in precision to mathematical language in the presence of students. In doing so, Ellen and her mentor offer students a model for collaborative work (Thompson & Schademan, 2019).

Evidence of TC learning of CIM reveals TCs learning from coaching moments that are public and real-time. These coaching moments sometimes involve engaging students in co-generative dialogue and eliciting students for authentic input on their learning. Because they occur in real-time in front of students, CIM also provides students a model for collaborative work.

***Growth Competence (GC).*** Soslau et al. (2015) describe GC as TCs learning to develop professionally based on internally directed learning. TCs learn GC by discussing teaching decisions and their enactment, articulating rationales for teaching decisions, and justifying their teaching decisions (Soslau et al., 2015). Collectively, these activities allow TCs to learn to reflect on their practice. Table 14 displays the presence of GC. Results show that all TCs engaged in GC by discussing their teaching decisions but less by articulating their reasoning or justifying their teaching decisions.

**Table 14**

*Presence of GC*

| Key Practice Sub-coding | Percent of participants coded for key practice (n=8) | Fraction of participants coded for key practice |
|---|---|---|
| GC-Justify Teaching Decisions | 50.0% | 4/8 |
| GC-Articulate Reasoning | 87.5% | 7/8 |
| GC-Discuss Teaching Decisions | 100.0% | 8/8 |

GC- Articulating Rationales (GC-AR) refers to TCs learning to articulate reasons or rationales for situations they encounter while teaching. For example, Carla reflects on her reason for being fearful of answering questions from her students:

> I was afraid that I wasn't going to be able to answer questions, but I made sure to prepare and review the topic ahead of time. My biggest fear is to look like I don't know enough about the subject. I talked to my teacher on my way out and she said that I didn't look nervous at all and that I did really well which made me feel really good. I think that I will start to get more involved every time I go but I think that it will require a couple of times. I just want for the students and myself to be comfortable with this transition of me being there for two days a week. When I was leaving, I was thinking about how much I enjoyed being there. I really liked helping all the students and it seemed to come naturally (Carla)

In this excerpt from Carla's reflection, she writes that she fears not having strong enough content knowledge as she begins her practicum experience. She is relieved to share that her mentor thought she did well. Carla learns to articulate her reason for being fearful. With the support of her mentor and a sense of self-awareness, she works through her anxiety so that she can focus on what she enjoys so much about being a teacher -- helping students.

GC-Discuss teaching decisions (GC-DTD) refers to TCs learning to express teaching decisions and enactments. For example, in one of his reflections, Carl describes the decision to display matrices on the board for students to inspect in a lesson about matrix operations:

> …we got into the activity for the day, which was a group activity where each group got a card that had a certain action on it such as AB-B, and there were 4 matrices on the board labeled A, B, C, and D. This worked out rather nicely, as it showed students that not all matrices can be multiplied together, as well as certain facts such as AB does not equal BA. During this part of the lesson the teacher and I were walking around, checking for understanding by asking students specific questions about how they got a certain answer, and in order to get a stamp that signified they had completed that problem, they had to tell us how they got whatever answer we asked for. (Carl)

In his reflection, Carl discusses the decision to display four different matrices on the board for students to inspect visually. He notices this decision "worked out rather nicely as it showed students that not all matrices can be multiplied together..".

GC-Justify Teaching Decisions **(**GC-JTD) refers to TCs' learning to produce justifications for teaching decisions they made. For example, Carla discusses the enactment of a lesson on two-step equations:

> They started two step equations that day. The format of the class is usually they do one problem as a class, then one problem by themselves, and then the cycle repeats. Since these kids need a little extra help, it gives me a chance to walk around the room and work with the students individually. This gives me a chance to get to know the students and how they think. I also came to a realization that day. I noticed that when helping students it is sometimes better to squat down and almost be at eye level with them when

> explaining things. I think it's hard for me to explain things to students while I'm standing over them because I can't see their reactions. Sometimes you can tell from a student's facial expression if they are confused or need more help. When it was time for the students to leave, some of them said bye to me and then thanked me for helping them that day. This made me feel really good and it took me by surprise but it was nice to hear. Knowing that I have made a difference and helped students understand the topic a little bit more makes all of this worth it (Carla)

This excerpt from Carla's reflection shows her justifying the decision to do one problem as a class and then one problem individually. She notices that by scaffolding the lesson in this manner, her students can work at a appropriate pace ("these kids need a little extra help"). She then justifies how her decision to be at "eye-level" with her students was reasonable. By leaning down to eye level, she can see her students' reactions especially their facial expressions, and how facial cues help her understand when her students need extra help. Finally, she shares that her students acknowledged her by thanking her and said bye to her, suggesting that her efforts in the real world of the classroom attending to her students' needs resulted in forging stronger relationships with her students.

Although GC-DTD and GC-JTD seem to overlap, Carla's reflection justifies her decision to be at eye level. Ultimately, excerpts from Carla's and Carl's reflections provide evidence of their learning GC. In addition, they both demonstrate how they are developing professionally based on internally directed learning through their practicum experience co-teaching (Soslau et al., 2015).

***Immersion in Real World (IRW).*** The key practice of IRW refers to TCs' learning to adopt a more realistic picture of what the real world of teaching involves through immersion in

the teaching profession. IRW is situated on two dimensions: feeling a sense of belonging in the classroom and feeling a sense of belonging in the school (Thompson & Schademan, 2019). Table 15 displays presence of IRW. Results show that TCs engaged in IRW while absorbed in classroom experiences and less in IRW while absorbed in school-wide experiences.

**Table 15**

*Presence of IRW*

| Key Practice Sub-coding | Percent of participants coded for key practice (n=8) | Fraction of participants coded for key practice |
|---|---|---|
| IRW-school | 75% | 6/8 |
| IRW-class | 100% | 8/8 |

IRW-Class (IRW-C) characterizes TC learning as a sense of place in the classroom and how classrooms can be characterized by differences in learners across periods or classes. When TCs learn IRW-Class, they develop a more realistic sense of the curriculum and use this understanding to attend to student learning in a particular class by collaboratively discussing with their mentor what should be modified to address student needs throughout the day better as they move from one period to the next (Thompson & Schademan, 2019). All participants reported having IRW-class learning opportunities. For example, Carla discusses how she felt like she belonged in the classroom after only a couple of weeks of co-teaching:

> … In my absence the teacher told me that some students were asking about me and why I wasn't there that week. When I did come back a number of students talked to me and one student in particular said "yay! You're back"! This makes me feel even more as if I am part of a classroom. The more students enjoy having me in class the more I feel confident and comfortable in teaching... (Carla)

Cesar also expressed a sense of comfort in the classroom as students adapted to his presence:

> …. as I have been getting very comfortable with the students I planned to come up to as many students as I can to assist with homework. Little did I know that the students were getting comfortable with me that I did not have to leave the area of my desk. Students kept going to me or the teacher to ask questions but, I did see that the same students that felt comfortable with me kept asking me for help several of times even when the teacher was available... (Cesar)

Other TCs reflected on how their immersion in the classroom led to their learning how classes are distinct from one another and that they must learn to adaptively teach their lessons from one period to the next to attend to student learning. For example, Carl reflects on his day teaching and shares:

> ...After this problem was finished, I asked both classes if they would like to try the others on their own, or if they wanted me to do one more of their choice, third period chose to have me do one more and then they worked on the other two, while fourth period decided to try the rest on their own… (Carl)

Notably, Carl reports learning how classes vary from period to period and how he must adapt his teaching based on student cues to meet the learning needs of his students. Similarly, Jamie reflects on how teaching her lesson to different classes elicited somewhat different results:

> During first period, the lesson and students were perfect. The students were attentive and could regain their focus easily. During the Kahoot game, students would follow along and actively participate. When I would complete a question on the board, I would have the students tell me what to do next. I would ask questions such as the following; "What formula are we using? Why?" "What will be our next step?" "Which side are we solving for?" We did not complete the review entirely, but [my mentor] and I felt that the

> students fully understood the material that was covered in class. First period was fantastic to say the least. During third period, the students would tend to become off task easily, especially during the Kahoot game. I would have to regain their attention every so often. (Jamie)

Like Carl, Jamie reports how she is learning to adapt her teaching from period to period to respond to her students' attention span.

IRW-Class learning in the practicum reveals TCs reflecting on how they developed a sense of place in the classroom as a community of learners. IRW-Class learning also reveals how TCs developed awareness of the need to differentiate (adapt) instruction from class to class to attend to student learning.

IRW-school (IRW-S) captures TC learning of the school and the norms associated with belonging in the school setting, which Thompson and Schademan (2019) describe as critical professional development for TCs' future practice. For example, Brianne reflects on how her mentor uses resources in the media center to enhance a computer science research project:

> …this research project was an awesome way for students to better learn the concepts in the chapter they were studying…What was also awesome, is that [my mentor] had the Media Center bring down a cabinet full of HP laptops so the students got their own computer and could do the research they needed for their project in class! Bringing this kind of technology into the classroom keeps the students engaged and gives them a different way of learning rather than passively learning and memorizing lecture. (Brianne)

Brianne reflects on learning how relationships with other parts of the school, namely the media center, can enable "bringing .. technology into the classroom" to improve student learning.

However, disruptions in teaching due to lockdowns came into focus for Fiona as she reflects on changes she and her mentor had to make suddenly to their lesson plan in response to a "lockdown" at the school:

> …while I was planning on doing this [activity] with second period too, I was unable to … there was a lockdown all day due to a threat to the school. The lockdown didn't start until the end of first period so she [my mentor] was able to teach first period the notes which is why I was able to do the activity with them. … [my mentor] and I taught 2nd period the notes from the day before then had them work on the practice problems they were giving with the notes. (Fiona)

IRW-School learning in the practicum captures TCs learning how professional relationships in a school's community afford teachers access to resources outside of the classroom that enhance student learning. IRW-School learning also captures TCs learning to cope with the realities of disruptions to classroom norms due to events beyond the teacher's control and even the school.

***Sharing Authority (ShA).*** ShA is a key practice that refers to opportunities TCs have to learn to share authority while co-teaching. TCs sharing authority is enacted in three ways: linguistically, physically, and interactionally (Thompson & Schademan, 2019). Table 16 shows presence of ShA. Results show that all TCs engaged in ShA through interaction and linguistic means, but only one TC reported ShA by physically sharing a workspace such as a desk.

**Table 16**

*Presence of ShA*

| Key Practice Sub-coding | Percent of participants coded for key practice (n=8) | Fraction of participants coded for key practice |
|---|---|---|
| ShA-Physical | 13% | 1/8 |
| ShA-Linguistic | 100% | 8/8 |
| ShA-Interactional | 100% | 8/8 |

ShA-Physical refers evidence of the physical sharing of the co-teaching space through the affordance of a desk for the TC, for example. ShA-Linguistic refers to the instances where the TC uses the language of "co," such as when TC refers to themselves in relation to their mentor and co-teaching pair as "we." ShA-Linguistic is also evident when the TC uses inclusive pronouns such as "our students" and "our classroom" (Thompson & Schademan, 2019). Finally, ShA-Interactional refers to evidence of when the TC is afforded equitable roles and responsibilities with their mentor, such as early opportunities to take the lead in instruction while co-teaching (Thompson & Schademan, 2019).

ShA-Physical (ShA-P) refers to the physical sharing of the co-teaching space through the affordance of a desk for the TC. For example, Cesar describes having a physical space of his own in the classroom:

> As I have been getting very comfortable with the students, I planned to come up to as many students as I can to assist with homework. Little did I know that the students were getting comfortable with me that I did not have to leave the area of my desk (Cesar)

This excerpt from Cesar's reflection captures Cesar describing the area of his desk and suggests that the co-teachers have enacted the sharing of the physical space in a tangible way for students. Notable is that this was the only code for ShA-Physical found in TC reflections or captured in observations.

ShA-Linguistic (ShA-L) refers to the instances where TCs use the language of "co," such as when TCs refer to themselves and their mentor collectively as "we" and when they use inclusive pronouns such as "our students" and "our classroom" (Thompson & Schademan, 2019). For example, Brianne notes

> …verbal participation of the students was effortless in majority of his classes, but this Geometry Honors class was very quiet and timid. Through repetitive questioning, [my mentor] was able to pull some information from them, but ..…**we** both realized that he would have to dig a little deeper when going over the notes… (Brianne)

Brianne's reflection captures "co" language as she describes how "we both realized he would have to dig a little deeper" to get students to participate. Brianne's reflection suggests she and her mentor have assumed a non-hierarchical and highly collaborative stance (Thompson & Schademan, 2019). Another example of the "language of -co" is evident in Carl's reflection when he explicitly refers to himself as a teacher:

> [My mentor] and I walked around the classroom answering any questions that arose, as well as asking students questions to get them to come up with the answers on their own. This method worked very well, as with two teachers, no students had to wait around to get their questions answered…(Carl)

As with Brianne's reflection, Carl's reflection captures his assumption of being a co-teacher with no regard to hierarchy. Additionally, Carl's reflection also captures a sense of being co-responsible with his mentor for student learning. To summarize, both TCs refer to themselves inclusively with their mentors without regard to the traditional student teaching hierarchy.

ShA-Interactional (ShA-I) refers to instances where TCs assume equitable roles and responsibilities while co-teaching with their mentor early in their co-teaching experience. These

excerpts often capture TCs reflecting on their first teaching experience with nervousness and excitement. These moments serve as early learning opportunities for TCs to lead instruction while co-teaching (Thompson & Schademan, 2019). For example, Brianne reflected on how she is being allowed to teach her mentor's Calculus class. Still, her repeated use of the language of "-co" (Thompson & Schademan, 2019) also suggests how her mentor supports her through having the lead role in the class:

> … [my mentor] allowed me to teach the chain rule and transcendental functions and repeated application of the chain rule. We worked out a plethora of different examples together as a class and we didn't just do it for them. We allowed students to answer as a class, decide what next steps to take, and even called on volunteers to work the rest of the problem out... (Brianne)

Carl expresses another example of this sharing of authority:

> ...during my third set of observations of [my mentor's] classes, for third and fourth period I was able to take the role of main teacher for the first time… [my mentor] and I were walking around and helping students and small groups who had questions until the end of each period. (Carl)

Despite taking the lead in instruction, TCs also report how their mentors offer support, as is evident in their rich, inclusive language. This rich language is especially clear in Brianne's reflection.

In summary, ShA reveals TCs learning how to be more central participants while co-teaching. Their more central participation is evident by assuming more equitable roles and responsibilities for student learning alongside their mentor.

***Co-mentoring (CM).*** CM is a key practice which Thompson and Schademan (2019) describe as co-teachers learning to simultaneously be a significant contributor and learner in the situated environment of the classroom. TCs learn to share their ideas for lesson content, instructional approaches learned in university coursework, and technology expertise. In addition, the co-teachers learn to draw on each other's strengths and position themselves to be important contributors to their shared practice. Table 17 displays the presence of CM in the dataset. Results show that two TCs reported engaging in CM.

