Implementation of Paired Placement and Co-Planning /Co-Teaching Field Experience Models Across Multiple Contexts

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Citation

Abstract
A consortium of 24 universities and their school partners engaged in a networked improvement community design to develop clinical experience models designed to build candidates’ facility with the effective mathematics teaching practices and other equitable teaching strategies to promote secondary school students’ success in achieving college- and career-ready standards. The authors discuss mechanisms to aid in the implementation of two alternative models: 1) the paired placement model, in which two prospective teachers are paired with a single mentor teacher, allowing the mentor teacher to provide purposeful coaching and mentoring and the two pre-service teachers to offer each other feedback, mentoring, and support; and 2) co-planning and co-teaching, which has been found to help teacher candidates gain greater pedagogical content knowledge and knowledge of students through collaboration and communication between teacher candidates and mentor teachers who plan, implement, and assess instruction together.

Introduction
For nearly nine decades, student teaching and field experiences of teacher candidates have remained significantly unchanged (Gyuton & McIntyre, 1990; King, 2006; Darling-Hammond, 2010). Historically, criticisms of teacher education have included the qualifications of teacher educators, the qualifications of teacher candidates, the structure of the institutions providing teacher education, the inconsistency of the curriculum in teacher education programs, DOI: 10.4018/978-1-5225-6249-8.ch002
and the gap between theory and practice (Darling-Hammond, 2010; Lanier & Little, 1986; Levine, 2006). However, since the early 2000s, there has been a global increase in research of reformed practices in teacher education programs and teacher candidate development (King, 2006; Capraro, Capraro, & Helfeldt, 2010; Tschida, Smith, Forgarty, 2015; Lang, Neal, Karvouni, Chandler, 2015). At the center of this reform has been an effort to connect theory to practice through well-designed field experiences (Darling-Hammond, 2010). According to the National Council for Accreditation of Teacher Education (NCATE) (2008), “field experiences and clinical practice are integral program components for the initial and advance preparation of teacher candidates” (p. 32). These experiences should allow teacher candidates to apply their acquired knowledge, skills, and dispositions in multiple settings relevant to their program of study (NCATE, 2008). Well designed and properly sequenced field experiences help teacher candidates successfully develop the competencies necessary to begin a career as teacher (NCATE, 2008). Additionally, to align teacher candidates’ pedagogical knowledge and teaching practices, collaboration among the teacher candidate, university instructor, and the mentor teacher must take place (NCATE, 2008, Putnum & Borko, 2000). The view of knowledge as socially-constructed clearly implies that an important part of learning to teach is becoming enculturated into the teaching community (Putnum & Borko, 2000). It is clear that learning from practice is key to developing well-prepared teacher candidates (Duncan-Howell, 2010). To ensure field experiences provide teacher candidates with the opportunities to learn through practice, several aspects of the field experience must be considered.

First, the assigned field experiences and teacher candidates’ education courses must be closely aligned and connected. In many cases, a disconnect exists between the university teacher-education courses and teacher candidates’ assigned field experiences (Zeichner, 2010; Darling-Hammond, 2010). It is not uncommon for a mentor teacher to have little or no knowledge about the course, or objectives for the course, in which the assigned teacher candidate is currently enrolled. Similarly, the instructor of the university courses often has little knowledge of the teaching practices of the mentor teacher for which his or her teacher candidates have been assigned (Zeichner, 2010). This disconnect may often result from field placement assignments being outsourced to a central administrative office, with little or no consideration given from university faculty, mentor teacher, or school administration (Zeichner, 2010). The disconnect may be further compounded as many tenure track faculty are not assigned to student supervision within field placements, thus, placing further separation between the teacher candidates’ courses and field placements (Ziechner, 2010).

Second, teacher candidates must be placed with quality and qualified mentor teachers (The National Council for Accreditation of Teacher Education [NCATE], 2010; Darling-Hammond, 2010). Darling-Hammond (2010) stated, “It is impossible to teach recruits how to teach powerfully by asking them to imagine what they have never seen or to suggest they ‘do the opposite’ of what they have observed in the classroom” (p. 42). No amount of education coursework can prepare students to be effective educators if they are only placed in settings that will further engrain ineffective teaching practices and beliefs (Darling-Hammond, 2010). Mentor teachers should—and must—be held to the highest of teaching standards; NCATE even recommended that multiple teacher education associations should collaborate in developing rigorous selection criteria to be used in selecting mentor teacher placements (NCATE, 2010).

In addition to mentor teachers being great teachers, mentor teachers must also have productive dispositions towards teacher education and mentoring (Darling-Hammond, 2010; NCATE, 2010; Zeichner, 2010). NCATE (2010) was specific in stating that those who serve as
mentor teachers should have an understanding of how adults learn. Specific to mentoring, Zeichner and Bier (2015) stated, “Building the capacity of schools to host teacher candidates for their clinical experiences and developing the capacity of teachers to be high-quality mentors must be priorities if we are serious about making clinical experiences the central aspect of teacher education” (p. 25). Furthermore, many states require mentor teachers to complete mentoring training prior to hosting teacher candidates (NCATE, 2010). Given the high demands and dual roles of mentor teachers—being both an effective teacher and teacher educator—mentor teachers should be compensated for their time and work (Darling-Hammond, 2010; NCATE, 2010; Zeichner, 2010).

The Clinical Experience Research Action Cluster (CERAC) of the Mathematics Teacher Education Partnership (MTE-P), a subsidiary of the Association of Public and Land Grant Universities, is one group that has taken on the challenge of transforming secondary mathematics teacher candidates’ field/clinical experiences. MTE-P is a consortium of over 104 U.S. universities and colleges, along with partner school districts, focused on improving the initial preparation of secondary mathematics teachers. MTE-P uses a network improvement community (NIC) design that incorporates improvement cycles to develop adaptable interventions across contexts to support comprehensive program improvement (Martin & Gobstein, 2015). NICs, such as the MTE-P are defined by four main characteristics:

1. They are focused on a well-specified common aim;
2. They are guided by a deep understanding of the problem, the system that produces it, and a shared working theory of how to improve it;
3. Their work is disciplined by the rigor of improvement science, and
4. They are coordinated to accelerate the development, testing, and refinement of interventions, their rapid diffusion out into the field, and their effective integration into varied educational contexts (Bryk et al., 2015; Russell et al., 2017, p. 3).

In summarizing the work of NICs, Russell et al. (2017) stated that “NICs are intended to situate practice improvement efforts in a supportive social architecture to accelerate a field’s capacity to learn to improve (p. 3)”. Rather than addressing a single dimension of a secondary mathematics program, MTE-P is undertaking parallel lines of research in multiple areas. Thus, the MTE-P is using improvement science as a mechanism to transform secondary mathematics education. Improvement Science is defined as “a disciplined approach to learning from practice, by deploying rapid tests of change to guide the development, revision and continued fine-tuning of new tools, work processes, roles and norms (Russell et al., 2017, p. 17).

This chapter focuses on one of the MTE-P’s lines of research related to clinical experiences. The CERAC consists of representatives of 24 university-led teams which have employed improvement science methods to developed resources that support improved models for both student teaching and early field experiences, as well as professional development for mentor teachers. Consistent with the calls for change in clinical experiences enumerated above and the NIC framework, the CERAC focuses on a problem that is two-fold:

1. There is an inadequate supply of quality mentor teachers to oversee clinical experiences. Too few teachers are well-versed in implementing the Common Core State Standards for Mathematics (CCSSM) and other college and career standards, and teachers are especially inexperienced with embedding the
Standards for Mathematical Practice into their teaching of content standards. The Standards for Mathematical Practice are eight habits of mind that mathematics teachers should strive to develop in their students. They include; 1) Make sense of problems and persevere in solving them, 2) Reason abstractly and quantitatively, 3) Construct viable arguments and critique the reasoning of others, 4) Model with mathematics, 5) Use appropriate tools strategically, 6) Attend to precision, 7) Look for and make use of structure, and 8) Look for and express regularity in repeated reasoning (National Governor Association [NGA] & the Council of Chief State School Officers, 2010.)

2. Bidirectional relationship between the teacher preparation programs and school partners in which clinical experiences take place are rare. Such relationships that reflect a common vision and shared commitment to the vision of CCSSM and other college and career standards, and other issues related to mathematics teaching and learning are critical to the development and mentoring of new teachers.