**Table 17**

*Presence of CM*

| CM Key Practice Sub-coding | Percent of participants coded for key practice (n=8) | Fraction of participants coded for key practice |
|---|---|---|
| CM | 25% | 2/8 |

For example, Jamie reflects on a strategy she enacted while co-teaching:

> … One strategy I've been implementing in the classroom is creating handouts that follow the presentation. I have observed that a lot of class time was wasted when students had to copy the notes from the PowerPoint, as well as drawing graphs and tables. Many of the students spent so much time drawing a graph because they wanted it to look perfect. I decided to provide handouts which included the question, blank tables, and blank graphs. The students enjoyed taking notes in this fashion… (Jamie)

Jamie's reflection captures her contribution of presentation handouts that she came up with based on observations in the classroom. Similarly, Fiona describes how she and her mentor shared ideas while planning a lesson:

> [My mentor] and I bounced back ideas with each other and finally decided upon doing a kahoot covering the material adding and subtracting matrices, multiplying matrices, finding the elements of matrices, and scalar matrices. (Fiona)

Fiona's reflection shows how she and her mentor are essential contributors and learners to planning a lesson on matrix operations. In summary, TCs learning of CM captures them contributing their ideas to the classroom while also learning with their mentor as a form of situated professional development (Thompson & Schademan, 2019).

***Negotiating Difference (ND).*** The key practice of ND refers to TCs' learning to "engage in tensions directly and work through them" while co-teaching (Thompson & Schademan, 2019). Table 18 shows the presence of ND. Results show half of the TCs engaged in ND.

**Table 18**

*Presence of ND*

| ND Key Practice Sub-coding | Percent of participants coded for key practice (n=8) | Fraction of participants coded for key practice |
|---|---|---|
| ND | 50% | 4/8 |

ND provides opportunities for the TC to learn to get proximate (Stevenson, 2021) when dealing with a tension they perceive in their co-teaching experience and work through the tension to turn their attention toward student learning (Thompson & Schademan, 2019). For example, in the following instance, Fiona reflects on a moment where she and her mentor attempt to negotiate the fallout of a lesson involving a station-teaching lesson that didn't go as planned:

> …for first period, the students were only able to move one time since they had such difficulty with the problems. [My mentor] ended up telling me I made some of the questions a little too difficult but most of the problems I used are problems I got from their semester exam she told me to take problems from. (Fiona)

This excerpt from Fiona's reflection captures a moment when she considers an exchange she had with her mentor. Her mentor tells her she made some of the questions "a little too difficult," yet Fiona assesses that ".. I used the problems from their semester exam she told me to take problems from…". Fiona does not share if she gets proximate with her mentor to negotiate the tension evident in her reflection. However, more importantly for Fiona's learning, her reflection may capture a missed learning opportunity for her to practice ND. Similarly, Carla's reflection also captures a moment where she reviews an exchange she had with her mentor:

> …For the Algebra 2 classes, we started the section on complex numbers. She [mentor] said that students tend to do well in this section so the students seemed to understand it pretty quickly. It's hard to get involved with these classes because she lectures the entire period. When she gives them problems to do on their own I try to walk around to help students but that seems to be the most that she'll let me do. I guess my issue is that I don't want to step on any toes and I want to respect the space that I am in. I don't want to overstep my boundaries which is why I'm hesitant to do more things in the Algebra 2 classes. She seems to be more open to letting me lead the Algebra 1A class…. (Carla)

Although Carla wants to "get involved" with the Algebra 2 classes, she seems unsure how to negotiate this opportunity. More importantly, this moment may capture a missed opportunity to practice negotiating differences with her mentor. In contrast, Ellen describes a moment where she and her mentor negotiate who will launch the lesson:

> [My mentor] asked if I wanted her to launch the lesson or if I wanted to. I thought it would be efficient for her to start the discussion. This allowed me to calm down any nerves and for the students get comfortable... Once [my mentor] handed it off to me I was

ready to show how I can be the lead teacher! I tried my best to not read off my notes while writing on the iPad… (Ellen)

Ellen reflects on how her mentor offered her a choice to launch the lesson. The affordance of choice demonstrates how Ellen's mentor initiates the negotiation around who will start the lesson, thereby getting proximate with Ellen and modeling ND. Ellen defers to her mentor so she will have the opportunity to calm down, and the students could settle into the lesson before she took over.

In summary, the key practice of ND learning is less apparent in TC reflections. Still, evident tensions may capture instances of missed learning opportunities for TCs to practice learning ND.

More broadly, the coding of the data reveals TCs learning of eight key practices associated with co-teaching in their practicum placements. In addition, multiple key practices appeared in many of the same segments or chunks of the qualitative data. To further explore the co-occurrence of codes in the data set, I conducted a co-occurrence analysis which I discuss further below.

**Co-occurrence Analysis.** Applying two or more codes to a data segment describes co-occurrence (Namey et al., 2008). Codes applied or grouped at higher frequencies suggest co-occurrence of themes and may be evidence of inter-relationships between the key practices (Namey et al., 2008). Table 19 displays key practice (KP) co-occurrences. The shaded diagonal represents the code frequencies by KP. Noteworthy is the high frequency of co-occurring codes of ShA across all KPs but particularly CE, GC, and AT. In the next section, I show evidence of these co-occurrence patterns through exemplars from the data set.

**Table 19**

*Key Practices Co-occurrence Matrix**

| KP Co-occurrence Matrix | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | AT | CE | CIM | CM | GC | IRW | ND | ShA |
| AT | 63 | 11 | 7 | 1 | 22 | 16 | 1 | 39 |
| CE | 11 | 139 | 9 | 2 | 13 | 9 | 3 | 55 |
| CIM | 7 | 9 | 46 | 0 | 4 | 2 | 2 | 7 |
| CM | 1 | 2 | 0 | 3 | 2 | 2 | 0 | 3 |
| GC | 22 | 13 | 4 | 2 | 55 | 23 | 2 | 49 |
| IRW | 16 | 9 | 2 | 2 | 23 | 79 | 2 | 27 |
| ND | 1 | 3 | 2 | 0 | 2 | 2 | 7 | 4 |
| ShA | 39 | 55 | 7 | 3 | 49 | 27 | 4 | 168 |

*Table 19 presents a two-dimensional view of co-occurrences and only relates two KPs at a time.

**Exemplars.** Exemplars of co-occurrences are segments from the qualitative data that were coded for two key practices. These exemplars reveal how TCs may be learning two key practices simultaneously.

***ShA and CE Co-occurrence.*** The co-occurrence of ShA and CE reveals how TCs were developing collaborative expertise while also learning to share authority. For example, ShA and CE occur together when Brianne explains sharing the teaching space with her mentor:

> Students took about eight minutes to solve both [problems] and then [my mentor] went over letter A and he let me do letter B with the class. From time to time we split up work in half and do partner teaching. [My mentor] realized fast that it's a lot less stressful with two teachers, and he doesn't have to try to get to every question they have … (Brianne)

This passage from Brianne's reflection shows her taking the lead on covering one of the two assigned Calculus problems with the students. Being allowed to take the lead on instruction is characteristic of ShA-I; further, Brianne describes how she and her mentor are splitting up the work and team teaching in this manner. By doing so, she is learning to be a co-responsible

partner in student learning. Working collaboratively as co-responsible partners in student learning is characteristic of CE (CO). Brianne adds that her mentor has realized the benefits of having a co-responsible partner by sharing, "it's a lot less stressful with two teachers.. .". In this last excerpt, Brianne acknowledges herself as a teacher, enacting ShA-Linguistic and exhibiting agency.

***ShA and GC Co-occurrence.*** The co-occurrence of ShA with GC reveals TCs developing growth competence or developing professionally through internally directed learning (Soslau et al., 2015) while also learning to share authority. For example, Cesar reflects,

> …Students kept going to me or the teacher to ask questions but, I did see that the same students that felt comfortable with me kept asking me for help several of times even when the teacher was available. It was as if those students relied on me and trusted me for help. As a teacher that is what I want. I want to feel like I am useful to students and be a role model for them. This week the students have also heard that I will be teaching the next lesson mostly by myself. This may have resulted in having more students walk up to me as they probably now really see me as a future teacher…. (Cesar)

This co-occurrence shows Cesar as thoughtful and internally directed as he considers how some students feel comfortable with him even when "the teacher" is available. In this instance, Cesar reflects on how he will be teaching the next lesson by himself (ShA-I). He attempts to explain why students feel comfortable with him (GC-AR) and reasons that being allowed to share in the instructional responsibility makes him appear as a real teacher to his students.

***ShA and AT Co-occurrence.*** The co-occurrence of ShA with AT reveals TCs learning how to adapt their teaching in response to contextual demands and student cues while also

learning to share authority. For example, Carl discusses how he learns from his mentor how to "differentiate the lesson a bit" to accommodate younger ninth-grade students:

> …we gave each group five minutes to complete the problem that was at their set of desks, and then once time was up the students rotated to the group with the next playing card, for instance a 9 would go to 10, and a 10 would go to a Jack, etc. This variation from the group activity we did with third and fourth period was to differentiate the lesson a bit for the 9th graders, who have a lot more energy to release, so we wanted to have a way the students could get up and move every now and again… (Carl)

Carl uses the language of "co" (Thompson & Schademan, 2019) by referring to adaptive teaching decisions in the plural, which is an indicator of ShA-Linguistic. Differentiating the lesson for different classes throughout the day characterizes AT where the co-teachers adapt instruction based on the needs for younger students to "move every now and again."

In summary, coding the participant data sources generated segments that captured evidence of all eight key practices. These suggest evidence of a high degree of learning of several of the key practices in the practicum. In addition, several key practices co-occur in the data set. For example, *Sharing Authority* is a key practice frequently coded with *Collaborative Expertise*, *Growth Competence*, and *Adaptive Teaching*.

**Research Question Two. Does TC Learning of Key Practices Impact Their Implementation of Equitable MTPs in Observations of TC Teaching?**

***Summary of Findings***

The goal of the co-teaching activity system is TC learning of specific key practices. The first research question explored the data set for evidence of these key practices in the practicum that used the co-teaching model. Results of research question one indicates evidence of TC

learning of these key practices. The second research question asks if this learning impacted how TCs implement MTPs when they were observed teaching mathematics. TC code frequencies were compared to the MCOP2 constructs of *Student Engagement* and *Teacher Facilitation* to determine whether TC learning impacted their implementation of MTPs in observations of their teaching. A correlational analysis revealed a strong positive association between the frequency of participant coding for AT and their mean scores for *Student Engagement* ($r(5) = .750, p < .05$).

***Quantitative Analysis***

**MCOP2 Construct Analysis.** Participants were observed co-teaching on two occasions. During these observations, the MCOP2 was completed. The MCOP2 consists of 16 Likert-scaled items. Each item was scored on a scale of zero to three. The MCOP2 measures *Student Engagement* and *Teacher Facilitation* constructs. The values of these constructs were found by adding up a subset of the MCOP2 16 items for each construct. Thus, the highest possible score for each construct is 27 (Gleason et al., 2015). Participant scores were calculated for each observation. The mean for each construct was then calculated based on the two observations. Table 20 displays the MCOP2 results for the eight participants.

**Table 20**

*MCOP2 Mean Scores for Student Engagement and Teacher Facilitation Constructs*

| | MCOP2 Constructs | |
|---|---|---|
| Participant (n=8) | Mean Student Engagement (observations=2) | Mean Teacher Facilitation (observations=2) |
| Fiona | 17 | 7 |
| Ellen | 21.5 | 17 |
| Carla | 19 | 12 |
| Jamie | 17.5 | 16.5 |
| Gary | 19 | 11.5 |

**Table 20 (Continued)**

| Participant (n=8) | Mean Student Engagement (observations=2) | Mean Teacher Facilitation (observations=2) |
|---|---|---|
| Carl | 23.5 | 15 |
| Cesar | 18 | 16 |
| Brianne | 21 | 14.5 |

**An Outlier in MCOP2 Data.** Fiona's MCOP2 scores are the lowest in the data set. I noted that Fiona's two observations were conducted during times when student attendance was unexpectedly low. During one of the two observations, the researcher noted that Fiona and her mentor were dealing with an unexpected "club day" where many students were absent. During the second observation, the researcher noted that the school had just had a threat of an active shooter the day before. In the wake of this event, several students chose not to attend school, and once again, many students were absent. Although observations were conducted on both days despite low attendance, the extraordinary circumstances may have impacted the co-teachers lesson planning and enactment. Therefore, Fiona's MCOP2 scores and code frequencies are treated as outliers and removed from the dataset for this research question.

**Descriptive Statistical Analysis of Data**. I conducted descriptive statistical analysis on the remaining dataset (n=7). Table 21 displays the result of this analysis for the MCOP2 data. These data suggest the MCOP2 construct scores are somewhat normally distributed given the skewness and kurtosis values.

**Table 21**

*Descriptive Statistics for Student Engagement and Teacher Facilitation*

| Descriptive Statistics on MCOP2 Constructs (n=7) | | |
|---|---|---|
| Descriptive Statistics | Mean Student Engagement | Mean Teacher Facilitation |
| Range | 6 | 5.5 |
| Minimum | 17.5 | 11.5 |
| Maximum | 23.5 | 17 |
| Mean | 19.9 | 14.6 |
| Std. Dev | 2.1 | 2.2 |
| Variance | 4.6 | 4.6 |
| Skewness | 0.65 | -0.64 |
| Kurtosis | -0.58 | -1.23 |

I also performed descriptive statistical analyses on proportional values for code frequencies. Preliminary exploratory analysis pointed to strong positive and negative associations with AT and GC code frequencies, respectively. Subsequently, these variables were transformed into proportional values of total code frequencies (n=560) to ensure continuous-continuous variable stipulation for the Pearson's correlation coefficient (Khamis, 2008). Table 22 shows the results of descriptive statistical analysis of GC and AT as proportions of total codes. These data suggest the *GC* and *AT* variables are somewhat normally distributed given the skewness and kurtosis values.

**Table 22**

*Descriptive Statistics on GC and AT Code Frequencies as Proportions of Total Codes*

| Descriptive Statistics (n=7) | | |
|---|---|---|
| Statistic | Percent GC | Percent AT |
| Range | 0.54 | 1.07 |
| Minimum | 0.89 | 0.71 |
| Maximum | 1.43 | 1.79 |
| Mean | 1.15 | 1.28 |

**Table 22 (Continued)**

| Statistic | Percent GC | Percent AT |
|---|---|---|
| Std. Deviation | 0.20 | 0.36 |
| Skewness | 0.73 | -0.43 |
| Kurtosis | -0.74 | -0.32 |

**Correlational analysis.** I used a Pearson's correlation coefficient to measure the strength of the linear relationship between the coding frequencies for each key practice and the MCOP2 constructs. AT and *Student Engagement* were strongly positively correlated r(5) = .750, $p<.05$. GC and *Student Engagement* were strongly negatively correlated r(5) =-.725, $p<.05$. Temporal patterns can explain the negative association with GC in the participant reflections. These patterns suggest that as participants' practicum began to conclude, their tendency to become more reflective increased, which increased their coding of GC. I explore the strong positive association of AT with *Student Engagement* further below.