The CERAC began as a working group with MTE-P in 2012. CERAC held face-to-face meetings and conference calls to discuss problems of practice related to clinical experiences. The discussions held in the meetings directed CERAC to focus on the various approaches to clinical experiences and their outcomes, the development of mentor teachers as teacher educators, and the impact of field experiences. To expand the investigation, MTE-P also sent surveys to its higher education partners to identify areas in which they believed their programs needed improvement related to clinical experiences. Some specific survey question related to clinical experiences were:

1. How do you select mentor teachers to work with your teacher candidates?
2. What professional development do you provide for mentor teachers prior to them supervising interns?
3. Do you provide any continuing professional development for mentor teachers?
4. What relationships exist between the program faculty and mentor teachers?
5. Do you have the typical model for supervising interns? That is, you have one intern is assigned to individual mentor teacher, with a university representative.
6. Are mathematics content courses connected to the internship experience in any way?

To coalesce the data collected, CERAC wrote a white paper which included a review of existing literature related to clinical experiences, results of the MTE-P survey, and references to the MTE-P guiding principles (MTE-P, 2014); Guiding Principle 7, which focuses directly on clinical experiences, follows:
Guiding Principle 7. Clinical Experiences
The teacher preparation program provides clinical experiences to ensure that teacher candidates are able to demonstrate practices found to be effective in supporting student success in mathematics as defined in the CCSSM and other college- and career-ready standards.

Indicators of the guiding principle include:

1. 7-A. **Embedded, Early, Sequential, and Intensive Clinical Experiences:** The teacher preparation program provides teacher candidates with intentional and appropriate clinical experiences that begin early in their program and become increasingly intense as they progress through the program, focused on learning and demonstrating effective mathematical and educational knowledge.

2. 7-B. **Well-Supervised Clinical Experiences, Aligned with Program Goals:** The teacher preparation program provides supervision of clinical experiences based on a partnership between knowledgeable university faculty and master teachers of mathematics, who share a common vision of mathematics teaching and learning.  

(MTE-P, Revised 2014)

The Guiding Principles document contains other principles and indicators related to clinical experiences which focus on teacher candidates’ content knowledge, disposition towards students, and awareness of equity issues. It is important to note that the Guiding Principles document served as one of the foundational documents for the writing of the *Standards for Preparing Teachers of Mathematics* (Association of Mathematics Teacher Educators, 2017).

The white paper provided a solid framework from which CERAC developed a fishbone diagram, “a tool that visually represents a group’s casual systems analysis and is also known as a cause and effect diagram” (Bryk, Gomez, Grunow, & LeMahieu, 2015, p.198). The white paper also provided the initial driver diagram, which is a tool that visually represents a group’s (NIC’s) working theory of practice improvement, creates a common language, and coordinates the efforts among many different individuals joined together in solving a shared problem (Bryk et al. 2015, p.199). Table 1.0, below contains the CERAC aim and driver diagram.
Components of the CERAC Driver Diagram

<table>
<thead>
<tr>
<th>Aim</th>
<th>Primary Drivers (What)</th>
<th>Secondary Drivers (How)</th>
<th>Tertiary Drivers (Change Ideas)</th>
</tr>
</thead>
<tbody>
<tr>
<td>During student teaching Teacher Candidates (TCs) will use each of the eight Mathematics Teaching Practices (NCTM, 2014) at least once a week during full time teaching.</td>
<td>Transparent and coherent system of mentor selection and support</td>
<td>Increase the number of effective mentor teachers who are well versed in the CCSSM and MTPs.</td>
<td>The development of a professional development program related to mentoring mathematics teachers.</td>
</tr>
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<td></td>
<td>Interdependency of methods course and early field experiences</td>
<td>Deliberate focus on connecting coursework of the methods course to the field experience of the candidates.</td>
<td>Provide ongoing professional development and course work related to the CCSSM and NCTM’s MTPs.</td>
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<td></td>
<td>Student teaching as clinical training</td>
<td>Ensure self–assessment – feedback from TCs about student teaching experience.</td>
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<td></td>
<td>Shared vision about teacher development</td>
<td>Establish collaborative meetings to negotiate conflicting beliefs and constraints relative to each partner.</td>
<td>Convene either face-to-face or online meetings to plan field experiences, articulate expectations, and reflect on norms and cultures within the class settings.</td>
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<tr>
<td></td>
<td>Focus on access and equity</td>
<td>Develop infrastructures and clinical experiences that best meet the needs of the candidates.</td>
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Table 1.0

In the first column is the CERAC’s aim, focuses on teacher candidates' weekly implementation of the eight Mathematics Teaching Practices (MTPs) (National Council of Teachers of Mathematics [NCTM], 2014) during full-time student teaching field. NCTM’s (2014) eight research-based Mathematics Teaching Practices (MTPs) delineate specific professional practices known to promote learning aligned with college and career ready content standards: 1) Establish mathematics goals to focus learning. 2) Implement tasks that promote reasoning and problem solving. 3) Use and connect mathematical representations. 4) Facilitate meaningful mathematical discourse. 5) Pose purposeful questions. 6) Build procedural fluency from conceptual understanding. 7) Support productive struggle in learning mathematics. and 8) Elicit and use evidence of student thinking. Learning about the MTPs must be at the core of teacher preparation coursework and reflected in their clinical experiences. However, there are not enough mentor teachers at the secondary mathematics level prepared to foster the growth of teacher candidates, due to a lack of proficiency with this new approach to teaching, which is in alignment with the NCTM (1989, 1991, 1995, 2000, 2014) standards documents, particularly the eight MTPs. The quantity of potential mentor teachers who are well-versed in implementing the
CCSSM and other college and career standards is limited, especially those regularly embedding the standards for mathematical practice into their teaching of content standards.

Even a cursory examination of the CCSSM and the MTPs reveals expectations for learning and teaching that are quite different from what is happening in many high school classrooms, and overwhelmingly so in the highest need schools, which remain more oriented toward shallow learning of formulas and algorithms (Flores, 2007; Strutchens, Quander, & Gutierrez, 2011). While university coursework can provide knowledge about content and about teaching strategies, it is during clinical experiences that prospective teachers develop the craft of teaching—for instance, the ability to design lessons that involve important mathematical ideas, design or select tasks that will help students to access those ideas, and implement instructional strategies to successfully execute the lesson (Leatham & Peterson 2010a). Consequently, teacher candidates often find it difficult to learn to implement the MTPs advocated by NCTM (2014).

The primary drivers are in the second column of Table 1.0. Primary drivers represent the community’s hypothesis about the main areas of influence necessary to advance the improvement aim (Bryk et al., 2015). The primary drivers in the diagram are as follows:

1. **Transparent and coherent system of mentor selection and support (mentor teachers & university supervisors).** Organize mentor selection and support around deepening expertise with math content, math standards, MTPs, and mentoring strategies.
2. **Interdependency of methods course and early field experiences.** Structure methods course assignments with a focus on MTPS and CCSSM such that they include engagement of mentor teachers.
3. **Student teaching as clinical training.** Ensure that requirements for student teaching and feedback during student teaching emphasize the responsibility of teacher candidates to advance mathematics learning among secondary students through collaboration with more expert mentors in use of MTPs.
4. **Shared vision about teacher development.** Ensure mutual agreement between district(s) and university about what quality teaching of secondary mathematics looks like and how to further skills of all teachers (including TCs) and see mentor teaching as part of a career ladder.
5. **Focus on access and equity.** Disrupt long-standing teaching practices that contribute to inequities in learning outcomes of students.

The secondary drivers are system components that are hypothesized to activate each primary driver change (Bryk et al., 2015). Table 1.0 shows the relationship between the primary drivers and the secondary drivers. Also included in Table 1.0 in the fourth column are tertiary drivers, change ideas that can help move the primary drivers forward. The tertiary drivers are action areas that the CERAC might address.

**Organization of the CERAC**

In order to meet our aim, the CERAC is made up of teams that contain representatives of the major stakeholders involved in clinical experiences. Each of the CERAC teams consists of at least one mathematics teacher educator, a mathematician, and a school partner. The CERAC is divided into three sub-RACs based on the three types of field experiences that we are
implementing to meet the goals that we set forth in our primary drivers and our aim statement. The sub-RACs are: Methods, Paired Placement, and Co-Planning and Co-Teaching. In accordance with improvement science, each sub-RAC is implementing Plan-Do-Study-Act (PDSA) cycles based on goals and objectives. Below we define the components of the PDSA cycle since we use the process as one of our most important tools for improving clinical experiences (Bryk et al. 2015, p. 122):

1. Plan
   - Define the change.
   - Make predictions about what will happen as a result.
   - Design a way to test the change on an appropriate scale.

2. Do
   - Carry out the change.
   - Collect data and document how change was implemented.

3. Study
   - Analyze the data.
   - Compare what happened to predictions.
   - Glean insights for next cycle.

4. Act
   - Decide what to do next based on what you learned.
   - Abandon the idea? Make adjustments? Expand the scale.

PDSA cycles help us to determine whether or not a change is actually an improvement and to move slowly in order to scale up more efficiently (Bryk et al., 2015). Moreover, PDSA cycles allow for opportunities to learn via practice, and is guided by three questions: “What are we trying to accomplish? How will we know that a change is an improvement? [and] What change can we make that will result in an improvement?” (Lewis, 2015, p. 55). In addition to implementing PDSA cycles sub-RACs may create specific instruments to measure the effectiveness of the tools they develop and the particular field experience model they are studying. The assessments completed by teacher candidates across the sub-RACs include the Mathematics Teaching Practices Survey, the MTEP Completers Survey, and the MCOP2. Below is a description of each of the RAC instruments:

- **Mathematics Teaching Practices Survey** (NCTM, 2014) is designed to monitor the extent to which teacher candidates have read, discussed, observed, planned, enacted, and received feedback on each MTP across the continuum. The teacher candidate will be asked to complete the survey multiple times throughout the continuum. The CERAC used a PDSA cycle to determine the correct format for the survey and to decide the best way to collect the data. We learned that the format for collecting the data was crucial in gathering usable data that could both inform institutions individually and collectively.

- **The Mathematics Classroom Observation Protocol for Practices (MCOP2)** is a K-16 mathematics classroom instrument designed to measure the degree of alignment of the mathematics classroom with the standards for mathematical practice from the CCSSM (NGA & CCSSO, 2010); the NCTM (2000) process standards; and recommendations for undergraduate mathematics instruction. The instrument contains 17 items intended to
measure three primary constructs (student engagement, lesson content, and classroom discourse) (Gleason & Cofer, 2014).

- **MTE-P Program Completer Survey** is designed for program completers to self-assess their success in developing the craft of teaching, based on the MTE-P Guiding Principles (MTE-P, 2014) and the mathematical teaching practices (NCTM, 2014). The survey also asks them to assess the success of their preparation program in alignment with the Guiding Principles, including their clinical experiences.

Teams work together via conference calls, email, and the Trellis (AAAS communication and collaborative platform). We use Dropbox and Trellis as a way of sharing files and materials. We have held face-to-face meetings as a RAC that included breakout meetings for sub-RACs. The sub-RACS have overlap areas that drive and focus the RAC, such as the emphasis on the effective Mathematics Teaching Practices (National Council of Teachers of Mathematics [NCTM], 2014), professional development for mentors related to the CCSSM and mentoring mathematics teacher candidates, and outcome measures. There are also specific goals to be attained within each of the sub-RACs. Each sub-RAC has developed its own specific research questions. The work of the CERAC is supported by NSF-IUSE collaborative grant entitled “Collaborative Research: Attaining Excellence in Secondary Mathematics Clinical Experiences with a Lens on Equity” (Project #1726362, #1726853, and #1726998). For our purposes the concept of equity includes “the fair distribution of material and human resources, intellectually challenging curricula, educational experiences that build on students’ cultures, languages, home experiences, and identities; and pedagogies that prepare students to engage in critical thought and democratic participation in society” (Lipman, 2004, p. 3).

In this chapter, we report on the work of the Co-planning/Co-teaching and Paired Placement sub-RACs. The sub-RACs are designed to address issues with the traditional model for clinical teaching, also known as an apprentice-type model for clinical teaching. This model consists of a teacher candidate going into a mentor teacher’s classroom for 8-15 weeks and gradually taking over the teaching responsibilities of the classroom. During this time, the teacher candidate receives feedback about his or her teaching practice from both the mentor teacher and the university supervisor. The success of the model depends upon many variables, one of which is the quality of the mentor teacher (Leatham & Peterson, 2010b). The teacher candidate depends on the mentor teacher to model effective instructional practices, to offer advice and helpful tips on facilitating student learning, to engage in reflection exercises, and to aid him or her in developing the craft of teaching. Nevertheless, finding sufficient numbers of quality mentor teachers, to ensure a meaningful clinical teaching experience for the teacher candidates, can be challenging. Limitations and challenges related to the traditional, apprentice-type model for clinical teaching highlight the need for researchers to explore other, non-traditional models for clinical teaching that may provide a more collaborative, reflective, and focused approach to providing a rich and meaningful culminating experience for teacher candidates. The paired placement model and the co-planning/co-teaching model are both approaches to student teaching that can lead to more progressive experiences for all stakeholders. Initially, the two sub-RACS worked parallel to each other and have shared ideas across sub-RACs during face-to-face meetings of the RAC as a whole. Each sub-RAC engaged in extensive literature reviews which informed their work separately. Thus, although there are some elements of the co-planning/co-
teaching model that are shared with the paired placement model the groups have worked as separate but connected entities.

Co-Planning and Co-Teaching Sub-Research Action Cluster (Sub-RAC)

Our co-planning and co-teaching (CPCT) sub-research action cluster (Sub-RAC) has made significant strides since the CERAC was formed in 2012. Being cognizant of differences that existed across programs (inclusive of differences in philosophical underpinning of school environment and university settings, challenges to recruit and retain teachers in schools which serve students from low income areas and have high mobility of teachers and students, limited professional development training provided to mentor teachers on new standard documents and curriculum materials, and minimal guidance provided of how to mentor teacher candidates) (Zeichner, 2010), the members of CERAC reviewed relevant literature across various disciplines to consider means to transform clinical experiences (Sears et al., 2017a). Co-teaching was deemed a promising change approach based on the success it facilitated in the field of special education (Bacharach, Heck, & Dahlberg, 2010). Based on our use of improvement science, commitment to this work, and the results garnered thus far, we have found that CPCT is quite promising to transform the field of secondary mathematics.

As stated earlier the CPCT sub-RAC has employed an improvement science methodological approach to systematically scale up CPCT in secondary mathematics clinical experiences across multiple institutions, in different states. The CPCT sub-RAC goal was to increase the number of institutions that adopted CPCT into their mathematics education clinical experiences, in an effort to further promote effective mathematics teaching practices that provide each and every student with the opportunity to learn meaningful and useful mathematics. Therefore, the data garnered from the process and balancing measures provided insights into the extent the change idea of using CPCT during clinical experiences occurred. The change idea was considered to be an improvement for the educational system if the teacher candidates more readily demonstrated all of the NCTM (2014) effective teaching practices during their clinical experiences. Thus, to promote a change idea which resulted in improvement, members of the sub-RAC frequently reflected on variance within and across institutions in an effort to identify factors that can help or hinder the implementation of CPCT into mathematics education clinical experiences and revised our future PDSA cycles accordingly (Sears et al., 2017a).

Co-planning and co-teaching (CPCT) is a paradigm shift from traditional approaches to student teaching or as we refer to it in this paper the clinical experiences. The use of CPCT during enacted lessons can increase opportunities for both teacher candidates and mentor teachers’ professional growth and job satisfaction, enhances teacher candidates’ understanding of curriculum and instruction, and improves the academic performance of K-12 students with disabilities academic performance (Bacharach, Heck & Dahlberg, 2010; Dieker, 1998; Idol, 2006; Murawski & Dieker, 2003; Rea, McLaughlin & Walter-Thomas, 2002; Rice & Zigmond, 2000). Due to the benefits of CPCT, members of the CPCT Sub-RAC, which comprised of 11 institutions, infuse CPCT into clinical experiences for secondary mathematics teacher candidates. The goal of the CPCT Sub-RAC is to enable mentor teachers and teacher candidates to carefully plan and subsequently use and focus on various co-teaching strategies throughout the clinical experiences. The sub-RAC focused on the following CPCT strategies: one teach, one observe; one teach, one assist; station teaching; parallel teaching; team teaching, and alternative teaching (Sears, 2017a). To promote CPCT as a viable model for the clinical experiences, members of the
CPCT sub-RAC used an initial plan-do-study-act cycle (PDSA) that emphasized a need for professional development for the collaborative instructional pair (e.g., student teacher and mentor teacher) and university supervisors, measured the nature and extent of CPCT being implemented, and monitored the need for intervention support throughout the clinical experiences (Figure 1).