***Qualitative Analysis***

The *Student Engagement* subscale measures the role of the student in the classroom and their engagement in the learning process through active participation, productive dialogue, and persistence (Gleason et al., 2015). Instances where AT occurs, and the student engagement is high are evident in Carl's reflection. For example, Carl describes how his mentor asks him to be "the new voice" in the classroom:

> …the day before the students had a substitute that was unable to help them with their assignment. Seeing as students were struggling with the assignment they had the day before, I was tasked to "be a new voice" to try and help the students clear up any misunderstandings that they had, that the teacher may not be able to get through to them. To do this I collected a bit of information from the students on what they were having

> trouble doing on the worksheet, and then had them pick a problem that they wanted me to go into detail about. These specific worksheets are set up to have each part of the problem in a different box, so it was easy to just go through the different steps required and find where students were struggling. For example, when given the equation $(x + 3)/(x\text{^}2 - 9)$ the students had a minor difficulty when canceling out $x + 3$ from the top and bottom, as they were unsure as to what would be left on the top. To remedy this I questioned the students as to what happens when you divide any number by itself, and they were able to tell me it works out to one, so I asked them if it worked the same if you divide a variable by itself, and after some discussion the students were able to clearly see that it also works out to one… (Carl)

Carl's reflection shows how he adaptively teaches in response to student cues he garners by soliciting his students for their input through productive dialogue. Similarly, Ellen describes how she and her mentor engaged their students through station teaching:

> …when the students walked in they picked a card from the deck. ..we asked them to find their partner that had the same number and colored card to do the activity with. We also asked them to start on the station nearest them. Then they go around to the next station based on their answer. There were a few questions on the bouncing and going through the x-axis and what degree does that give the zeros. Once I was able to clarify that for a group they were able to find the correct answer... I had the answer key and gave them hints on what problem they made a mistake on. A lot of them made a mistake on the first one! They all freaked out a little and I said don't stress it's okay! (Ellen)

Ellen's reflection shows how she adaptively teaches in response to her students' questions while moving from station to station and thereby engaging students in productive dialogue. In these

excerpts from their reflections, Ellen and Carl reveal how they learn to engage students and adaptively co-teach simultaneously in their teaching practice. These excerpts from the qualitative data suggest evidence of the strong positive association patterns found between AT and *Student Engagement*.

**Research Question Three. How does the Community of Co-teachers in a Co-teaching-modeled Practicum Support TC learning?**

***Summary of Findings***

The community is the social group the subject belongs to while engaged in an activity (Yamagata-Lynch, 2010). Further, Campbell and Dunleavy (2016) describe this social group as those in the classroom. More specifically, TCs are engaged in the social group defined immediately by themselves and their mentors. I investigated the collaborative relationship between the co-teachers using the results of the Just-In-Time (JIT) Survey. The JIT survey is a 16-item Likert scaled survey. Responses range from zero to five. The results provided a snapshot of the co-teaching relationship from the participants who completed the survey. The findings suggest a significant difference in how participants perceive their comfort communicating with their mentor when grouped by their frequency of AT coding. Participants with higher-than-average AT instances responded significantly higher than those with lower-than-average AT instances ($t(5) = -2.67,\ p\ = .045$) on the question, "You feel comfortable communicating your ideas with your mentor".

***Quantitative Analysis***

To discern how the community comprised of the TC and mentor impacted TC learning, I analyzed the results of JIT survey which captured TCs' perceptions of their relationship and communication with their mentor.

**Descriptive Statistics of JIT Survey Data.** Table 23 displays descriptive statistics for data garnered from the JIT survey. These results show that some TC responses were more variable that others given the skewness and kurtosis values.

**Table 23**

*JIT Survey Descriptive Statistics*

| Descriptive Statistics for JIT Survey (n=7) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Item | Min | Max | Mean | St.Dev | Variance | Skewness | Kurtosis |
| 1. Your mentor supports you in implementing co-teaching. | 3 | 5 | 4.7 | 0.8 | 0.6 | -2.6 | 7.0 |
| 2. You feel like a "real" teacher in the classroom | 4 | 5 | 4.4 | 0.5 | 0.3 | 0.4 | -2.8 |
| 3. You feel comfortable communicating your ideas with your mentor. | 3 | 5 | 4.4 | 0.8 | 0.6 | -1.1 | 0.3 |
| 4. You feel comfortable communicating your ideas with your mentor. | 3 | 5 | 4.3 | 0.8 | 0.6 | -0.6 | -0.4 |
| 5. You regularly plan lessons with your mentor. | 1 | 4 | 2.9 | 1.1 | 1.1 | -0.8 | 0.3 |
| 6. You regularly reflect about lessons with your mentor. | 2 | 5 | 3.9 | 1.1 | 1.1 | -0.8 | 0.3 |
| 7. When you are not the lead teacher, you frequently move around the room and engage students, individually and collectively, in mathematical discussions. | 3 | 5 | 4.6 | 0.8 | 0.6 | -1.8 | 2.4 |
| 8. Your co-teaching experiences influence your instructional planning and practices. | 3 | 5 | 4.3 | 1.0 | 0.9 | -0.8 | -1.7 |
| 9. Co-teaching increases your confidence about your classroom management skills. | 3 | 5 | 4.4 | 0.8 | 0.6 | -1.1 | 0.3 |
| 10. Co-teaching helped you learn from your mentor | 3 | 5 | 4.4 | 0.8 | 0.6 | -1.1 | 0.3 |
| 11. You and your mentor consistently teach lessons together. | 2 | 5 | 3.3 | 1.0 | 0.9 | 0.9 | 1.2 |
| 12. Your mentor consistently provides feedback about your lessons. | 3 | 5 | 4.0 | 1.0 | 1.0 | 0.0 | -2.6 |
| 13. Co-teaching has been beneficial to my development as a teacher. | 4 | 5 | 4.6 | 0.5 | 0.3 | -0.4 | -2.8 |
| 14. You use at least three of the co-teaching strategies per week. | 2 | 5 | 3.3 | 1.3 | 1.6 | 0.7 | -1.1 |
| 15. You and your mentor have a scheduled time for co-planning. | 1 | 5 | 2.7 | 1.4 | 1.9 | 0.7 | -0.3 |
| 16. When co-planning/co-teaching, you and your mentor discuss (implement) student-centered instruction. | 3 | 5 | 4.1 | 0.7 | 0.5 | -0.2 | 0.3 |

**Grouping of TCs Based on AT Code Frequencies.** To further compare JIT survey results, I grouped TCs by AT code frequency. I placed participants into two groups based on the

frequency of their AT codes with the average AT code frequency serving as a cut point for the groups. The first group, Group One (n=3), consisted of those participants who reported lower than average AT code frequencies. The second group, Group Two (n=4), consisted of those participants who reported higher than average AT code frequencies. Table 24 presents JIT survey results by group assigned.

**Table 24**

*JIT survey results by Grouping Associated with AT instances*

| JIT Survey Results | Group 1<br>AT Lower than Mean<br>(n=3) | Group 2<br>AT Higher than Mean<br>(n=4) |
|---|---|---|
| 1. Your mentor supports you in implementing co-teaching. | 4.3 | 5.0 |
| 2. You feel like a "real" teacher in the classroom | 4.0 | 4.8 |
| 3. You feel comfortable communicating your ideas with your mentor. | 4.0 | 4.8 |
| 4. You feel comfortable communicating your ideas with your mentor. | 3.7 | 4.8 |
| 5. You regularly plan lessons with your mentor. | 3.3 | 2.5 |
| 6. You regularly reflect about lessons with your mentor. | 3.0 | 4.5 |
| 7. When you are not the lead teacher, you frequently move around the room and engage students, individually and collectively, in mathematical discussions. | 4.3 | 4.8 |
| 8. Your co-teaching experiences influence your instructional planning and practices. | 4.0 | 4.5 |
| 9. Co-teaching increases your confidence about your classroom management skills. | 4.3 | 4.5 |
| 10. Co-teaching helped you learn from your mentor | 4.0 | 4.8 |
| 11. You and your mentor consistently teach lessons together. | 3.3 | 3.3 |
| 12. Your mentor consistently provides feedback about your lessons. | 4.0 | 4.0 |
| 13. Co-teaching has been beneficial to my development as a teacher. | 4.3 | 4.8 |
| 14. You use at least three of the co-teaching strategies per week. | 2.7 | 3.8 |
| 15. You and your mentor have a scheduled time for co-planning. | 3.7 | 2.0 |
| 16. When co-planning/co-teaching, you and your mentor discuss (implement) student-centered instruction. | 3.7 | 4.5 |
| Mean | 3.8 | 4.2 |

To compare JIT survey results between these two groups, I conducted an independent samples t-test for each question on the JIT survey. This test was found to be statistically significant, $t(5) = -2.67,\ p\ = .045$, for question 4. The effect size for this analysis ($d$=2.16) was found to exceed Cohen's (1988) convention for a large effect ($d$=.80). The results suggest that Group 2 ($M$=4.75, $SD$=.50) responded higher on question 4 than Group 1 ($M$=3.67, $SD$=.578). These results suggest that TCs who reported more instances of AT also felt more comfortable communicating their ideas to their mentors.

**Research Question Four. What Roles (Rules) Impact Learning for TCs in Practicum Placements?**

***Summary of Findings***

In the co-teaching activity system, rules are the norms established by the community to govern its members (Engeström, 1999). To explore the Rules element of the co-teaching activity system, the roles mentors exhibit while co-teaching characterized the norms for the co-teaching community defined by TC and mentor. TCs reflections and survey responses revealed mentor roles aligned with Guise, Habib et al. (2017)'s co-teaching continuum of mentor's roles. This continuum aligns mentor roles with categories ranging from roles that exemplify highly traditional student teaching roles to roles that display highly collaborative community-of-practice roles. Results suggest that TCs who reported higher instances of AT also reported higher instances of mentors who exemplified more collaborative community-of-practice type roles.

***Quantitative Analysis of Qualitative Data***

**Frequency Analysis.** I coded participant reflections and survey responses for alignment to the co-teaching continuum categories. Table 25 reveals the code frequencies based on the four

categories of the co-teaching continuum (Guise, Habib, et al., 2017). I coded a total of 98 segments from participant reflections and survey responses.

**Table 25**

*Participant Code Frequencies for Mentor Roles Continuum*

| Participant | Traditional | Blended | Forward momentum | Scaffold & Grow | Total |
|---|---|---|---|---|---|
| Fiona | 0 | 2 | 5 | 2 | 9 |
| Brianne | 0 | 0 | 6 | 2 | 8 |
| Carl | 0 | 0 | 8 | 3 | 11 |
| Carla | 11 | 5 | 1 | 0 | 17 |
| Cesar | 2 | 4 | 6 | 1 | 13 |
| Ellen | 0 | 3 | 10 | 4 | 17 |
| Gary | 1 | 3 | 2 | 1 | 7 |
| Jamie | 0 | 8 | 4 | 4 | 16 |
| Total | 14 | 25 | 42 | 17 | 98 |

Table 26 displays the code frequencies as a proportion of the total codes by the participant and by category out of total codes. Higher percentages of coded segments fell in the Blended and Forward Momentum categories than Scaffold & Grow or Traditional. Noteworthy is that participants in Group Two (shaded) generated codes in higher percentages in the categories of Forward Momentum and Scaffold & Grow. These categories of the co-teaching continuum align with mentors who exhibit more collaborative community-of-practice dispositions (Guise, Habib, et al., 2017).

**Table 26**

*Participant Code Frequency Row Percentage of Mentor Roles Continuum*

| Participant | Traditional | Blended | Forward momentum | Scaffold & Grow | Total |
|---|---|---|---|---|---|
| Fiona | 0% | 22.2% | 55.6% | 22.2% | 100% |
| Brianne | 0% | 0% | 75% | 25% | 100% |
| Carl | 0% | 0% | 72.7% | 27.3% | 100% |

**Table 26 (Continued)**

| Participant | Traditional | Blended | Forward momentum | Scaffold & Grow | Total |
|---|---|---|---|---|---|
| Carla | 64.7% | 29.4% | 5.9% | 0% | 100% |
| Cesar | 15.4% | 30.8% | 46.2% | 7.7% | 100% |
| Ellen | 0% | 17.7% | 58.8% | 23.5% | 100% |
| Gary | 14.3% | 42.9% | 28.6% | 14.3% | 100% |
| Jamie | 0% | 50% | 25% | 25% | 100% |
| Total | 14.3% | 25.5% | 42.9% | 17.4% | 100% |

**Exemplars.** Coded segments for each category offer a snapshot of what TCs encountered in their community of practice with their mentors during their practicum. Each of the categories of the co-teaching continuum is described below, along with supporting qualitative data.

***Traditional.*** The Traditional category of the co-teaching continuum (Guise, Habib, et al., 2017) describes a co-teaching arrangement where co-teaching aligns to a traditional student teaching and where the TC perceives co-teaching as being dominated by one-teach one assist (as the TC's preference) and as a noticeable power differential with the mentor co-teacher taking the lead, taking primary responsibility, and being the expert (Guise, Habib, et al., 2017). Following is Carla's reflection early on in her practicum when she converses with her mentor:

> …I mentioned that I would like to help teach as much as possible and she said that she's had a lot of interns come and go so she knows what to expect. I was relieved that she had done this before and knew what to expect… I think one of my main concerns with teaching is that I look very young and it can be a little intimidating being in that environment. I expressed my concerns with her and she assured me that she wouldn't put me in a situation that I am not ready for… she told me to brush up on the topics they were learning which are piecewise functions for algebra 2 and one step equations for algebra 1A… (Carla)

Noteworthy is how Carla describes her mentor as knowing what to expect and Carla's expression of relief of being with a more experienced mentor. This segment captures an expert/novice dynamic where Carla shares her concerns with her mentor, and she perceives her mentor is taking the lead and not putting her in a situation she may not be ready for. This dynamic reveals how her mentor assumes a more active role while Carla accepts being "coached" and takes a more observer role. Similarly, Cesar reflects, "… being new to the class, the teacher had me observing and assist students who needed help while she taught the lesson…". In both of these excerpts, TCs express a more subordinate role to their mentor in both instances, which characterizes a novice/expert dynamic seen in traditional student teaching arrangements.

***Blended.*** The Blended category of Guise, Habib, et al. (2017)'s co-teaching continuum describes a co-teaching arrangement where the TC perceives opportunities to collaborate and learn through feedback the knowledge already known by the co-teacher and by using a predominance of the one-teach, one assist co-teaching strategy. Following is Cesar's reflection later in practicum. He reflects:

> …as I go forward with my teacher training, I have experienced many of situations where the students in class are lost in the lesson. This results in me and the teacher improvising and changing up the rest of the lesson. This happened in some cases where students would not understand new material due to not understanding previous material. Some students get lost when the lesson is containing too much information in a short amount of time as well. To help with this the teacher has suggested I completely stop the lesson at the point that the students show confusion and to create a brand-new demonstration or problem example.… (Cesar)

In this instance, Cesar's reflection captures his perception of his mentor as someone in an expert role giving him necessary feedback about his teaching that is fundamental to his learning and already known by the mentor.