Moreover, the Sub-RAC members have placed an emphasis on training and disseminating information about how to implement CPCT effectively. Initial findings indicate that even though the mentor teachers and teacher candidates perceived co-teaching to be beneficial because it increased opportunities for individualized instruction, they acknowledged a need for more subject-specific professional development (Sears et al., 2017b). Considering that there exists limited literature within the field of secondary mathematics of how to employ CPCT during enacted lessons, the CPCT sub-RAC members have sought to provide practical instructional examples and insights into the complexities and challenges of implementing CPCT within the realm of secondary mathematics. Members of the sub-RAC are engaged in creating lesson plans and vignettes, and in writing articles for both research and practitioner audiences that illustrates how CPCT can be enacted within secondary mathematics settings. Additionally, the members have developed and facilitated CPCT professional development activities at their respective sites and assisted with data collection to provide insight into the nature of implementation of CPCT during clinical experiences.

In the subsequent paragraphs, we will provide an overview of literature pertinent to CPCT, a description of efforts to use CPCT within mathematics education clinical experiences, challenges that were encountered relative to the implementation of CPCT in secondary mathematics, and lessons learned thus far.

**Relevant Literature Pertaining to Co-Planning and Co-Teaching**

There are various co-teaching strategies, inclusive of: one teach-one observe; station teaching; parallel teaching; alternative teaching; teaming; and one teach, one assist (Bacharach, DOI: 10.4018/978-1-5225-6249-8.ch002
Heck, & Dahlberg, 2010; Friend, & Cook, 2007; Sears et al., 2017a). During co-teaching, two teachers build a parity-based relationship by partnering together to facilitate the delivery and assessment of instruction to a diverse student population (Bacharch, Heck, & Dahlberg, 2010; Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010; Kohler-Evans, 2006). Co-teachers share their instructional responsibilities, classroom spaces, and often engage in the negotiation of their roles to more readily use the expertise of all parties to promote students’ academic success and closing achievement gaps that may exist (Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010; Bacharch, Heck & Dahlberg, 2010). Thus, for the professional relationship between the teacher candidate and the mentor teacher to be perceived as co-teaching, the teacher candidate must be perceived and respected as a teacher in the classroom from the onset (Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010). Administrative support (Scruggs, Mastropieri, & McDuffie, 2007), and professional development training is also needed to support teachers who seek to employ co-teaching (Cardullo & Forsythe, 2013). Cardullo and Forsythe (2013) noted that when co-teaching is adopted, professional development should be provided to inform mentor teachers and teacher candidates about their responsibilities, provide an opportunity to interact with each other, and address challenges that might be encountered (e.g., approaches to cultivate productive consultations) (Feiman–Nemser, 2001).

Co-teaching provides behavioral and academic support for students with and without disabilities (Scruggs, Mastropieri, & McDuffie, 2007), and has been proven effective in supporting English language learners (Pardini, 2006), and gifted students (Hughes & Murawski, 2001). According to Sileo and van Garderen (2010), co-teaching can benefit students with special needs because it enhances their confidence, self-esteem, academic performance, and relationship with their peers. Bacharach and Heck (2012) studied the impact of co-teaching on student achievement in an elementary mathematics and reading environment and found that the improvement in student performance was statistically significant.

Furthermore, co-teaching models can be beneficial to mentor teachers and teacher candidates (Sears et al., 2017a), because it encourages mutual support, sharing resources, and facilitates a partnership (Bacharach, & Heck, 2012). When co-teaching is employed it increases opportunities for personalized student instruction, promotes professional collaboration among teachers, fosters job satisfaction, and facilitates teachers overall professional growth (Sileo & Van Garderen, 2010). Teacher candidates value being introduced as teachers from the onset, being active in the classroom, and the professional bond that is established (Bacharach & Heck, 2012). Bacharach and Heck (2012) noted that “students in a classroom that used the co-teaching model of student teaching statistically outperformed their peers in classrooms that were taught by either a single teacher or a mentor teacher and teacher candidate using a traditional model of student teaching in both reading and math” (Bacharach & Heck, 2012, p. 52). The authors also reported that teacher candidates that engaged in co-teaching outperformed their peers on the state assessment measure for new teachers. Hence, co-teaching can be beneficial to students, mentor teachers, and teacher candidates.

Regardless of the co-teaching strategies that may be employed, it is essential that the instructional pair engages in careful planning of the lessons to identify the objectives that will be addressed, activities that will be used, and formative and summative strategies that will be employed (Scruggs, Mastropieri, & McDuffie, 2007). To better understand the fidelity of co-teaching, Bryant, Davis, Dieker, Pearl, and Kirkpatrick (2012) examined the nature of 755 co-teaching lesson plans and found that pairs planned together for 65% of the time, and one teach one assist was the most dominant approach employed. Although there are some challenges to
effective co-planning (e.g., insufficient time), co-planning permits proactive discussions across the curriculum, use of varied instructional practices, utilization of various co-teaching models, and assessment of the CPCT models (which can be done by university supervisors and faculty members) (Murawski & Dieker, 2013).

Efforts to Advance Co-Planning and Co-Teaching in Secondary Mathematics Clinical Experiences

Since 2012, the CPCT sub-RAC has used improvement science to advance the goal of the NIC, and to increase the utilization of CPCT at multiple institutions. To measure the extent of our efforts we developed several instruments to measure the nature and implementation of CPCT during enacted lessons. Additionally, members of the sub-RAC participated in monthly virtual and annual face-to-face meetings, created modules and professional development training, and disseminated their work via multiple formats. In this section, we will describe activities we engaged in to achieve our overarching goal.

Instrument development to measure CPCT

Weiss and Brigham (2000) suggested that there are problems with co-teaching research: Information about measures is omitted; only successful cases are reported; reports indicated that teacher personality was the critical variable in the success of the co-teaching; and subjective results are noted. Thus, “the future of co-teaching may be dependent on increasing the quantity and quality of research on it and placing co-teaching in the larger context of school reform and improvement” (Friend, Cook, Hurley-Chamberlain, & Shamberger, 2010, p. 10). Therefore, we sought to extend research related to co-teaching and address identified shortcomings of previous research by (1) utilizing and sharing instruments used to measure the influence of co-teaching; (2) examining teacher candidates’ experiences throughout their field-based preparation (i.e., practicum and internship); and (3) examining the influence of professional development on the success of co-teaching. Thus, our CPCT sub-RAC created instruments to measure the nature of CPCT during clinical experiences, and the effectiveness of professional development that focused on CPCT. Particularly, members of the sub-RAC created the following instruments to obtain balancing and process measures relative to CPCT: Pre-survey, professional development survey, just-in-time survey, post-survey and mathematical practices survey. A brief description of the various instruments that were developed is described below:

- **Pre-survey:** This survey asks respondents to rate the extent or their knowledge and ability to implement the Common Core Content Standards and the Standards for Mathematical Practice (CCSSO, 2010), strategies to teach diverse learners, perspectives about CPCT, and assessment practices using a Likert scale (Oloff-Lewis, Biagetti, Cayton, Grady, Stone, McCulloch, Edgington, & Sears, 2014a).
- **Professional development survey:** This survey asks respondents to describe the effectiveness of the training and their understanding of co-planning and co-teaching. Individuals are asked to rate their perceived knowledge about CPCT and the effectiveness of the professional development (Sutton, 2018).
- **Just-in-time survey:** This survey asks respondents to gauge their co-teaching experiences as the semester progresses using a Likert Scale. Individuals are asked to rate the quality of communication of the pair, the frequency of co-planning, benefits of co-teaching, and describe instructional norms. An additional comment section is included in the event
individuals would like to elaborate on his/her experience. There are two versions of the just-in-time survey, one for the mentor teachers, and the other for the teacher candidates (Sears, Maynor, Cayton, Grady, Stone, McCulloch, Edgington, & Oloff-Lewis, 2014).

- Exit survey: This questionnaire includes open-ended questions to inquire about participants’ experiences with co-teaching, interactions with collaborators, and the influence of the professional development (Oloff-Lewis, Biagetti, Cayton, Grady, Stone, McCulloch, Edgington, & Sears, 2014b).

Members of the CPCT sub-RAC have sought to garner data at their prospective sites and share observational findings during monthly and annual meetings, which will be monitored longitudinally.