***Forward Momentum.*** The Forward Momentum category of Guise, Habib, et al. (2017)'s co-teaching continuum describes a co-teaching arrangement when the TC perceives being on equal footing with their co-teachers. In this category, the co-teachers move beyond receiving feedback, and the TC feels benefits from nurturing their socio-emotional development, such as opportunities to develop confidence in teaching. TCs also perceives working together and collaboratively with co-teacher by using a variety of strategies. For example, Carl's reflection captures how he works collaboratively with his mentor and ends up impacting student learning in a special way:

> This class had a lot of student engagement, as even when the teacher or I was talking, we were asking a lot of questions to the students and having them think for themselves. This made the classroom experience very student centered, and students showed a lot of progress towards becoming self-sufficient in correcting any misunderstandings that would arise when they were completing this assignment. One way that I was productive in this class as well, was the fact that about half way through the class, one of the student's partners left, and I saw that this deteriorated the students' work ethic. So, to account for this I became the partner of this student pretending to need help on a few of the problems, and having the student explain to me how to do certain parts. This worked wonders with this student, as they quickly finished all of the problems and they were able to work on building their mathematical communication skills… (Carl)

Carl's reflection shows a team-teaching moment when he and his mentor are co-responsible for student learning. He reports, "..we were asking a lot of questions to students and having them think for themselves.. ". The language of "co-.." (Thompson & Schademan, 2019) captures his perception of his mentor as an equal partner. Instead of a novice/expert dynamic, Carl perceives being a co-teacher. When one of the students unexpectedly leaves, Carl decides to step into the gap and take the place of the departing partner. His agency in taking responsibility for student learning in the moment translates into his growing confidence as a teacher because his decision "worked wonders with this student."

***Scaffold & Grow.*** The Scaffold & Grow category of Guise, Habib, et al. (2017)'s co-teaching continuum describes a co-teaching arrangement where mentors:

> ...approached their role as a cooperating teacher similarly to how they approached teaching in their classroom, focusing on creating a carefully scaffolded, differentiated experience based on the needs of the individual pre-service teacher…positioning themselves as learners right alongside their pre-service teachers.. (p. 378).

For example, early on in his practicum, Carl expresses appreciation for how his mentor allows him to observe:

> … as it was my first day, the teacher wanted me to simply observe the class and ascertain his teaching style, as well as get a feel for the classroom climate. This was actually helpful in certain ways, as I was able to see how the teacher would differentiate his teaching style to fit the needs of his students, and I was also able to understand that the teacher keeps a mostly relaxed and open classroom climate, that makes the students feel as though they are free to ask questions and make mistakes, as long as they are trying…. (Carl).

Carl realizes that, instead of expecting him to observe passively, his mentor is being strategic about meeting his needs to "ascertain his teaching style as well as get a feel for the classroom climate." Similarly, Jamie shares a similar encounter with her mentor in her first reflection of her practicum:

> [My mentor] also showed me some of the presentations she uses during her classes and the incorporation of technology. She said that she would be more than willing to try any new ideas that I think would be beneficial to her classroom…. she said that for the first couple weeks, I can observe and help students, while learning the class routines, procedures, and student names. After that, I can begin teaching lessons. She seemed excited to work with me and is looking forward to being my mentor teacher. I am excited to begin working with [my mentor] on Monday… (Jamie)

Jamie shares how her mentor expresses openness to "try any new ideas" and, by doing so, positions herself as a learner right alongside her TC.

In summary, TC reflections offer a snapshot of their co-teaching experiences in their practicum with their mentors in a community of practice. TC perceptions of their communities reveal how they perceive actions by their mentors as collaboratively supporting their learning and growth on a continuum.

**Research Question Five: How Do CPCT Strategies (Division of Labor) in Co-teaching Modeled Practicum Support TC Learning?**

***Summary of Findings***

The activity system's division of labor element refers to how the tasks are shared among the community (Yamagata-Lynch, 2010). The Division of Labor element of the co-teaching activity system was explored through survey responses. TC responses to open-ended survey

questions regarding their preference for co-teaching and co-planning strategies were analyzed using Guise, Habib et al. (2017)'s Co-teaching Continuum. TC responses (n=4) suggest a preference for more collaborative co-teaching and co-planning strategies.

***Qualitative Results***

**Co-teaching Strategies Preferred.** Results of survey responses to the question "Which co-teaching strategies are you most comfortable using? Why?" suggest that TCs who responded (n=4) are more likely to choose more collaborative forms of co-teaching. For example, Carl responded, "Pretty much all of them, depending on the situation..". Similarly, Brianne responded,

> Team teaching or parallel teaching; this way both teachers are able to cover the material together but the material may be divided in half. At any moment, either one can chime in or add ideas to help strengthen the message or convey the appropriate knowledge that the students are supposed to be learning (Brianne).

Brianne identifies team teaching and parallel teaching as two strategies that require the co-teachers to "divide the material in half" while also providing them an opportunity to teach by adding ideas to support student learning adaptively. Jamie also expresses a preference for collaborative co-teaching strategies by offering "..Station Teaching and Team Teaching because I enjoy collaborating with the mentor teacher…". TC responses reveal their preference for working more collaboratively with their mentors.

**Co-planning Strategies Preferred.** Results of survey responses to the question " Which co-planning strategies are you most comfortable using? Why?" suggest that TCs who responded (n=4) are also more likely to prefer more collaborative forms of co-planning. For example, Brianne responded, "Parallel planning or partner planning…two different people providing ideas

and plans leaves room for bouncing ideas off of each other and developing more thorough plans for their lessons…". Jamie similarly expressed an explicit desire to be collaborative with her mentor by responding, "Partner planning and Team planning because I enjoy collaborating. Honestly, I am comfortable with any strategy. I wouldn't mind creating the lesson plan.."

In summary, TCs who responded to survey questions about which co-teaching and co-planning strategies they preferred explicitly chose more collaborative strategies that involved the co-teachers sharing in the responsibilities more equitably. These findings suggest TCs responses are suggestive of alignment with Blended, Forward Momentum, and Scaffold and Grow continuum categories.

**Research Question 6: What Contradictions Impact TC Learning?**

***Summary of Findings***

Tensions in an activity system reveal inner contradictions in an activity system. Analyzing these contradictions is essential for analyzing an activity system (Yamagata-Lynch & Haudenschild, 2009). Contradictions can exist within an element, between elements, and between an element and the outcome of the activity system. In analyzing an activity system, these contradictions reveal "growth" points that allow the system to change (Roth et al., 2002). Therefore, tensions and contradictions were explored in the co-teaching activity system by coding TC reflections for evidence of tensions. Tensions were relatively few in the data set. However, findings reveal TCs expressing tension associated with contradicting values.

***Qualitative Analysis***

I coded TC reflections for tensions. I further analyzed these segments for evidence of contradictions. Primary contradictions refer to instances when the participants in an activity such as co-teaching encounter multiple value systems within an element of the system that generates

conflict causing tension (Yamagata-Lynch & Haudenschild, 2009). Following are excerpts from the dataset where tension appeared, along with my interpretation of the underlying contradictions.

**Contradictions in Community.** Tensions revealed evidence of contradictions in TC values within the community of mentor and TC. For example, Carla experiences conflict as she tries to describe her preference to visit the classroom on a day other than Friday:

> We decided that I would come for 6 hours a week so 3 hours on Monday and 3 hours on Friday. I was nervous to do Fridays because teachers don't have much planned since students will be off for the weekend. Another concern was that some teachers do weekly quizzes on Friday so I wasn't sure how that would work out. [My mentor] said that it shouldn't be a problem and that her students do the same amount of work every day of the week... (Carla)

This excerpt from Carla's reflection shows tension around which days of the week Carla should spend in the classroom. Carla seems to be experiencing two conflicting value systems. She values respecting her mentor as an expert mentor. Yet, she values gaining experience and expresses how Fridays can be days when students might take off for the weekend and subsequently teachers wouldn't have much planned besides quizzes, limiting TC's ability to gain valued teaching time. There seems to be a difference in opinion between Carla and her mentor regarding Fridays and whether those days will provide Carla with the needed teaching time. Notably, an outcome of the co-teaching activity system is the key practice of *Negotiating Difference* (ND). However, it is not clear from Carla's reflection whether the tension hinders or helps her develop the goal of learning ND practice.

Another instance of conflicting value systems is discernable in Gary's reflections about a summative test his mentor gave their students:

> …the test that the students were given was a test made from one of the other teachers at the school that teaches the same course but only for honors. This [raised] some flags in my mind about how this test is going to go with [my mentor] and my students. We have only one class that is Algebra 2 Honors and the rest that are regular. Once I got to the school, she told me the students will be taking this test that will be the summative assessment for topic two in their curriculum. I asked her to let me take this test to see how hard it would be and see what questions could give the students the most trouble. It took me a pre-service teacher a whole 47 minutes to take the test which is equivalent to one class period. I thought that this test is one meant for strictly an honors class and not for regular. I informed [my mentor] how difficult test [is] that she is going to give and she said it is too late to make any adjustments to it for the regular algebra classes and the only thing she [can] do is change how many points the test will be out of… (Gary)

In his reflection, Gary describes tension with his mentor about a test she administers to their students. Gary values fairness and questions whether it is fair for them to give their students a test made for honors students, given their students are regular. Gary describes how he enters a "brave space" and practices ND by offering to take the test himself to provide evidence about its difficulty; he ultimately engages his mentor in negotiating how many points each question will be worth.

In summary, contradictions in the activity system reveal tensions in TCs' reflections around Negotiating Difference (ND), an outcome of the activity system. These tensions are few in TC reflections, but these tensions reveal contradictions in values in the element of Community

that may impact TC Learning but may also offer “growth points” that allow the co-teaching activity system to change (Roth et al., 2002).

# CHAPTER FIVE DISCUSSION

## Scope and Sequence

In this chapter, I briefly review the background and purpose of this study, as well as my research questions and methodology. I then present relevant findings, implications for practice, limitations, and future research.

## Background and Purpose of the Study

Recently published empirical studies on co-teaching establish how co-teaching facilitates TC learning opportunities of key practices during semester-long and year-long field placements (Soslau et al., 2015; Thompson & Schademan, 2019). Key practices have been described as complex practices that are predictable and stable across contexts (Grudnoff et al., 2017). However, little of this empirical research explores TC learning in the practicum when time in the field is limited. Also, little of this empirical research specifically explores TCs who are studying to become secondary mathematics teachers. Therefore, this study attempted to determine if TC learning of key practices facilitated by co-teaching was evident in the practicum placements for secondary mathematics TCs. This study also explored how evidence of TC learning was associated with TCs' implementation of MTPs when TCs were observed teaching. By exploring co-teaching in early clinical placements such as the practicum, this study intends to add to research on effective co-teaching in early clinical placements.

## Research questions

This study addressed the following questions:

1. Is there evidence of TC Learning of co-teaching key practices in practicum placements?

2. Does TC learning of key practices impact their implementation of equitable MTPs in observations of TC teaching?
3. How does the community of co-teachers in a co-teaching-modeled practicum support TC learning?
4. What roles impact learning for TCs in practicum placements?
5. How do CPCT Strategies in co-teaching modeled practicum support TC learning?
6. What contradictions impact TC learning?

## Methodology

This study frames TC learning through the conceptual lens of an activity system. An activity system is a conceptual framework that captures the complex learning environment of co-teaching in early clinical placements (Yamagata-Lynch, 2010). This study uses a convergent mixed methods design to analyze TC participant data collected from their practicum.

## Discussion of Findings

### *Summary of Findings*

Coding of TC data sources revealed that TCs report learning the eight key practices associated with co-teaching during their practicum. In addition, correlational analysis suggests a strong positive association between the frequency of coding of the key practice *Adaptive Teaching* and the MCOP2 construct of *Student Engagement*. Lastly, TCs who report more instances of the key practice *Adaptive Teaching* also perceive their mentor as being more collaborative and feel more comfortable communicating their ideas to their mentor. More broadly, the co-teaching activity system elements exhibit more collaborative characteristics for TCs who report higher instances of *Adaptive Teaching*. Finally, although there was little

evidence of tension in the co-teaching activity system, tensions that were reported had to do with TCs reporting instances of conflicting values while co-teaching.

***Research Finding: TCs Report Learning Key Practices in Their Practicum***

The goal of the co-teaching activity system is TC learning of specific key practices that researchers have asserted are facilitated by co-teaching. To determine if the co-teaching activity system described in this study achieved this goal, I explored whether there was evidence of these key practices in practicum clinical placements. TC code frequencies of key practices garnered from TC reflections and observations revealed evidence of TC learning of all eight of these key practices. The most frequently coded key practices were *Sharing Authority* and *Collaborative Expertise*. Additionally, several key practices co-occurred in the data set. Notably, *Sharing Authority* frequently occurred together with *Growth Competence*, *Collaborative Expertise*, and *Adaptive Teaching*.

The finding that TCs report learning of all key practices in their practicum supports what co-teaching researchers have already established about TC learning of key practices in their studies of semester-long and year-long clinical placements that utilize the co-teaching model (Soslau et al., 2015; Thompson & Schademan, 2019). Additionally, Thompson and Schademan (2019) also asserted that certain key practices (such as *Sharing Authority*) are foundational to TC learning in clinical practices modeled on co-teaching. These foundational key practices, such as *Sharing Authority,* essentially facilitate other learning opportunities such as *Growth Competence*, *Adaptive Teaching*, and *Collaborative Expertise* because they establish a collaborative community of practice (Guise, Habib, et al., 2017; Soslau et al., 2015; Thompson & Schademan, 2019). Comparably, this study found that *Sharing Authority* frequently co-occurred with *Growth Competence*, *Collaborative Expertise*, and *Adaptive Teaching*. However, this study shows

evidence of TC learning of key practices along with co-occurrence patterns distinctly within the practicum when TCs co-teach for a mere 60 hours. This time attribute is considerably less co-teaching time than what year-long placements involve and what earlier researchers have studied. Also distinctive is that this finding occurs in practicum placements for secondary mathematics TCs. These practicum hours contain ample evidence of TCs reflecting on learning of key practices established in earlier empirical research of longer placements. Nonetheless, this evidence does not imply that TCs have mastered these key practices. Just because TCs report evidence of the key practice does not mean they have necessarily mastered the complexities associated with any one particular key practice (Grudnoff et al., 2017). Rather, this finding indicates that co-teaching in the practicum establishes a fertile environment for TCs to begin their learning of the complexities of these key practices.

***Research Finding: TC learning of Adaptive Teaching May Impact Implementation of MTPs***

To determine if TC learning of key practices impacted how TCs' implementation of MTPs while teaching, TC code frequencies of key practices were compared to the MCOP2 constructs of *Student Engagement* and *Teacher Facilitation.* A correlational analysis revealed a strong positive association between the frequency of participant coding for *Adaptive Teaching* and their mean scores for *Student Engagement* $(r(5) = .750, p < .05)$. Although these findings suggest there may be an association between the code frequencies of *Adaptive Teaching* and the construct of *Student Engagement*, this association does not imply causality. However, this association may reflect what is evident in empirical studies on co-teaching and *Adaptive Teaching*. For example, Soslau et al. (2018) documented an association between *Adaptive Teaching* and student learning when they described how co-teacher *huddles* were the context for developing *Adaptive Teaching Expertise*. They describe *huddles* as instances when two or more

teachers use short, focused meetings before, during, or after a lesson to discuss a shift or adaptation to co-planned instruction. These *huddles* "...combat teaching decisions that might result in pupils' misconceptions of content..." (p.100). Further, they describe *Adaptive Teaching* as a critical practice for TCs to develop because when TCs learn to adaptively teach, they learn to respond to the needs of students and to positively impact student learning (Soslau, 2012).