**Accountability: Monthly Online Meetings and Annual Face-to-Face Meeting**

In order to maintain momentum, and to promote a culture of accountability, holding frequent meetings of the members of the CPCT sub-RAC was vital (Darling-Hammond, 1989). Being cognizant that each faculty member had institutional and personal demands, in addition to the responsibilities required of them by the MTE-P, we had to carefully plan meetings while being sensitive to time constraints. The sub-RAC members acknowledged that too many meetings could become burdensome, and too few meetings could potentially reduce the attention mathematics teacher educators placed on the implementation of CPCT during clinical experiences. Hence, a consensus was reached among sub-RAC members to hold a once a month, one hour, standing meeting, and that all parties would make a conscious effort to participate in a face-to-face annual meeting. During the monthly meeting, participants describe implementation challenges and complexities at their institution, reflected on data garnered, provided feedback to their peers, and identified factors that contributed to variances across the various sites. While at the annual meeting, the members of the sub-RAC reflected on the lessons learned across the year and created PDSA cycles to guide their efforts for the subsequent year.

Roles and responsibilities were assigned to all parties, and particularly a team leader had the responsibility to contribute to the sustainability of the efforts. For instance, members were assigned to be professional development facilitators, authors, data analysts, interviewers, and instrument developers. Giving each person a responsibility, empowered team members and increased opportunities for them to take ownership of the progress made.

**Professional development training and modules development**

To provide an overview of what CPCT is, and how it can be used to focus on students learning, members of the sub-RAC created three online training modules (Brosnan, 2014; Grady & Cayton, 2014; Grady & Cayton, 2016). These modules were disseminated among members of the sub-RAC and are currently accessible via Trellis, which allows for the sharing of multidisciplinary communications. Additionally, members of the sub-RAC agreed to facilitate full-day professional development training at various sites. Teacher candidates were also afforded an opportunity to participate in the professional development. The instructional feedback on the professional development was rather positive. The data garnered from the pre-survey suggested preservice teachers perceived co-teaching was quite promising. The preservice teachers noted,
“I’ll be able to learn how to influence more students in different ways, but finding which method works best for me will take some time.” Preservice teacher 1, pre-survey - August 29, 2017

“Benefits: More help and eyes in the classroom. Easier facilitation of ideas and activities with students and more support.” Preservice teacher 2, pre-survey – August 29, 2017

Nevertheless, they also identified challenge of learning how to co-teach. Particularly they noted:

“A challenge would be working with others.” Preservice teacher 3, pre-survey – August 29, 2017

“Learning how to work as a team and not having to remember every piece of information will be very beneficial. I also believe that it could help with teaching our strengths.” Preservice teacher 3, pre-survey – August 29, 2017

The identified challenge of needing guidance as to how to enact co-teaching professional development was critical. Thus, we sought to develop modules that can help individuals conceptualize how to co-teach. Highlights of the trainings were video recorded, and edited clips of the video recording will be accessible online. The creation of the modules and professional development training were needed to provide foundational insights for individuals seeking to adopt CPCT at their respective institutions, and to support instructional pairs who desire to diversify the CPCT strategies employed. As a result of the professional development, the following were perceived benefits:

“I really enjoyed the training. I think that pairing pre-service and in-service teacher was incredibly helpful because it helped us see both perspectives.” (Collaborating Teacher 1, Professional Development Survey – January 20, 2018)

“Effective communication strategies to use with intern/mentor collaboration.” (Collaborating Teacher 2 – Professional Development Survey – January 20, 2018)

“I did learn some new information, and I like the presentation of strategies that I was not very familiar with and these can be implemented in the classroom.

I have FUSED in the past and unless it was a test day; both teachers were always up and moving. And this is a good strategy to share with the interning teachers from day one.” (Collaborating Teacher 3, Professional Development Survey – January 20, 2018)

“I enjoyed the activities that were provided for us to participate in throughout the day, and that we were able to learn multiple avenues to take with each strategy
that we practiced together. “ (Preservice Teacher 4, Professional Development Survey – January 20, 2018 )

Challenges

Even though we are a geographically dispersed team (GDT), our group does not face many of the same challenges that most GDTs face (Polzer, Crisp, Jarvenpaa and Kim, 2006; Gibson & Gibbs, 2006). For instance, a GDT might have poor communication, lack effective relationships, lack a common goal, and do not use technology. From the beginning, we faced two main challenges: 1) challenges within our sub-RAC relative to data collection and 2) challenges in providing training at our institutions across the sub-RAC.

Mathematics education is just one discipline among many subject-specific teacher education programs, which typically do not operate in a silo. Therefore, even if a faculty is willing to engage in our efforts, they may face resistance at their respective institution due to site-specific factors and norms, which may not easily be changed. Thus, in adopting change, it is important to reflect on the change idea in relation to the institutional norms that can potentially hinder or halt the idea from being implemented.

Challenges Within the CPCT Sub-RAC

Our primary challenge focuses mainly on the differences across our institutions, and how we collect data and measure the impact of CPCT. Being cognizant that timelines for field experiences can vary across institutions, as well as institutions may use their own instruments, we were challenged to create and implement a common set of measures. The implementation of common measures requires us to be flexible as to when the data will be garnered, and how the data will be garnered. For instance, the survey questions may need to be added to a larger instrument used by a particular institution, and the timeline to collect data can vary across the fall and spring academic semesters.

Additionally, institutions have had uneven success in getting the instructional pairs to complete all survey instruments which makes capturing the fidelity of co-planning and co-teaching difficult. The instructional pairs acknowledged that too many instruments, and the time required to co-plan can be quite demanding. Hence, it is important that the end justifies the means, and the narrative used to market CPCT needs to be mindful of the amount of time required for an effective adoption.

Moreover, given that each institution was at a different stage of implementation of CPCT strategies, there existed variance in the nature of support needed at each institution. For example, while some institutions were piloting data collection with one teacher candidate, supervisor, and mentor teacher, other institutions had full implementation of CPCT. Hence, we readily reflected on the nature of the questions posed that guided our inquiry, and the systematic approach to collect data across the CPCT sub-RAC.

Institutional Challenges

Both teacher candidates and their mentors, need to be trained in the use of CPCT strategies. Each institution handles the professional development training of instructional pairs differently. As a result, the execution of CPCT varies tremendously across institutions. Furthermore, in order to accurately acquire data, all supervisors must be trained and
calibrated using several instruments. Some states do not require that supervisors of secondary mathematics teacher candidates have a mathematics background, resulting in a smaller pool of qualified and trained supervisors who can collect data, which may lead to an overall reduction in our data.

We also acknowledge that the cost to fund faculty to attend professional conferences to disseminate the work relative to CPCT, and to attend the annual meeting can be expensive. Hence, we have frequently solicited grant funds to offset the cost, and hope that universities will support their faculty members as well.

**Lessons Learned about the Use of Co-Planning and Co-Teaching during Clinical Experiences**

We found that CPCT can promote student learning and increase opportunities to engage in mathematical discourse between the instructional pairs. Nevertheless, there exists variance in the extent to which it is adopted across institutions. Despite differences across the sites, members of the CPCT sub-RAC have identified the need to provide professional development training to instructional pairs, and to support the use of CPCT throughout the clinical experience. Thus, we are now challenged to make resources readily available, via an online platform, to provide insights to the mathematics education community of how to unpack CPCT within the context of secondary mathematics clinical experiences.

**Paired Placement Sub-RAC: Student Teaching Experience**

To increase the quality of the student teaching experience and address the inadequate supply of quality mentor teachers to oversee the experiences, a sub-RAC was formed to focus on the paired placement student teaching model. In this model, a pair of student teachers work daily with an experienced mathematics mentor/coach who is devoted full time to helping the student teachers address the craft of teaching, plan lessons jointly, and teach those same lessons while actively observing, reflecting, and revising (Leatham & Peterson, 2010b). According to Leatham and Peterson (2010b), within this setting student teachers are slated to quickly realize not everyone learns the way they learn, and their focus shifts to the learning of their students rather than their own learning. For the past four years, the Paired Placement Sub-RAC has been developing syllabi and workshop guides to help mathematics teacher education programs effectively implement the model across multiple contexts. The Paired Placement Sub-RAC used PDSA cycles to refine the syllabi and workshop guides, and this process helped to refine and better guide the implementation of the paired placement model across multiple institutions. The different institutions within the sub-RAC are governed by individual state codes and other regulations related to clinical experiences, which forced the sub-RAC to develop syllabi, workshop guides, and other materials that could be adapted to different program contexts. Furthermore, the sub-RAC was challenged to both focused on the aim of the CERAC that “during student teaching Teacher Candidates (TCs) will use each of the eight Mathematics Teaching Practices (NCTM, 2014) at least once a week during full time teaching” and positive implementation of the paired placement model.

**Selected Literature Related to the Paired Placement Model**
Academic institutions in many countries have implemented a variety of field experience models for teacher candidates that are different from the traditional model. Paired field placements have seen an increase in England since the 90s (King, 2006). This field placement model requires teacher candidates to “work together in the same classroom, receiving joint mentoring, while sharing the timetable and collaborating on planning, teaching, and assessing” students’ work (King, 2006, p. 371). Nokes, Bullough, Egan, Birrell and Hansen (2008) studied paired-placement internships of prospective secondary teachers, reporting that the student teachers learned through “tensions, dialog, and reflections” due to “being placed with a peer” (p. 2168). Results indicated students in these teachers’ classrooms benefited from the collaboration of the teaching team. The push of the teachers to work through problems, along with the perturbation that comes from differences of opinion, led to better student understanding. In agreement, based on findings from a literature review focused on the paired placement model, Mau (2013) recommended placing pairs of student teachers with one mentor teacher and implementing a model of learning to teach that encourages collaboration, pedagogical risk taking, increased reflection, and better classroom management.

Even though this model has numerous benefits, Goodnough et al. (2008) identified pitfalls perceived by the teacher candidates, such as becoming dependent on each other in negative ways, not knowing who is in charge of managing the class, feeling a lack of individuality, and competing with each other. Goodnough et al. (2008) also discussed perceived problems noted by mentor teachers, such as one of the teacher candidates becoming too dependent on the other one, the mentor teacher not feeling equally connected to both teacher candidates, the mentor teacher comparing the teacher candidates too much, and confusion as to which teacher in the room is in charge of managing the class. The authors claimed that the benefits far outweighed the possible pitfalls, which could be avoided if addressed from the onset of the experience.

More recently, academic institutions in Australia have also begun to implement field experience models that use paired placements. Australia’s La Trobe University (LTU) Teaching School Model was developed from successful medical school models that have embedded clinical placements and Professional Development Schools in the United States (Lang et al., 2015). Additionally, principals from participating schools were heavily involved with the development of the model which resulted in a strong partnership between the university and the schools (Lang et al., 2015). The LTU Teaching School Model places pairs of teacher candidates in schools with one mentor teacher twice a week for one semester or one academic year. As a result, this model extends the number of professional field placement days for teacher candidates beyond the requirements set by the teaching regulation body (Lang et al., 2015). The benefits of the LTU Teaching School Model were bidirectional for teacher candidates and mentor teachers. Following their field placements, teacher candidates indicated that they had a greater appreciation of educational theory and greater knowledge of school workings (Lang et al., 2015). They also felt that they were better candidates for teaching positions and broadened their understanding of the role and requirements of the teacher in the school (Lang et al., 2015). Feedback provided from mentor teachers provided evidence that the Teaching School Model builds a community of educators. All of the mentor teachers indicated that they believed the extended placement and team-building approach allowed them increased opportunities to reflect on the teaching and learning that occurred in the classroom (Lang et al., 2015). Thus, the paired placement model has the potential to serve as a solution for several challenges for mathematics teacher education programs. Some of the challenges that could be addressed by using the paired
placement model includes: decreasing the number of quality mentor teachers needed to support
teacher candidates, improving the experience of student teaching for all stakeholders, and
increasing the professional growth of all stakeholders.

Efforts to Implement the Paired Placement Model in Secondary Mathematics Clinical
Experiences

The Paired Placement Sub-RAC is comprised of members representing five institutions. The
Sub-RAC focuses on the paired placement model for student teaching in which two
prospective teachers are paired with a single mentor teacher. Teams are gradually implementing
the model across the different universities. Below is a table showing the implementation of the
pairs:

Table of Pairs Implemented Per University for Fall and Spring Semesters 2013 – 2018

<table>
<thead>
<tr>
<th>Semester</th>
<th>West University</th>
<th>Southeast</th>
<th>Central University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2013</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spring 2014</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spring 2015</td>
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<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Fall 2016</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spring 2017</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fall 2017</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Spring 2018</td>
<td>0</td>
<td>2</td>
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</tr>
</tbody>
</table>

Members of the paired placement sub-RAC initially met through conference calls and
Dropbox. We discussed the pros and cons of the model and decided that it was worth trying out.
Initially, we all agreed that we would try it out with our strongest teacher candidates and mentor
teachers. We targeted mentor teachers with whom we had worked with extensively either
through providing professional development, or they had gone through our graduate programs or
both. The interns were selected based on their participation in classes, scholarly attributes, and
work ethics. We wanted to focus as much as possible on the execution of the model and not the
differences in the participants. We also thought carefully about the pairs of participants and their
personalities. The West University team implemented the model fall 2013 and reported to the
other teams about its findings. Spring 2014, other teams implemented the model.
As teams
implemented the model over the semesters listed in the chart they refined the syllabi, orientation
materials and workshops to best meet the needs of the teams’ contexts. Teams also work with
their participants to adjust the model within their context using PDSA cycles. Members of the
teams monitor how well the three teachers work together within the classroom, what timing and
transitional issues need to be addressed, and whether or not student learning is the primary focus
of the three teachers within the paired placement setting. Teams monitor the process throughout
the semesters. Teams meet via conference calls to discuss the results of the implementations and
identify areas for change and improvement. Teacher candidates’ journals; mentor teacher -
university supervisor -and the pair debriefings which occur throughout the semesters; data from
PDSA cycles; and teacher candidate observations and other university assessments are used to
gather evidence of teacher candidates progress and the effectiveness of the model.

Paired placement sub-RAC workshop and orientation session protocols emphasize the
major components of the model and the importance of the teacher candidates gradually
implementing the eight mathematics teaching practices (NCTM, 2014). Below is a list of
elements usually included in the sessions for both the mentor teachers and the teacher candidates:

1. Introductions (facilitators and participants)
2. Brief review of the Mathematics Teaching Practices (MTPs) (It is assumed that
   the students have learned about the practices throughout their program during
   their practicum courses.
   a. Read through the MTPs
   b. Watch a video to see how they are implemented in instruction
   c. Discuss the MTPs survey and the goals for the semester.
   d. Many of us also discuss the High Leverage Practices
      (HLPs) (http://www.teachingworks.org/work-of-teaching/high-leverage-
      practices) and ask the teacher candidates and mentor teachers to compare
      the two sets of practices. The HLPs include the MTPs and other practices
      that are essential to teaching and learning across disciplines.
3. We review the major elements of the paired placement model.
   a. There is always a lead teacher even though the three may plan together
      and assist students during the lesson.
   b. We discuss the pros and cons of the model and especially discuss ways of
      preventing negative scenarios from happening.
   c. We discuss benefits of the model such as the opportunities to reflect on
      teaching, constant feedback, collaboration around student learning, and
      profession learning from other teachers in the room.
   d. We also discuss scheduling:
      i. Need to meet state code requirements for teaching loads for both
         teacher candidates
      ii. Transition periods
      iii. Observations and other assessments
   e. Activities for the teacher candidates to do when they are not leading the
      lessons
      i. Assist the lead teacher
      ii. Purposeful observation tasks during a peer’s lesson (The teacher
          candidate focuses on a certain aspect of teaching like discourse,
          student engagement, or questioning and reports findings during the
          debriefing of the lesson.)
      iii. Observe other mathematics teachers in the school.
   f. Purposeful times when the lead teacher (teacher candidate) has the
      opportunity to be in the classroom alone with the students to build
      management skills.
4. Research related to the Models
   i. PDSA Cycles
   ii. Surveys
   iii. Observations
Implementation of the Model within Individual Universities

Three institutions have been actively implementing the model. The other institutions in the sub-RAC have participated in the development model but have not yet been able to implement it. A brief summary of the experiences at the three implementing institutions follows, followed by a summary of what was learned across the institutions.