***Research Finding: The Co-Teaching Activity System Exhibits a More Collaborative Context for TC Learning***

Several of this study's research questions explore elements of the co-teaching activity system. These elements provide context for the TCs as they engage in learning. To better understand this context and how it might influence TC learning, the elements of community, rules, and division of labor were explored using data garnered in the practicum. Findings suggest that *Adaptive Teaching* code frequencies are higher for TCs who report being more comfortable communicating with their mentor and who perceive their mentors as more collaborative.

These findings support co-teaching researchers' findings that TC learning in clinical placements may depend upon an effective co-teaching environment where power is shared (i.e., *Sharing Authority*), that is highly collaborative (i.e., *Collaborative Expertise*), and where mentors embrace less hierarchical roles (Guise, Habib, et al., 2017; Soslau et al., 2019; Thompson & Schademan, 2019). More specifically, Guise, Habib, et al. (2017) found that successful co-teaching depends upon co-teachers establishing a community of practice where the co-teachers collaboratively construct knowledge together. More broadly, Guise, Habib, et al. (2017) asserted that co-teaching stimulates a shift in perspective relative to teacher learning. This shift in perspective results in the co-teachers seeing themselves as a community of practice based on collaborative learning and growth. In keeping with their assertion, this study's findings

support that a practicum modeled on co-teaching is fertile soil for stimulating TC learning of key practices such as *Adaptive Teaching*.

***Research Finding: Inner Contradictions of Values May Impact TC Learning***

Tensions in an activity system reveal inner contradictions in an activity system (Yamagata-Lynch & Haudenschild, 2009). Analyzing these tensions and contradictions is an important part of analyzing an activity system because these contradictions are treated as "growth" points that allow the system to change (Roth et al., 2002). TC reflections were coded for tensions to explore inherent contradictions in the co-teaching activity system. Tensions were relatively few in the data set. However, findings reveal TCs expressing tension associated with contradicting values (Yamagata-Lynch & Haudenschild, 2009).

The finding that TCs reflected on instances where they perceived tension in their co-teaching experience is consistent with Soslau et al. (2019) who described how TCs do not consistently perceive themselves as agents of their own learning and relied on their mentors to initiate changes; this complacency in their learning could have hindered their learning opportunities. Yet, these instances of tension in TC reflections and observations were limited in the practicum data sources. Perhaps this scarcity was due to the practicum clinical placement being too brief to produce tension. Also, perhaps few instances of tension were evident because TCs were not explicitly encouraged to reflect on tensions. Also, reflections are self-reported data sources. TCs reflect on their perceptions of experiences while co-teaching in their practicum. Accordingly, TCs may have a desire to present a mostly positive perspective on their experiences because of a desire to project an upbeat outlook. In the same way, Caprano et al. (2010) advised that self-report data is inherently faulty because of. "... the expectation that all people want to look good to authority figures because they have a need to impress or please others that supplant

the need to be honest; therefore, self-report data are inherently fault…" (p. 148). Therefore, instances of tension may be underreported by the TCs in an effort to put their best foot forward.

Regardless, evidence of tensions present opportunities for growth in the co-teaching activity system. Consequently, preparing TCs and their mentors to explicitly describe any perceived tensions in their co-teaching clinical experiences in terms of promoting or inhibiting their learning opportunities in the future may be a starting point to identifying growth points in the co-teaching activity system.

## Implications for Practice

### *Co-teaching in the Practicum Creates a Complex Yet Fertile Environment for TCs to Learn Key Practices*

The major implication of this study is that co-teaching in a secondary mathematics practicum cultivates a complex yet fertile ecology for TCs learning of several key practices. Primarily, this study illuminates TC learning of these key practices, which are known to occur in final field placements that use co-teaching. Yet, some of these key practices are facilitated by co-teaching, such as *Sharing Authority*, while others depend on effective co-teaching such as *Adaptive Expertise* (Soslau et al., 2015; Thompson & Schademan, 2019). In other words, without the co-teachers effectively sharing authority in the classroom, they would find engaging in collective efforts to adapt instruction based on student cues challenging. This study captures the interdependency of these key practices in the co-occurrence patterns. These co-occurrence patterns also capture what Thompson and Schademan (2019) asserted when they found that certain key practices are instrumental to effective co-teaching. This description paints a picture of a fertile yet layered learning environment into which our TCs are transplanted when they begin co-teaching in their clinical practice. Further, illuminating the learning in the practicum

provides evidence of the type of learning AACTE (2018) emphasized in their infrastructure proclamation statement that clinical practice ought to assume TCs will learn in a "complex and dynamic classroom environment" and will focus on "..not only on how long teacher candidates learn in the field but also on what happens in the field.." (p. 26). In support of this assertion, this study reveals that shortly after TCs are established in their co-teaching practicum, they begin learning several key practices relatively quickly.

Although this study provides evidence of TC learning from a single co-teaching practicum, these findings raise the question, how might early learning of key practices in a co-teaching practicum be cultivated to prepare TCs for their final field placements. More specifically, how might learning in the practicum help prepare TCs to be more collaborative-practice ready (Gilbert et al., 2010) or co-teaching practice-ready (Soslau et al., 2018) when they enter their final field placements? Bacharach and Team (2007) described how their co-teaching pairs engaged in ".. discussions about participants' readiness to share and commit to the co-teaching relationship.." (p. 3). However, Thompson and Schademan (2019) asserted the need to develop TC readiness in terms of their developing critical agency and their ability to "see themselves as equitable collaborators who also bring new ideas, the ability to relate differently to students, and evidence-based content knowledge learned through credential coursework..." (p. 8). Possibly the practicum could be envisioned as a space where "readiness" of TC learning of these key practices is more explicitly fostered. Towards that end, TC critical agency was evident in Carl's reflection:

> ...the day before the students had a substitute that was unable to help them with their assignment. Seeing as students were struggling with the assignment they had the day before, I was tasked to "be a new voice" to try and help the students clear up any

misunderstandings that they had, that the teacher may not be able to get through to them... (Carl)

In this instance, Carl's mentor affords Carl the opportunity to be a "new voice" -- an equitable co-teacher who brings fresh ideas to the learning community along with the ability to relate to students in new ways. By doing so, Carl's mentor affords him the opportunity to develop his "readiness" as an equitable collaborator in student learning and to practice being a critical partner in the classroom community of practice.

More broadly, Carl's reflection also suggests that he perceives he is being prepared to "...make a positive difference to the learning opportunities and outcomes of diverse, particularly disadvantaged, students..." (Grudnoff et al., 2017, p. 306), which Grudnoff et al. (2017) describe as a practice that promotes equity because it promotes student learning. To conclude, this finding of TC learning of key practices in the practicum raises interesting possibilities for how the practicum could be designed around key practices. Ultimately the learning of these complex key practices may depend on TCs' readiness to collaborate and co-teach in their final field placements. Yet, their readiness may enhance their learning to be a critical partner in the classroom and to develop a practice that promotes equity through promoting student learning for all students.

***When TCs Learn to Adaptively Teach, They Learn Patterns of Practice for Equity***

The results of this study also illuminate TCs learning to adaptively teach in the fertile learning environment of their practicum. When TCs learn to adaptively teach, they are learning to respond to the needs of students and to positively impact student learning (Soslau, 2012). Therefore, *Adaptive Teaching* represents a crucial strategy in addressing inequitable outcomes for students because it allows co-teachers coaching moments that result in immediate corrections

in their practice in response to student cues and authentic student input (Grudnoff et al., 2017; Soslau et al., 2015). As TCs learn to adaptively teach, they learn to foster the development of practices that are more effective for those students who are struggling (Ainscow, 2020). Therefore, instances of *Adaptive Teaching* may provide evidence of TCs learning to enact practice that generates positive outcomes for students who may be marginalized learners. Cochran-Smith et al. (2016) described "putting equity front and center in initial teacher education" (p. 67). Learning to adapt to student cues suggests "...patterns of practice for equity can be taught and learned in the crucible of practice through a variety of processes where in TCs and their mentors work together..." (Cochran-Smith et al., 2016). One such example of this enactment shone in Cesar's reflection, where he describes how his mentor helps him adaptively teach in real-time:

> ...everything in the lesson was going great until we had to write an equation of the trendline. The students showed confusion when no one wanted to volunteer or answer any of my guiding questions. At this point, my teacher told me to explain to the students how to write [an] equation for a line on a completely different example. I started a different example from scratch and made sure that by the end of class the students were not lost anymore… (Cesar)

In this instance, Cesar reflects on a moment in his teaching when he realizes his students are confused, yet he admits he does not know how to respond to their confusion until his mentor suggests he teach a mini-lesson on how to write an equation of a line. This example captures how *Adaptive Teaching* can be implemented in smaller doses and practiced immediately. This example also shows how TCs are learning to enact practice that generates positive outcomes for their students based on their learning to construct strategies for particular contexts (Cochran-

Smith et al., 2016). This example further suggests that patterns of equitable practice can be taught and learned in the crucible of practice as TCs and mentors work collaboratively together.

### *Activity Theory Conceptualizes the Co-teaching Practicum as a Complex Learning Environment*

A third implication of this study is the value of using activity theory and a co-teaching activity system to explore TC learning while co-teaching during the practicum. An activity system such as the one proposed in this study offers one possibility for conceptualizing the complex nature of TC learning while co-teaching (Weinberg et al., 2020). For example, the complexity of TC learning while co-teaching is evident in TCs' interrelated social experiences in community with their mentor and in their perceptions of the mentor roles that govern their community. Further, a co-teaching activity system, with its web of tensions, may also offer a new way to depict co-teaching as a learning ecology because co-teaching distinctively entails interrelated interacting elements rather than separate factors that work to impact TC learning (Cobb et al., 2003). More broadly, a co-teaching activity system as a conceptual lens may capture the learning paradigm between co-teachers as they share work as co-responsible partners in student learning (Cayton et al., 2017; Grady et al., 2016; Guise, Habib, et al., 2017).

## Limitations

There are several notable limitations in this study. These are addressed below.

### *Limitations of Sample Size*

The sample size and sampling for this study were based on a semester of practicum class data. Therefore, the sample size was predetermined, and the sampling was convenient in nature. This presents a limitation for this study because it is difficult to ascertain whether saturation in terms of key practices and tensions has been achieved for the particular population. Marshall et

al. (2013) advised that ensuring there is "enough" data is crucial to credible analysis and reporting in qualitative research. However, Boddy (2016) affirmed that smaller sample sizes could be used to inform and illuminate " .. areas or findings that are potentially highly relevant" (p. 426). Despite the limitation in sample size and the nature of convenience sampling, this study may illuminate TC learning in the practicum.

### *MCOP2 Limited Observations*

This study uses the MCOP2 to measure *Student Engagement* and *Teacher Facilitation* constructs. The MCOP2 is designed to measure the teaching practices in mathematics classrooms as expressed in standards documents published by national organizations focused on mathematics teaching and learning. However, the MCOP2 is a validated instrument based on at least three observations of these teaching practices (Gleason et al., 2017). This study uses two observations for each TC. Therefore, less than three observations present a limitation in the reliability of MCOP2 measures of the constructs of *Student Engagement* and *Teacher Facilitation.* Nevertheless, the data collected from the MCOP2 aligned with TC reflections and other data reporting tools. Therefore, the MCOP2 data was triangulated, and the patterns observed were consistent with the TC reflections and observations.

### *Missing Voices*

This study captures TC voices through reflections, observations, and surveys. However, TCs are only one of the many voices in the community of a co-teaching activity system. Notably, the voices of mentors and university supervisors are missing. Without their voices, critical perspectives on TC learning in a co-teaching activity system are absent.

### *Limitations of Self-Reported Data*

A portion of the data in this study is self-reported data. Caprano et al. (2010) advised that self-reported data is inherently faulty because of. "... the expectation that all people want to look good to authority figures because they have a need to impress or please others that supplant the need to be honest; therefore, self-report data are inherently fault…" (p. 148). Therefore, the use of self-reported data presents a limitation for this study because it may present misleading perspectives on TC learning in a co-teaching activity system. Nevertheless, due to data triangulation and observations by two researchers, the claims made were able to be substantiated.

## Future Research

### *Explore Coaching in the Practicum*

Similar to what Thompson and Schademan (2019) advised, future research could explore more of a coaching model in early clinical placements. A coaching model might allow TCs to gain greater expertise in certain key practices prior to their clinical internship. Coaching could emphasize *Adaptive Teaching Expertise* for example, and by doing so, establish "...patterns of practice for equity that could be studied and learned in the crucible of practice..." (Cochran-Smith et al., 2016). Coaching could include TCs studying vignettes of key practices such as *Negotiating Difference* so that they acquire proximation skills and can further develop agency of their own learning.

### *Distinguish Terms*

This study did not distinguish the term key practices from the term high-leverage practices (AACTE, 2018; Ball & Forzani, 2011). High-leverage practices have been described by Ball and Forzani (2011) as "... those practices at the heart of the work of teaching and most likely to affect student learning.." (p. 40). Similarly, Grossman et al. (2009) described core practices as

those that are high-leverage, occur with high frequency, and can be applied in multiple curricula contexts and with different instructional approaches, can be mastered by new teachers, allow new teachers to learn about students and teaching, maintain the integrity and complex nature of teaching, and are based on research and may improve student achievement. Future research could explore the literature relative to the nuanced differences of these terms in the context of a clinical practice that uses a co-teaching.

### *Draw on Richer Data Sources*

This study coded TC reflections for key practices. Future research could explore TC learning in the practicum using richer data sources such as interviews and focus groups, and video.

### *Associate Key Practices with Co-teaching and Co-planning Strategies*

This study did not deconstruct associations of key practices with certain co-teaching and co-planning strategies. Future research could explore these associations.

### *Expand Participant Pool*

This study gleaned evidence of TC learning from a single practicum class. This study could be expanded to include multiple practicum classes. Data across multiple practicum classes could be analyzed for more evidence of TC learning and co-occurrence patterns.

### *Explore Co-teaching Key Practices in Hybrid/Remote Learning Venues*

This study considers co-teaching in face-to-face classrooms that occurred prior to the pandemic. Yet, the pandemic forced teacher preparation programs to adapt their clinical practice to use virtual or online/remote instruction venues in some cases. TCs and their mentors who were co-teaching adapted their co-teaching practice to these virtual spaces. Future research could explore how key practices are evident in hybrid and online/remote learning environments that

use co-teaching. Future research could also explore what practices emerge from these hybrid/remote learning venues. For example, how might teacher candidates exhibit their digital teaching competence (Keefe, 2020) as they co-teach.

### *Explore Purposeful Observation*

This study reveals that TC learning of key practices in early clinical practice may begin as soon as they are engaged in co-teaching. Yet Mourlam et al., (2019) proposed a purposeful observation phase in their residency model. Mourlam et al., (2019) described purposeful observation as an opportunity TCs would have to learn about students, their mentor, and the school environment prior to co-teaching. Yet, Morris (2003) asserted that purposeful observation should be guided by observation parameters that structure a TC's observations, and brings to the forefront "... relevant existing knowledge, skills or attitudes in readiness for further learning.." (p. 3). Future research might consider the nature and role of purposeful observation of co-teaching in early clinical practice such as the practicum and what key practices TCs might look for as they purposefully observe instances of co-teaching in authentic classroom environments. Cohorts of TCs could purposefully observe other cohorts who are co-teaching in their clinical internship, for example.

### *Explore How Noticing is Enacted Through Adaptive Teaching*

Several classroom practices are equity-based teaching practices. They are specifically reflecting, noticing, and engaging in community (Chao et al., 2016). Noticing refers to TCs ability to pay attention to students' mathematical thinking and is a critical skill for equity-based teaching. Future research could explore how developing TCs' noticing skills is enacted through *Adaptive Teaching*.

### *Explore How Co-teaching Key Practices Facilitate the Teaching of Mathematics in Terms of Rigor and Productive Dialogue.*

This study suggests that the key practice of Adaptive Teaching may impact student engagement in observations of TC teaching of mathematics. However future studies could further explore how the co-teaching key practices may impact the rigor of the mathematics taught and the discourse evident in in TCs' mathematics teaching. Future studies could also consider how key practices impact rigor and discourse across various content-specific and contextual domains.

### *Develop a Unified Description of Co-teaching*

Co-teaching lacks a unified definition in the literature. Further, practitioners disagree regarding the purpose of co-teaching and this disagreement undermines implementation efforts and potential benefits (Hackett et al., 2019; Hackett et al., 2020). Future research could explore a more unified description of co-teaching.

## Conclusion

In conclusion, one way to transform clinical practice for secondary mathematics TCs may be to consider the learning evident in their early clinical placements that use co-teaching. TC learning in this complex learning environment reveals evidence of their learning of eight key practices facilitated by co-teaching. TC learning of these key practices seems to occur even when TCs co-teach for only 60 hours. The implication of this study for teacher preparation programs is that by cultivating early learning of these key practices in a co-teaching practicum, teacher preparation programs may ensure TCs are collaborative-practice ready or co-teaching practice-ready for learning of these key practices in their final field or clinical internship.

## REFERENCES


AACTE. (2018). A Pivot Towards Clinical Practice, Its Lexicon and the Renewal of Educator Preparation [Report]. https://aacte.org/resources/research-reports-and-briefs/clinical-practice-commission-report/

Ainscow, M. (2020). Promoting inclusion and equity in education: lessons from international experiences. *Nordic Journal of Studies in Educational Policy*, *6*(1), 7-16. doi: 10.1080/20020317.2020.1729587

APLU. (2021). *Mathematics Teacher Education Partnership*. Retrieved September 9, 2021 from https://www.aplu.org/projects-and-initiatives/stem-education/mathematics-teacher-education-partnership/

Bacharach, N., Heck, T. W., & Dahlberg, K. (2010). Changing the Face of Student Teaching Through Coteaching. *32*(1), 3-14. doi:10.1080/01626620.2010.10463538

Bacharach, N., & Team, C.-T. (2007). Utilizing co-teaching during the student teaching experience.https://www.aascu.org/uploadedfiles/aascu/content/root/programs/teachereducation/07_st_cloud.pdf

Ball, D., & Forzani, F. (2011). Teaching skillful teaching. *The Effective Educator*, 68(4), 40–45.

Boddy, C. R. (2016). Sample size for qualitative research. *Qualitative Market Research: An International Journal*, *19*(4), 426-432. doi:10.1108/qmr-06-2016-0053

Brosnan, Jaede, M., Brownstein, E., & Stroot, S. (2014, April 7). Co-planning and co-teaching in an urban context. Paper presented at the 2014 annual meeting of the American Educational Research Association. Retrieved February 12, 2020, from the AERA Online Paper Repository.

Campbell, S. S., & Dunleavy, T. K. (2016). Connecting university course work and practitioner knowledge through mediated field experiences. *Teacher Education Quarterly*, *43*(3), 49-70. http://www.jstor.org/stable/teaceducquar.43.3.49

Caprano, R. M., Capraro, M. M., Capraro, R. M., & Helfeldt, J. (2010). Do differing types of field experiences make a difference in teacher candidates' perceived level of competence? *Teacher Education Quarterly*, *37*(1), 131-154. https://www.jstor.org/stable/23479302

Cayton, C., Sears, R., Grady, M., Oloff-Lewis, J., Preston, R. V., & Brosnan, P. (2017). Improving pre-service secondary mathematics clinical experiences through co-planning and co-teaching [Article]. In E. Galindo & J. Newton, (Eds.), Proceedings of the 39th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (pp. 1524-1532). Indianapolis, IN: Hoosier Association of Mathematics Teacher Educators.

Chao, T., Murray, E., & Gutiérrez, R. (2014). What are classroom practices that support equity-based mathematics teaching? [Research Brief.] National Council of Teachers of Mathematics, Reston, VA. http://www. nctm. org/Research-and-Advocacy/Research-Brief-and-Clips/Classroom-Practices-That-Support-Equity-Based-Mathematics-Teaching.

Cobb, P., Confrey, J., DiSessa, A., Lehrer, R., & Schauble, L. (2003). Design experiments in educational research. *Educational Researcher*, *32*(1), 9-13. doi: 10.3102/0013189X032001009

Cochran-Smith, M., Ell, F., Grudnoff, L., Haigh, M., Hill, M., & Ludlow, L. (2016). Initial teacher education: What does it take to put equity at the center? *Teaching and Teacher Education*, *57*, 67-78. doi: 10.1016/j.tate.2016.03.006

Cochran-Smith, M., Villegas, A. M., Abrams, L., Chavez-Moreno, L., Mills, T., & Stern, R. (2015). Critiquing teacher preparation research: An overview of the field, part II. *Journal of Teacher Education*, *66*(2), 109-121. doi: 10.1177/0022487114558268

Cook, L., & Friend, M. (1995). Co-teaching: Guidelines for creating effective practices. *Focus On Exceptional Children*, 28(3), 1-16. doi: 10.17161/foec.v28i3.6852

Creswell, J., & Guetterman, T. (2019). Educational research: planning, conducting, and evaluating quantitative and qualitative research (Sixth ed.). Pearson.

Creswell, J. W. (2002). Educational research : planning, conducting, and evaluating quantitative and qualitative research  Merrill.

Crotty, M., & Crotty, M. F. (1998). The foundations of social research: Meaning and perspective in the research process. Sage.

Darling-Hammond, L. (2006). Constructing 21st-century teacher education. *Journal of Teacher Education*, *57*(3), 300-314. doi: 10.1177/0022487105285962

Darling-Hammond, L., & Oakes, J. (2021). *Preparing teachers for deeper learning*. Harvard Education Press.

Darragh, J. J., Picanco, K. E., Tully, D., & Henning, A. S. (2011). When teachers collaborate, good things happen: Teacher candidate perspectives of the co-teach model for the student

teaching internship. *The Journal of the Association of Independent Liberal Arts Colleges of Teacher Education*, *8*(1), 83-109.

Decuir-Gunby, J. T., Marshall, P. L., & McCulloch, A. W. (2011). Developing and Using a Codebook for the Analysis of Interview Data: An Example from a Professional Development Research Project. *Field Methods*, *23*(2), 136-155. doi: 10.1177/1525822x10388468

Dieker, L. A., & Murawski, W. W. (2003). Co-teaching at the secondary level: Unique issues, current trends, and suggestions for success. *The High School Journal*, *86*(4), 1-13. https://www.jstor.org/stable/40364319

Drewes, A., Soslau, E., & Scantlebury, K. (2020). Striving towards an ideal: coevaluation of student coteaching experiences. *Journal of Education for Teaching*, 1-15. doi: 10.1080/02607476.2020.1845954

Eick, C. J., Ware, F. N., & Williams, P. G. (2003). Coteaching in a science methods course: A situated learning model of becoming a teacher. *Journal of Teacher Education*, *54*(1), 74-85. doi: 10.1177/0022487102238659

Engeström, Y. (1999). Activity theory and individual and social transformation. *Perspectives on activity theory*, *19*(38), 19-30.

Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of education and work*, *14*(1), 133-156. doi: 10.1080/13639080020028747

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs—principles and practices. *Health services research*, *48*(6pt2), 2134-2156. doi: 10.1111/1475-6773.12117

Fowler Jr, F. J. (2013). *Survey research methods*. Sage publications.

Gallo-Fox, J., & Scantlebury, K. (2015). "It isn't necessarily sunshine and daisies every time": coplanning opportunities and challenges when student teaching. *Asia-Pacific Journal of Teacher Education*, *43*(4), 324-337. doi:10.1080/1359866X.2015.1060294

Gallo-Fox, J., & Scantlebury, K. (2016). Coteaching as professional development for cooperating teachers. *Teaching and Teacher Education*, *60*, 191-202. doi:10.1016/j.tate.2016.08.007

Gilbert, J. H., Yan, J., & Hoffman, S. J. (2010). A WHO report: framework for action on interprofessional education and collaborative practice. *Journal of Allied Health*, *39*(3), 196-197. https://apps.who.int/iris/bitstream/handle/10665/70185/?sequence=1

Gleason, J., Livers, S., & Zelkowski, J. (2017). Mathematics classroom observation protocol for practices (MCOP2): A validation study. *Investigations in Mathematics Learning*, *9*(3), 111-129. doi:10.1080/19477503.2017.1308697

Gleason, J., Livers, S. D., Zelkowski, J., Gleason, J., Livers, S., & Zelkowski, J. (2015). Mathematics classroom observation protocol for practices: Descriptors manual. Retrieved from http://jgleason.people.ua.edu/mcop2.html

Grady, M., Cayton, C., Preston, R. V., & Sinicrope, R. (2019). Co-planning strategies for mentor teachers and interns. *Theory & Practice in Rural Education*, *9*(2), 79-91. doi: 10.3776/tpre.2019.v9n2p79-91

Grady, M., Cayton, C., Sinicrope, R., Preston, R., & Funsch, A. (2016). Shifting paradigms for pre-service teachers' internship experiences: co-teaching as a model for relationships. [Article]. In E. Galindo & J. Newton, (Eds.), Proceedings of the 38th annual meeting of

the North American Chapter of the International Group for the Psychology of Mathematics Education (pp. 869-872). Tucson, AZ: The University of Arizona.

Grbich, C. (2012). Qualitative data analysis: An introduction. Sage.

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching, 15*(2), 273-289. doi:10.1080/13540600902875340

Grudnoff, L., Haigh, M., Hill, M., Cochran-Smith, M., Ell, F., & Ludlow, L. (2017). Teaching for equity: insights from international evidence with implications for a teacher education curriculum. *The Curriculum Journal*, *28*(3), 305-326. doi: 10.1080/09585176.2017.1292934

Guise, M., Habib, M., Robbins, A., Hegg, S., Hoellwarth, C., & Stauch, N. (2016). Preconditions for Success and Barriers to Implementation: The Importance of Collaborative and Reflective Dispositions to Foster Professional Growth during a Coteaching Clinical Experience. *Teacher Education Quarterly*, *43*(4), 55-75. https://www.jstor.org/stable/10.2307/teaceducquar.43.4.55

Guise, M., Habib, M., Thiessen, K., & Robbins, A. (2017). Continuum of co-teaching implementation: Moving from traditional student teaching to co-teaching. *Teaching and Teacher Education*, 370. doi:10.1016/j.tate.2017.05.002

Guise, M., & Thiessen, K. (2016). From Pre-Service to Employed Teacher. *Educational Renaissance*, *5*(1), 37-51. doi:10.33499/edren.v5i1.99

Guise, M., Thiessen, K., Robbins, A., Habib, M., Stauch, N., & Hoellwarth, C. (2017). The evolution of clinical practice: Moving from traditional student teaching to co-teaching. In

C. Martin & D. Polly (Eds.), *Handbook of research on teacher education and professional development* (pp. 1-33). IGI Global.

Gutiérrez, R. (2007). Context Matters: Equity, success, and the future of mathematics education [Article]. In T. Lamberg & L Wiest, (Eds), Proceedings of the 29th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (pp. 1-18). Lake Tahoe, NV. University of Nevada

Hackett, J., Bang, M., Goulter, A., & Battista, M. (2019). Crossing risky boundaries: Learning to authentically and equitably co-teach through design and practice [Article]. *Teaching and Teacher Education*, *86*(102889). doi:10.1016/j.tate.2019.102889

Hackett, J., Kruzich, J., Goulter, A., & Battista, M. (2020). Tearing down the invisible walls: Designing, implementing, and theorizing psychologically safer co-teaching for inclusion. *Journal of Educational Change*, 1-28. doi:10.1007/s10833-020-09401-3

Heck, T. W., Bacharach, N., & Dahlberg, K. (2008). Co-teaching: Enhancing the student teaching experience [Article]. In Eighth Annual International Business and Economics Research & College Teaching and Learning Conference Proceedings (pp. 1-11). Las Vegas, NV.

Horn, I. S. (2007). Fast kids, slow kids, lazy kids: Framing the mismatch problem in mathematics teachers' conversations. *The Journal of the Learning Sciences*, *16*(1), 37-79.

Illeris, K. (2009). *Contemporary Theories of Learning: Learning Theorists -- in Their Own Words* 1st. ed. Routledge.

Jez, R. J. (2020). Examining Equitable Practices Within Teacher Preparation. *Teacher Education Quarterly*, *47*(4), 100-106.

Keefe, E. S. (2020). Learning to practice digitally: Advancing preservice teachers' preparation via virtual teaching and coaching. *Journal of Technology and Teacher Education*, *28*(2), 223-232.

Khamis, H. (2008). Measures of association: how to choose? *Journal of Diagnostic Medical Sonography*, *24*(3), 155-162.

Kuutti, K. (1996). Activity theory as a potential framework for human-computer interaction research. In B.A. Nardi (Ed), *Context and consciousness: Activity theory and human-computer interaction*, MIT Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge university press.

Liao, H., & Hitchcock, J. (2018). Reported credibility techniques in higher education evaluation studies that use qualitative methods: A research synthesis. *Evaluation and Program Planning*, *68*, 157-165. doi:10.1016/j.evalprogplan.2018.03.005

Linneberg, M. S., & Korsgaard, S. (2019). Coding qualitative data: A synthesis guiding the novice. *Qualitative Research Journal*. *19*(3), 259–270. doi:10.1108/qrj-12-2018-0012

Marshall, B., Cardon, P., Poddar, A., & Fontenot, R. (2013). Does sample size matter in qualitative research?: A review of qualitative interviews in IS research. *Journal of computer information systems*, *54*(1), 11-22. doi:10.1080/08874417.2013.11645667

Martin, G., Lawler, B., Lischka, A., & Smith, W. (Eds). (2020). The mathematics teacher education partnership : The power of a networked improvement community to transform secondary mathematics teacher preparation. Information Age Publishing, Incorporated.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A Methods Sourcebook*. Sage.