West University
Efforts to revise the clinical experiences student teaching internship at West University began in March 2012. Representatives from two school districts and the university attended the initial MTE-P meeting in Atlanta and chose to focus upon providing future teachers with the opportunity to work with fewer more experienced mentor teachers by pairing the placements during the traditional student teaching 16-week semester. In-service sessions for the mentor teachers and university supervisors were provided in advance that allowed all to share questions and concerns about the model, which was a novel phenomenon to them. Co-planning lessons was essential, because for each lesson, there were three teachers in the room co-teaching the lesson—bouncing statements and questions off each other—in a classroom that was rearranged from rows to small groups of students with a focus on implementing the CCSSM’s standards for mathematical practice in both theory and practice. One of the biggest obstacles was in overcoming the traditional model’s hidden agenda that the teacher candidate should learn to survive on her or his own; and shifting to this new model’s agenda of ensuring that each teacher candidate would learn to collaborate with others, to understand that the teacher does not know all, but works with her/his students to explain, to reason through problems together.

Team members at West University communicated that this craft of teaching was successful based on feedback received from teacher candidates, as exemplified in the following quotes from a teacher candidate:

I think the goal of the internship was to prepare my teaching partner and I to teach our own classes and collaborate with future colleagues. I also think the goal was to provide a better experience for the students, as they had access to multiple teachers and were able to get more one-on-one help. (Teacher Candidate, Spring 2014)

Another teacher candidate shared:

One time I took a risk when my mentor teacher suggested that I incorporate some type of group activity into my review lesson, so I developed a group activity that was a little more complex than I usually would have created. I created a lot more complex and meaningful tasks and activities that I possibly could not have come up with on my own.

(Teacher Candidate, Spring 2014)

Central University
The paired placement model has been successfully implemented for three semesters at Central University. In Spring 2015 we had three pairs, Spring 2016 two pairs, and Spring 2017 one pair. The decline in the number of pairs across the semesters was due to the number of
teacher candidates and mentor teachers and nothing else. During each implementation, all pairs of teacher candidates were placed in the same mathematics department at the same school. No other models for student teaching were used at the selected school because program leaders believed that both the teacher candidates and the mentor teachers would be better supported if clinical teaching expectations and procedures were consistent within the school.

During each placement, the teacher candidates’ level of teaching responsibility increased across a 14-week experience. The schedule started where collaboration as a trio (two teacher candidates and the mentor teacher) was emphasized, with the mentor teacher taking a lead role in all aspects of lesson planning, lesson implementation, and classroom management. During this time, the pair of teacher candidates took a secondary role. A few weeks into the experience, the role of the mentor teacher changed from a lead to a secondary role with an emphasis on facilitation of the pair of teacher candidates. During this time, the teacher candidates took the lead role working as a cohesive team by co-planning and co-teaching. They worked on lesson planning and implementation as a duo but relied on support from the mentor teacher to identify pitfalls and to strengthen weak aspects of their teaching. During the remaining weeks, the role of the mentor teacher remained the same, but the teacher candidates worked on formulating their individual teaching practices. They had to do so, however, in a uniform and syncretized manner to help ensure smooth orchestration of the classroom learning environment. During the last half of the 14-weeks, each teacher candidates took on full teaching responsibilities for five consecutive days. The other teacher candidate had focused assignments which included shadowing students, observing other mathematics teachers, interviewing students on their mathematical thought processes, and participating in a book study. The wide range of activities, increased level of responsibility, and multiple forms of support provided the teacher candidates a rich, complete, collaborative, and multi-focused clinical teaching experience that was very different from the traditional models. Below are quotes from participants which illustrate their experience and growth:

“Ask for advice from each other, get input and encouragement from each other. This happened more at the beginning than at the end probably because we didn’t see each other as much. Shared the grading, copying, covered each other’s back” (Teacher Candidate, Spring 2015)

“Toward the beginning we planned individually, but toward the end we started planning more together. We realized the importance of the two of us knowing how we each taught things and we had better ideas when we planned together.” (Teacher Candidate, Spring 2015)

“Collaboration was more intense at the beginning, but the option to comment on teaching remained throughout the whole experience. As the experience went on, we became more independent. We carpooled a lot and on the way back from school we could discuss the day. This helped us build community and reflect on previous days, ask each other questions and opinions. This helped us catch something that one didn’t.” (Teacher Candidate, Spring 2015)

Becoming professional teachers depends upon understanding that teachers model the behaviors they expect and demand from students and work in collaboration with partners across school districts and universities.

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Southeast University

Team members at Southeast University had multiple constraints within their context, so they selected the teacher candidates and the mentor teachers carefully when they implemented the model. Thus, they use both the paired placement model and traditional model during the internship experience to meet the needs of their teacher candidates and to try an alternative model to student teaching. Mentors teachers who were selected to host paired teacher candidates either held advanced degrees from the program or had attended over 200 hours of professional development provided through projects directed by the secondary mathematics teacher education faculty at Southeast University. The program coordinator wanted to ensure that the mentor could assist the teacher candidates in developing the eight mathematics teaching practices. Team members provided two separate orientation workshops and sessions for teacher candidates using each model. During the paired placement workshop and orientation sessions, emphases are placed on the CCSSM (2010) Standards for Mathematical Practice and the NCTM (2014) Mathematics Teaching Practices, the craft of teaching as discussed by Leatham and Peterson (2010a), high leverage practices (Hill et al., 2008), scheduling within the paired placement model, and pros and cons related to the paired placement model. Emphasis is also placed on the trio being cognizant of who will serve as the lead teacher for a given day. University required assessments and the assessments that are used across the CERAC are also discussed.

Student teaching at Southeast University lasts for 15 weeks in which the teacher candidate gradually takes on full responsibility for all of the mentor teacher’s classes for twenty days, with ten of those days as consecutive days. This requirement of a full-teaching load is a state requirement. However, recently there has been more flexibility with the ten consecutive days being replaced with two sets of five consecutive days. Most of the pairs of student teachers have stated that planning their lead teaching schedule is the most difficult part of the experience due to the state regulations and the district holidays. Once the schedule for lead teaching and transitioning from teacher to each teacher candidate and from teacher candidate to teacher candidate is complete working with each other has gone well. Furthermore, coordinating the scheduling was one of the first improvements made as a result of implementing a PDSA cycle. We learned that we needed to place the pair of teacher candidates with the mentor teacher during their methods course prior to the internship experience so that they were familiar with the teacher and the school prior to the student teaching experience so that the pair was ready to take on teaching responsibilities quickly. Below is a schedule of rotation provided by one of the mentor teachers:

- **Week 1**: Teacher candidates observe, help teach with homework, help with groups, etc.
- **Week 2**: Teacher candidates co-teach with mentor teacher using mentor teacher's lessons
- **Week 3**: Teacher candidates co-teach with co-planned lessons (transition week)
- **Week 4-Week 8**: Teacher Candidate 1 takes main responsibility with Teacher Candidate 2 helping when needed or observing. Teacher Candidate 1’s professional work sample (PWS) is completed during this time.
- **Week 9**: Teacher Candidates co-teach with co-planned lessons (transition week)
Week 10-Week 14: Teacher Candidate 2 takes main responsibility with Teacher Candidate 1 helping when needed or observing. Teacher Candidate 2’s PWS is completed during this time.

Week 15: Teacher Candidates co-teach with co-planned lessons (transition week)

Week 16: Teacher Candidates wrap-up, do more observations of other teachers, hand classes back to the mentor teacher. (The pairs usually begin one week earlier than the traditional model interns.)

The PWS that teacher candidates complete, is one of their assessments during student teaching. They are required to annotate their lesson plan, reflect on the lesson after a debriefing with their university supervisor, mentor teacher, and a peer who observed the same lesson, and discuss the students’ understanding of the concepts taught. Quotes from teacher candidates participating in the model indicated that the model is affording the predicted opportunities for growth for the teacher candidates:

“I am so glad that I got to have the experience of doing my internship alongside a peer. I truly believe that I learned more than I would have if I had been on my own. We constantly reflected with one another whether it was in the car to or from the school or in a more formal reflection time.” (Teacher Candidate, Spring 2014)

“We were continually talking to one another about our experiences. . . . After each class we talked about what worked and what didn’t without realizing that we were reflecting on our teaching, which helped us improve.” (Teacher Candidate, Spring 2014)

“I also think this experience helped me to become a much more collaborative teacher. Before this semester I would have tended to simply work alone and not work with my fellow teachers. However, this semester I saw the importance of working with peers. It was so great when the three of us worked together with students’ best interest as our priority. I saw first-hand that lessons ran more smoothly, and students benefitted the most when we all put input into how best to approach and teach a lesson.” (Teacher Candidate, Spring 2014)

I think having the opportunity to collaborate and gain different perspectives and ideas from each other is the most beneficial part of paired internship. Not only having an experienced teacher is helpful, but also having another intern has been a major success for my learning during my internship. Mr. B. is full of wisdom about teaching and mathematics that I am so thankful to learn, but Jay has brought a unique perspective for me. Since he is also learning, he has been able to bring new ideas to the table and help me implement them. Through this we have been able to walk together through ideas that have failed and succeeded. I have truly enjoyed my paired internship and have been so thankful for this opportunity! (Teacher Candidate, Spring 2016)
Working together to better support the students has been great. One of the classes in particular needs more attention, and we are able to give it. It is also helpful to have two pairs of eyes watching me teach lessons during my first 10 days (from both a peer and a pro), as I feel like I am receiving genuine and helpful feedback from both. (Teacher Candidate, Spring 2018)

Additionally, there have been positive outcomes for the mentor teachers who have served as hosts for paired placements. Below are quotes from a mentor teacher:

“Sought my colleagues’ advice and tried to encourage collaboration in my department more after being a part of the experience.”