Morgan, D. L. (2019). Commentary—After triangulation, what next? *Journal of Mixed Methods Research, 13*(1), 6-11. doi:10.1177/1558689818780596

Morris, C. (2003). Teaching and learning through active observation. CiteseerX. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.528.8974&rep=rep1&type=pdf

Morton, B. M., & Birky, G. D. (2015). Innovative University-School Partnerships Co-Teaching in Secondary Settings. *Issues in Teacher Education*, *24*(2), 119-132.

Moseholm, E., & Fetters, M. D. (2017). Conceptual models to guide integration during analysis in convergent mixed methods studies. *Methodological Innovations*, *10*(2), 1-11. doi:10.1177/2059799117703118

Mourlam, D. J., De Jong, D., Shudak, N. J., & Baron, M. (2019). A phenomenological case study of teacher candidate experiences during a yearlong teacher residency program. *The Teacher Educator*, *54*(4), 397-419. doi:10.1080/08878730.2019.1590750

Murawski, W. W., & Lochner, W. W. (2011). Observing co-teaching: What to ask for, look for, and listen for. *Intervention in school and clinic*, *46*(3), 174-183. doi:10.1177/1053451210378165

Namey, E., Guest, G., Thairu, L., & Johnson, L. (2008). Data reduction techniques for large qualitative data sets. G. Guest & K. MacQueen (Eds), *Handbook for team-based qualitative research* (pp. 137-161). Altamira Press.

National Council for the Teachers of Mathematics, NCTM (2014). *Principles to actions: Ensuring mathematical success for all*. National Council for the Teachers of Mathematics.

Nussbaumer, D. (2012). An overview of cultural historical activity theory (CHAT) use in classroom research 2000 to 2009. *Educational review*, *64*(1), 37-55. doi: 10.1080/00131911.2011.553947

Olmstead, K., Ashton, J. R., & Wilkens, C. P. (2020). Do You Really Want to Do This?: Teacher Candidate Perspectives on Imperfect Placements. *Teacher Education Quarterly*, *47*(4), 56-77.

Oloff-Lewis, J., Biagetti, S., Cayton, C., Grady, M., Stone, J., Riggs, L., Sears, R., & Castro-Minnehan, C. (2018a). Mentee Teacher Post-Survey.

Oloff-Lewis, J., Biagetti, S., Cayton, C., Grady, M., Stone, J., Riggs, L., Sears, R., & Castro-Minnehan, C. (2018b). Mentee Teacher Pre-Survey.

Rogoff, B., Baker-Sennett, J., Lacasa, P., & Goldsmith, D. (1995). Development through participation in sociocultural activity. *New Directions for Child and Adolescent Development*, 1995(67), 45–65. doi: 10.1002/cd.23219956707

Rogoff, B., Matusov, E., & White, C. (1996). Models of teaching and learning: Participation in a community of learners. *The handbook of education and human development*, 388-414.

Roth, W.-M., & Lee, Y.-J. (2007). "Vygotsky's neglected legacy": Cultural-historical activity theory. *Review of Educational Research*, *77*(2), 186-232. doi:10.3102/0034654306298273

Roth, W.-M., Masciotra, D., & Boyd, N. (1999). Becoming-in-the-classroom: A case study of teacher development through coteaching. *Teaching and Teacher Education*, *15*(7), 771-784. doi:10.1016/s0742-051x(99)00027-x

Roth, W. M., Tobin, K., Zimmermann, A., Bryant, N., & Davis, C. (2002). Lessons on and from the dihybrid cross: An activity–theoretical study of learning in coteaching. *Journal of*

*Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *39*(3), 253-282. doi: 10.1002/tea.10018

Saldaña, J. (2021). The coding manual for qualitative researchers. Sage.

Sandoval Jr, C., van Es, E. A., Campbell, S. L., & Santagata, R. (2020). Creating Coherence in Teacher Preparation: Examining Teacher Candidates' Conceptualizations and Practices for Equity. *Teacher Education Quarterly*, *47*(4), 8-32.

Sannino, A., Daniels, H., & Gutiérrez, K. D. (2009). Activity theory between historical engagement and future-making practice. A. Sannino, H. Daniels, & K. Gutierrez (Eds), *Learning and expanding with activity theory*. Cambridge University Press.

Scantlebury, K., Gallo-Fox, J., & Wassell, B. (2008). Coteaching as a model for preservice secondary science teacher education. *Teaching and Teacher Education*, *24*(4), 967-981. https://doi.org/10.1016/j.tate.2007.10.008

Scruggs, T. E., Mastropieri, M. A., & McDuffie, K. A. (2007). Co-teaching in inclusive classrooms: A metasynthesis of qualitative research. *Exceptional children*, *73*(4), 392-416. doi: 10.1177/001440290707300401

Sears, R., Maynor, J., Cayton, C., Grady, M., Stone, J., McCulloch, A., Edgington, C., & Oloff-Lewis, J. (2014). Mentee Just in Time Survey.

Soslau, E. (2012). Opportunities to develop adaptive teaching expertise during supervisory conferences. *Teaching and Teacher Education*, *28*(5), 768-779. doi:10.1016/j.tate.2012.02.009

Soslau, E., Gallo-Fox, J., & Scantlebury, K. (2015). Opportunities for learning in a co-teaching model: Implications for university-based field instructors. Paper presented at the 2015

annual meeting of the American Educational Research Association. Retrieved Feburary 12, 2020 from the AERA Online Paper Repository

Soslau, E., Gallo-Fox, J., & Scantlebury, K. (2019). The promises and realities of implementing a coteaching model of student teaching. *Journal of Teacher Education*, *70*(3), 265-279. doi: 10.1177/0022487117750126

Soslau, E., Kotch-Jester, S., Scantlebury, K., & Gleason, S. (2018). Coteachers' huddles: Developing adaptive teaching expertise during student teaching. *Teaching and Teacher Education: An International Journal of Research and Studies*, *73*(1), 99-108. doi: 10.1016/j.tate.2018.03.016

Stevenson, B. (2021). *Stevenson Shares Message of hope and justice with spring graduates*. https://record.umich.edu/articles/stevenson-shares-message-of-hope-and-justice-with-graduates/

Thompson, M., & Schademan, A. (2019). Gaining fluency: Five practices that mediate effective co-teaching between pre-service and mentor teachers [Article]. *Teaching and Teacher Education*, *86*. doi: 10.1016/j.tate.2019.102903

Tobin, K. (2006). Learning to teach through coteaching and cogenerative dialogue. *Teaching Education*, *17*(2), 133-142. doi: 10.1080/10476210600680358

Tobin, K., & Roth, W. M. (2005). Implementing coteaching and cogenerative dialoguing in urban science education. *School Science and Mathematics*, *105*(6), 313-322. doi:10.1111/j.1949-8594.2005.tb18132.x

Tschida, C. M., Smith, J. J., & Fogarty, E. A. (2015). "It Just Works Better": Introducing the 2:1 Model of Co-Teaching in Teacher Preparation. *Rural Educator*, *36*(2), 11-26. doi:10.35608/ruraled.v36i2.340

Weinberg, A. E., Sebald, A., Stevenson, C. A., & Wakefield, W. (2020). Toward conceptual clarity: A scoping review of coteaching in teacher education. *The Teacher Educator*, *55*(2), 190-213.

Wenger, E. (1998). Communities of practice : learning, meaning, and identity. Cambridge University Press.

World Health Organization. (2010). *Framework for action on interprofessional education and collaborative practice*. (No. WHO/HRH/HPN/10.3). World Health Organization.

Williams, H., & Ditch, R. (2019). Co-teaching: Equity for English Learners? *Theory & Practice in Rural Education*, *9*(2), 20-34. doi:10.3776/tpre.2019.v9n2p20-34

Yamagata-Lynch, L. C. (2010). Activity systems analysis methods: Understanding complex learning environments. Springer Science & Business Media.

Yamagata-Lynch, L. C., & Haudenschild, M. T. (2009). Using activity systems analysis to identify inner contradictions in teacher professional development. *Teaching and Teacher Education*, *25*(3), 507-517. doi: 10.1016/j.tate.2008.09.014

# APPENDICES

## Appendix A - Code Book for Key Practices

Codebooks were created using guidelines articulated by (Decuir-Gunby et al., 2011). The following codebook was developed using empirical research on Key Practices and TC learning opportunities developed by Soslau et al. (2015) and Thompson and Schademan (2019).

| Key Practice | Description From Cited Article | Code/SubCode Used |
|---|---|---|
| Adaptive teaching (Soslau et al., 2015) | • Adapt instruction based on student cues<br>• Adapt instruction based on contextual demands<br>• Adapt instruction based on balancing experimental teaching approaches with risks to pupil learning and well being | AT-student cues<br>AT-context<br>AT-balancing |
| Collaborative expertise (Soslau et al., 2015) | • Co-teachers practice evaluating instructional approaches<br>• Co-teachers practiced sharing teaching space<br>• Co-teachers practiced responding to planning curriculum and (discuss implications of curriculum choices, ask for ideas, advice, support)<br>• Co-teachers practiced responding to being co-responsible for pupil learning | CE-co-teachers practice evaluating instructional approaches CE-EIA<br>CE-co-teachers practice sharing teaching space CE-STS<br>CE-co-teachers practice responding to planning curriculum CE-PC (discuss implication of curriculum choices.. ask for ideas, advice, support (Tobin, 2006))<br><br>CE-practice responding to being co-responsible for student learning CE-CO |
| Growth competence (Soslau et al., 2015) | • Ability to develop professionally on the basis of internally directed learning<br>• Not competency-based teacher ed.<br>• Discussions of teaching decisions and enactments<br>• Engaging in practice of articulating rationales<br>• Producing justifications for teaching decisions<br>• Combined these provide TC opportunities to develop skills to reflect on practice now and in the future | GC-discussions of teaching decisions (GC-DTD)<br>GC-engaging in practice of articulating rationales (GC-AR)<br>GC-producing justifications for teaching decisions (GC-JTD)<br>-Justifying decisions<br>-Articulating reasoning/sense making |
| Negotiating difference (Thompson & Schademan, 2019) | • Pairs engage in tensions and work through them<br>• Pairs engage in a "brave space"<br>• Pairs engage to build from differences and turn attention towards students<br>• Pairs achieve honesty in relationship<br>• Involves getting “proximate” when dealing with a tension to work through the tension and achieve authenticity | ND |
| Sharing authority (Thompson & Schademan, 2019) | • Enacted linguistically, physically, and interactionally in coteaching practice: | ShA-L<br>ShA-P<br>ShA-I |

| Key Practice | Description From Cited Article | Code/SubCode Used |
|---|---|---|
| | ○ Linguistically- Referring to each other as co-teachers, use of inclusive pronouns, he language of "co-" evident<br>○ Physically- Providing a desk for TC<br>○ Interactionally- Taking on equitable roles and responsibilities in coteaching and co-planning; leveling of traditional hierarchy in interactions with students; providing TC early opportunities to take on a lead instructional or planning role with mentor support; being introduced to students as a teacher; more central participation | |
| Co-mentoring (Thompson & Schademan, 2019) | • Co-teachers were situated simultaneously as significant contributors and learners<br>• Begins with planning meetings/sessions during which mentors share curricula and activities they typically use to teach content and TCs also contribute ideas for lesson content, instructional approaches learned in university coursework or expertise with technology<br>• Co-teachers recognize and draw on each other's unique strengths and resources<br>Co-teachers plan lessons around one another's area of expertise<br>• Situated professional development for both co-teachers<br>Both positioned as important contributors to a shared practice | CM |
| Coaching in the moment (Thompson & Schademan, 2019) | • Instructional conversation carried out in front of students<br>• Allows TCs and mentors to modify instruction to better meet student needs<br>• Adaptive teaching<br>• A result of formatively assessing student needs and sometimes from directly soliciting student input<br>• Like cogenerative dialogues<br>• Collaboratively produced cogenerative dialogue focused on understanding and improving student learning<br>• Public and jointly decided modeling for students how to collaborate productively with others<br>• At the micro-level allows teachers to modify their instruction on the spot and model for students how to productively negotiate differences of opinion<br>• Timely, non-evaluative and able to be acted upon immediately<br>• Came when co-teachers elicited student input directly<br>• Daily non-evaluative corrections in their practice<br>• Involves invitations for authentic student input | CIM-student cues<br>CIM-collaborative dialogue<br>CIM -authentic student input<br>CIM-observation |

| Key Practice | Description From Cited Article | Code/SubCode Used |
|---|---|---|
| Immersing in real-world experience (Thompson & Schademan, 2019) | • Immersion into formal aspects of the teaching profession<br>• PD on two dimensions: belonging in the classroom and belonging at school<br>• Gaining a more realistic picture of what the real-world of teaching involved<br>• TCs experience every period and learn that different classes involve different learners, curricula, class routines, and lesson modifications<br>• TCs learn differentiation across classes and are better able to forge meaningful relationships with their students often in the first couple of weeks<br>• TCs become participants in the classrooms<br>• TCs have a clearer sense of the curriculum and use this knowledge to answer student questions in class or brainstorm aloud with their mentor about what should be modified to better address student needs<br>• TCs develop a strong sense of belonging in the classroom that translates to belonging at school<br>• TCs invited to attend staff meetings, IEP meetings etc.,. which permit TCs develop collegial relationships with other faculty and gain PD for their future practice | IRW-classroom<br><br>IRW-school |

## Appendix B - Code Book for Continuum Categories of Mentor Roles

Codebooks were created using guidelines articulated by (Decuir-Gunby et al., 2011). The following codebook was developed using the Continuum Categories developed by Guise, Habib, et al. (2017).

| Category Description per Guise, Habib, et al. (2017) | Code |
|---|---|
| **Traditional student teaching**<br>• Planning primarily done individually (either the pre-service teacher or the cooperating teacher took the lead)<br>• Co-instructional strategies primarily used included one teach/one observe and one teach/one assist in addition to solo time<br>• Pre-service teacher received feedback on his/her teaching from the cooperating teacher<br><br>**Key words from article that were used to characterize traditional student teaching**<br><br>• Expert/novice<br>• Pairs rely on traditional notions of apprenticeship<br>• "Coaching as a way of experts training nonexperts to use teaching or cognitive strategies that are already worked out"<br>• Mentor responsible for teaching<br>• One teach/one observe<br>• One teach/one assist<br>• Few instances of co-planning<br>• Role<br>  • Supervisor practica<br>  • Classroom placeholder<br>  • Role of evaluator<br>• TC assumes a subordinate role<br>• Use original plans of mentor<br>• Co-teacher responsible for planning<br>• Limited collaboration<br>• Teaching occurred in isolation with one teacher in charge<br>• Power differential (strong content knowledge, years of experience)<br>• TC seen as less knowledgeable<br>• Unidirectional<br>• Co-teaching not implemented the way they were trained | TST-E/N<br>TST-Coaching<br>TST-Mentor Teaches<br>TST-Mentor Supervisor<br>TST-Mentor Evaluator<br>TST - Power |
| **Blended experience**<br>• Blended experience: co-teaching guidance needed<br>• Planning, instructing, and assessing occurred individually and in collaboration with the cooperating teacher<br>• Co-instructional strategies primarily used included one teach/one observe, one teach/one assist, and team teaching<br>• Pre-service teacher received feedback on his/her teaching from the cooperating teacher<br><br>**Key words used to describe blended in article**<br>• Mixture of traditional teaching and co-teaching<br>• develop knowledge that was already known by the cooperating teacher | BE-Feedback<br>BE -CD<br>BE-Some Coteaching<br>BE-Relationship<br>BE- TC modifies lessons/plans of mentor by adding own ideas |

| Category Description per Guise, Habib, et al. (2017) | Code |
|---|---|
| • Some co-teaching<br>  • One teach one observe<br>  • One teach one assist<br>  • Team teaching (tag)<br>• Some co-planning<br>• One teach/one observe<br>• One teach/one assist<br>• Team teaching<br>• Collaboratively planned lessons<br>• TC modifies lessons/plans of Mentor by adding own ideas<br>• Collaboratively generate new lessons/units together<br>• Evidence of "Co-generative dialogue"<br>• Relationship development outside of classroom<br>• Interest in learning more about co-teaching, "are we doing this right?" | |
| **Forward Momentum**<br>• Forward momentum: lessons learned<br>• Co-teachers implemented co-planning, co-instructing, and co-assessing<br>• Co-teachers were strategic with when to implement co-teaching and when to implement solo time<br>• Co-teachers reflected on lessons collaboratively, moving beyond feedback on just the pre-service teacher's practice | FM-Strategic Solo<br>FM-50/50<br>FM-Oscillate<br>FM-Co-diff teaching<br>FM-co-plan<br>FM-nurturing<br>FM-co-teacher language implying 50/50 dynamic |
| **Key words used to describe forward momentum in article**<br>• Implements a variety of CPCT strategies<br>• Jointly modify lessons<br>• 50/50 lesson planning (50% TC, 50% Mentor)<br>• involve the TC actively in the classroom from day one and have an equal power dynamic<br>• oscillate between who was in the lead<br>• Differentiated teaching<br>• recognizing that there was more to co-teaching than co- instructing | |
| **Scaffold and Growth**<br>• Scaffold and grow; lifelong learners<br>• Co-teachers implemented various approaches to co- planning, co-instructing, and co-assessing<br>• Co-teachers were strategic with when to implement co- teaching and when to implement solo time<br>• Co-teachers reflected on lessons collaboratively, moving beyond feedback on just the pre-service teacher's practice<br>• The cooperating teacher showed openness to new ideas and was learning alongside the pre-service teacher | S&G-Strategic solo<br>S&G-Co-reflect<br>S&G-Co-learners<br>S&G-Equals<br>S&G- TC learning first |
| **Key words used to describe scaffold and growth in article**<br>• Mentor differentiates TC learning responding to needs of mentee<br>• Mentor growth mindset<br>• Mentor positions as learner alongside TC as a participant in the community of practice<br>• more equal power dynamic than is typically associated with traditional student teaching | |

| Category Description per Guise, Habib, et al. (2017) | Code |
|---|---|
| • implementing a variety of co- planning and co-instructing strategies so that both teachers had opportunities to assist, lead, and collaborate at different moments in the field experience.<br>• power dynamic created was [is] collaborative and both teachers were engaged in reflective practice<br>• collaboratively construct knowledge together | |

## Appendix C Just in Time (JIT) Survey

The JIT Survey used in this study is shown below (Sears et al., 2014). Each of the statements below is followed by a rating scale, which ranges from Strongly Agree (5) to Strongly Disagree (1).

| Question | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| 1. Your mentor supports you in implementing co-teaching. | | | | | |
| 2. You feel like a "real" teacher in the classroom. | | | | | |
| 3. You feel comfortable communicating your ideas with your mentor. | | | | | |
| 4. You feel comfortable communicating your ideas with your mentor. | | | | | |
| 5. You regularly plan lessons with your mentor. | | | | | |
| 6. You regularly reflect about lessons with your mentor. | | | | | |
| 7. When you are not the lead teacher, you frequently move around the room and engage students, individually and collectively, in mathematical discussions. | | | | | |
| 8. Your co-teaching experiences influence your instructional planning and practices. | | | | | |
| 9. Co-teaching increases your confidence about your classroom management skills. | | | | | |
| 10. Co-teaching helped you learn from your mentor. | | | | | |
| 11. You and your mentor consistently teach lessons together. | | | | | |
| 12. Your mentor consistently provides feedback about your lessons. | | | | | |
| 13. Co-teaching has been beneficial to my development as a teacher. | | | | | |
| 14. You use at least three of the co-teaching strategies per week. | | | | | |
| 15. You and your mentor have a scheduled time for co-planning. | | | | | |
| 16. When co-planning/ co-teaching, you and your mentor discuss (implement) student-centered instruction. | | | | | |

## Appendix D Pre and Post Survey

The following pre and post surveys were used in this study.

### *Pre survey*

The TC pre-survey is shown below (Oloff-Lewis et al., 2018b).

1. Which best describes your knowledge of the **co-teaching strategies**. (One teach, One observe; One teach, One assist; Station Teaching; Parallel Teaching; Supplemental/ Differentiated/ Alternative Teaching; Team Teaching)

- No knowledge 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- I know & could implement them all 5 (5)

2. Which **co-teaching strategies** are you most comfortable using? Why?

3. How did you learn about the **co-teaching strategies?** Check all that apply.

- Course work/methods course (1)
- Professional development (face-to-face only) (2)
- Online module(s) only (3)
- Hybrid face-to-face/online module (4)
- Other (5) _____
- I have not learned about the co-teaching strategies (6)

4. What do you believe will be the benefits of your **co-teaching e**xperience?

5. What do you believe will be the challenges of your **co-teaching** experience?

6. Which best describe your knowledge of the **co-planning strategies.** (One plan, One assist; Partner Planning; One reflect, One plan; One plan, One react; Parallel Planning; Team Planning)

- No knowledge 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- I know & could implement them all 5 (5)

7. Which **co-planning strategies** are you most comfortable using? Why?

8. How did you learn about the **co-planning strategies**? Check all that apply.
- Course work/methods course (1)
- Professional development (face-to-face only) (2)
- Online module(s) only (3)
- Hybrid face-to-face/online module (4)
- Other (5) _____
- I have not learned about the co-planning strategies (6)

9. What do you believe will be the benefits of your **co-planning** experiences?
10. What do you believe will be the challenges of your **co-planning** experiences?
11. What role do you think your mentor will take during planning and instruction?
12. Explain why teachers should promote access and equity in mathematics.
13. Please identify strategies that could be used to promote equity in the classroom setting

**Mathematical teaching practices**
For each practice, please choose one option per row

| | Yes (1) | No (2) |
|---|---|---|
| I have read about this practice. (1) | | |
| I have participated in a discussion about this practice in a workshop or class. (2) | | |
| I have seen this practice either in a classroom or video. (3) | | |
| I have planned for this practice in a lesson plan. (4) | | |
| I have tried this practice in a classroom. (5) | | |
| I have received feedback about my use on this practice. (6) | | |

14. **Establish mathematics goals to focus learning.**
Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.

15. **Implement tasks that promote reasoning and problem solving.**
Effective teaching of mathematics engages students in solving and discussing tasks that promote.

16. **Use and connect mathematical representations.**
Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.

17. **Facilitate meaningful mathematical discourse.**
Effective teaching of mathematics facilitates discourse among students to build shared

understanding of mathematical ideas by analyzing and comparing student approaches and arguments.

18. **Pose purposeful questions.**
Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.

19. **Build procedural fluency from conceptual understanding.**
Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.

20. **Support productive struggle in learning mathematics.**
Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.

21. **Elicit and use evidence of student thinking.** Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

22. Is there anything you'd like to tell us about your progress toward understanding and using the Mathematics Teaching Practices?

***Post survey***

The TC post survey used in this study is shown below (Oloff-Lewis et al., 2018a).

1. Which best describes your knowledge of the **co-teaching strategies**. (One teach, One observe; One teach, One assist; Station Teaching; Parallel Teaching; Supplemental/ Differentiated/ Alternative Teaching; Team Teaching)
- No knowledge 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- I know & could implement them all 5 (5)

2. Which co-teaching strategies are you most comfortable using? Why?
3. Which co-teaching strategies did you use most often? Why?
4. How did you learn about the co-teaching strategies? Check all that apply.

- Course work/methods course (1)
- Professional development (face-to-face only) (2)
- Online module(s) only (3)
- Hybrid face-to-face/online module (4)
- Other (5) _____
- I have not learned about the co-teaching strategies (6)

5. What do you believe are the benefits of your co-teaching experience?
6. What do you believe are the challenges of your co-teaching experience?
7. How valuable was co-teaching in your clinical experience?
   - No Knowledge 1 (1)
   - 2 (2)
   - 3 (3)
   - 4 (4)
   - I know them & could implement them all 5 (5)

8. What recommendations would you make to improve your co-teaching experience?
9. Which best describe your knowledge of the co-planning strategies. (One plan, One assist; Partner Planning; One reflect, One plan; One plan, One react; Parallel Planning; Team Planning)
   - No knowledge 1 (1)
   - 2 (2)
   - 3 (3)
   - 4 (4)
   - I know & could implement them all 5 (5)

10. Which co-planning strategies are you most comfortable using? Why?
11. Which co-planning strategies did you use most often? Why?
12. How did you learn about the co-planning strategies? Check all that apply.
    - Course work/methods course (1)
    - Professional development (face-to-face only) (2)
    - Online module(s) only (3)
    - Hybrid face-to-face/online module (4)
    - Other (5) _____
    - I have not learned about the co-planning strategies (6)

13. What do you believe are the benefits of your co-planning experiences?
14. What do you believe are the challenges of your co-planning experiences?
15. How valuable was co-planning in your clinical experience?
    - Not valuable 1 (1)
    - 2 (2)
    - 3 (3)
    - 4 (4)
    - Extremely valuable 5 (5)

16. What recommendations would you make to improve your co-planning experience?
17. What role did your mentor take during planning and instruction?
18. How did the following experiences influence your co-planning and co-teaching practices? Check all that apply.

- Course work/methods course (1)
- Professional development (face-to-face only) (2)
- Online module(s) only (3)
- Hybrid face-to-face/online module (4)
- Other (5) _____
- I have not learned about the co-planning strategies (6)

19. Explain why teachers should promote access and equity in mathematics.
20. Please identify at least 3 strategies that you used to promote equity in the classroom setting.
21. How did your use of equity strategies promote student learning?

**Mathematical teaching practices**

For each practice, please choose one option per row

| | Yes (1) | No (2) |
|---|---|---|
| I have read about this practice. (1) | | |
| I have participated in a discussion about this practice in a workshop or class. (2) | | |
| I have seen this practice either in a classroom or video. (3) | | |
| I have planned for this practice in a lesson plan. (4) | | |
| I have tried this practice in a classroom. (5) | | |
| I have received feedback about my use on this practice. (6) | | |

22**. Establish mathematics goals to focus learning.**
Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.

23. **Implement tasks that promote reasoning and problem solving.**
Effective teaching of mathematics engages students in solving and discussing tasks that promote.

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Effective teaching of mathematics engages students in making connections among mathematical

representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.

25. **Facilitate meaningful mathematical discourse.**
Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.

26. **Pose purposeful questions.**
Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.

27. **Build procedural fluency from conceptual understanding.**
Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.

28. **Support productive struggle in learning mathematics.**
Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.

29. **Elicit and use evidence of student thinking.** Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

30. Is there anything you'd like to tell us about your progress toward understanding and using the Mathematics Teaching Practices?

**Appendix E IRB Documentation**

UNIVERSITY of SOUTH FLORIDA

APPROVAL

April 22, 2021

Ruthmae Sears
4202 E. Fowler Ave., EDU105
Tampa, FL 33620

Dear Dr. Ruthmae Sears:

On 4/22/2021, the IRB reviewed and approved the following protocol:

| | |
|---|---|
| Application Type: | Continuing Review |
| IRB ID: | Pro00030535_CR000002 |
| Review Type: | Expedited 5 |
| Title: | Collaborative Research: Attaining Excellence in Secondary Mathematics Clinical Experiences with a Lens on Equity ( #1726362 - University of South Florida) |
| Funding: | National Science Foundation |
| IND, IDE, or HDE: | None |
| Approved Protocol and Consent(s)/Assent(s): | • Version 2_ September 23 2020 _IRB Protocol _ Without track changes .docx;<br><br>Approved study documents can be found under the 'Documents' tab in the main study workspace. Use the stamped consent found under the 'Last Finalized' column under the 'Documents' tab. |

Within 30 days of the anniversary date of study approval, confirm your research is ongoing by clicking Confirm Ongoing Research in BullsIRB, or if your research is complete, submit a study closure request in BullsIRB by clicking Create Modification/CR.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,
Gina Larsen
IRB Manager
**Institutional Review Boards / Research Integrity & Compliance**
FWA No. 00001669
University of South Florida / 3702 Spectrum Blvd., Suite 165 / Tampa, FL 33612 / 813-974-5638

## Appendix F Copyright Permissions

### *Campbell & Dunleavy, (2016) Copyright Permission*

9/16/21, 5:42 PM Mail - Cynthia Castro-Minnehan - Outlook

The permission you request to adapt the figure from the Campbell & Dunleavy article in Teacher Education Quarterly for your dissertation research is granted with the understanding that you will give full credit to the co-authors and to Teacher Education Quarterly by identifying the volume and issue in which the original figure appeared.

--Alan H. Jones, Publisher, Caddo Gap Press

Campbell, S. S., & Dunleavy, T. K. (2016). Connecting university course work and practitioner knowledge through mediated field experiences. Teacher Education Quarterly, 43(3), 49-70.

### *Engstrom (2001) Copyright Permission*

**Re: Request Permission to use Figure 2**

**Engeström, Yrjö H M <yrjo.engestrom@helsinki.fi>**

Mon 10/25/2021 2:27 PM

To:

Cynthia Castro-Minnehan <ccastrominne@usf.edu>

Dear Cynthia, I hereby grant you permission to reproduce the figure specified in your request below.

Sincerely,

Yrjö Engeström

On 25 Oct 2021, at 19.47, Cynthia Castro-Minnehan <ccastrominne@usf.edu> wrote:

Hello Dr. Engestrom-
I hope this email finds you well.

I am reaching out to request permission to use figure 2 from your journal article,

Yrjö Engeström (2001) Expansive Learning at Work: Toward an activity theoretical reconceptualization, Journal of Education and Work, 14:1, 133-156, DOI: 10.1080/13639080020028747

I have had some issue gaining permission from the Journal of Education and Work. I am making final edits to my dissertation and would very much like to include figure 2 from this article with your permission. If it is possible to grant this permission, please let me know.

Thank you,
Cynthia

Cynthia Castro-Minnehan
*she/her/hers*
Research Assistant
NSF Grant -- Collaborative Research: Attaining Excellence in Secondary Mathematics Clinical Experiences with a Lens on Equity
University of South Florida
College of Education
Department of Teaching and Learning
4202 E. Fowler Ave.
Tampa, FL 33620