“Felt more accountable for holding teacher candidates to the mathematical teaching practices and mathematical practice standards and using them myself.”

“Encouraged the implementation of a social justice lesson.”

“Deep discussions: We constantly focused on lesson goals and standards, and discussions around assessment and proper measurements were a necessity. Little discussion was on classroom management.”

“1-1 vs. 2-1 placement: There was a sense of collaboration during discussions rather than a sense of critiquing or judgement.” (Mentor Teacher, Spring 2015)

Overall, the paired placement model has gone well at Southeast University. Following are insights about the model from a university supervisor. This university supervisor was also a Ph.D. candidate in mathematics education and had previous experience teaching secondary mathematics. The supervisor had also recently completed a university supervisor apprenticeship with a mathematics teacher educator, which included supervising a teacher candidate individually and alongside the mathematics teacher educator. Although the apprenticeship was completed with a traditional internship model, the collaboration between the supervisor, mentor teacher, mathematics teacher educator, and teacher candidate provided the supervisor a perspective into collaboration and multiple perspectives also present within the paired-placement model. The following semester, the university supervisor was assigned one pair of student teachers; the assigned mentor teacher had previous experience implementing the paired-placement model. In order to meet the state requirement of 20-full time teaching days, a second mentor teacher was occasionally used. For example, while one teacher candidate completed her full-time teaching requirements within the primary mentor teacher’s classroom, the other teacher candidate was able to teach approximately 2 to 3 class periods within the other mentor teacher’s classroom. This provided the teacher candidate not completing her full-time requirements opportunities to teach mathematics and to still maintain a presence in the primary mentor teacher’s classroom. Observations were planned in a manner that allowed the university supervisor to observe one of the candidates teach, while sitting alongside the second candidate. During the observation, the university supervisor and second teacher candidate often reflected
and discussed possible improvements and strengths as related to the other teacher candidate’s instruction. The university supervisor identified these unique observation opportunities as providing powerful learning opportunities. Following each observation, lesson debriefing included both interns, the mentor teacher, and the university supervisor. Given that all were provided equal opportunities to speak and reflect on the enacted lesson, a professional learning community of multiple perspectives developed. Lastly, the university supervisor observed an unspoken accountability between the interns to teaching using the Mathematics Teacher Practices. The university supervisor hypothesized that because both interns understood the teaching expectations, neither intern was willing to deviate from best practices due to the accountability of having their pair intern present.

Lessons Learned Across Universities

Through PDSA cycles and data collected from participants, the Paired Placement sub-RAC is learning much about the design, implementation, and monitoring of the model. As stated above, in one context state codes required that teacher candidates must teach full-time for 20 days during the internship and 10 of those days need to be consecutive. This individual constraint provided a good platform for discussion about maintaining flexibility of the model across institutions. The implementation of the model for consecutive years across institutions helped the sub-RAC reach numerous conclusions, some of which are: (a) placing teacher candidates with the mentor teacher for the clinical experience connected to the secondary methods course helps the teacher candidates to become familiar with the school environment, teacher’s practices, and the students, (b) the peer-to-peer collaboration helps teacher candidates to assume teaching roles within the mentor teacher’s classroom more rapidly, (c) the teacher candidates’ anxieties regarding unfamiliar school contexts were eased largely because of the peer-to-peer support, (d) the teacher candidates needed to be clear to students who among the trio of teachers was the lead teacher, and (e) to best support the students the teacher candidates need to be sure that their pedagogical approaches are aligned.

Another cross institutional finding is the importance to provide the non-lead teacher of the pair with targeted observation tasks. Various tasks across institutions were implemented and were adapted to meet the needs and constraints of the various programs. Some of the tasks focused on the lead teacher’s orchestration of discourse including types of questions. Other tasks had the teacher candidates investigate the students’ mathematical thinking and problem-solving processes or identify techniques (like proximity) the lead teacher used for classroom management. Also included in the observation tasks were prompts for identifying particular students who were or were not participating in lesson activities and predicting reasons for lack of engagement. These focused observation assignments provided a better, and more focused, opportunity for each teacher candidate to be engaged in the teaching and learning process, and to analyze situations or contexts in which they may have previously not thought to observe.

Overall, the institutions involved in the Paired Placement sub-RAC agree the paired placement model has many advantages. Throughout their implementation of the model, the members of the sub-RAC have found that the paired placement model allows teacher candidates to better focus on student learning and the craft of teaching. The support of a peer who is exposed to similar experiences helps to bond the teacher candidates in ways that other models do not. Teacher candidates and mentor teachers who have experienced the paired placement model believe the model promotes both mentor teacher and teacher candidate growth in teaching as well as growth in the high school students’ opportunity to learn and master mathematical
content. Overwhelmingly, teacher candidates across all institutions stated that the paired placement model helped them to better understand the strengths of collaboration in teaching and has inspired them to be more collaborative in their own teaching practice. Across all universities, results indicate that the mentor teachers, teacher candidates, and students benefited from having three instructors in the classroom. The increased size of the teaching team allowed teacher candidates to focus more on how students learn mathematics and how students think about mathematics rather than classroom management and lesson planning.

Challenges of Implementing the Model

The challenges of implementation across the universities varied. Some of the challenges centered on individual state laws for clinical teaching, mentor teacher buy-in for the non-traditional model, and training university supervisors on the non-traditional model. At some institutions, the researchers have to play the role of university supervisor because the training for such a supervisor had not yet been developed. Also, carefully pairing up the teacher candidates was cited as an attribute for successful implementation. Educating all stakeholders in the paired-placement model on possible situations that may arise and presenting possible solutions helps to better prepare all participants for challenges that might arise.

Conclusion

The CERAC is actively engaged in developing tools, testing clinical experience models, and analyzing the effectiveness of the tools and models on the development of teacher candidates’ proficiency with the mathematics teaching practices. The sub-RACs have different foci and have accomplished different goals, however we have common interests in fostering effective field experiences for secondary mathematics teacher candidate. The work of CERAC has the potential to move the field forward. Team members have been pleased with the positive impact of the student focused and collaborative clinical experience models, co-planning and co-teaching and paired placement, that we have had the opportunity to explore in our programs. The CERAC members also see the work as scalable and transformative.
References


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**Instruments**


**Professional Development Modules**


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Key Words

Co-planning and co-teaching is an approach to clinical experiences where the teacher candidate and the mentor teacher co-share the responsibilities related to teaching and learning in a classroom.

Mathematics Teaching Practices – teaching strategies espoused by the National Council of Teachers of Mathematics to support students’ development of the Standards for Mathematical Practice.

Mentor teacher is a person who supports the growth and development of a teacher candidate during a clinical experience in the schools.

Network Improvement Community is a group of people with a common aim and who uses improvement science to solve a problem of practice.

Paired placement is a clinical experience approach in which two teacher candidates are placed with one mentor teacher, and the candidates have the opportunity to learn from each other as well as receive support from their mentor teacher.

Research Action Cluster a subgroup of a network improvement community focused on developing an understanding of a particular problem of practice through improvement science.

Secondary mathematics teacher candidates are undergraduate students preparing to teach in grades 6-12.

Student teaching is the phase of teacher candidates’ programs when the candidates spend 10 to 15 weeks in a school setting to learn about teaching at the grade level or course level they desire to teach upon completion of their program.