IMPACT OF MEDIATED FIELD EXPERIENCES ON TEACHER CANDIDATES' SELF-REPORTED LEARNING: A MULTI-INSTITUTIONAL DESCRIPTIVE PILOT STUDY

Barbara Ann Swartz
West Chester University
bswartz@wcupa.edu

Esther M. H. Billings
Grand Valley State University
billinge@gvsu.edu

Melinda Knapp
Oregon State University-Cascades
meanderbnapp@osucascades.edu

Holly Henderson Pinter
Western Carolina University
hhpinter@wcu.edu

Sararose D. Lynch
Westminster College
lynchsd@westminster.edu

Mediated Field Experiences (MFEs) provide teacher candidates (TCs) structured opportunities to unpack and enact core teaching practices, gain mathematics content and pedagogical knowledge, and reflect critically on mathematics teaching and learning. In this paper we present findings from a multi-institutional descriptive pilot study that investigates the impact of MFEs on TC learning. TCs reported that they (1) deepened their understanding of the targeted core teaching practice(s), (2) developed a vision of ambitious mathematics teaching, (3) recognized the importance of cultivating a positive classroom learning community, and (4) increased their confidence when teaching after their completion of a one-term course implementing MFEs.

Keywords: Preservice Teacher Education, Instructional Vision, Teacher Beliefs

Efforts to improve the preparation of teachers are not new, and recent publications have begun to define the knowledge, skills and dispositions of a "well-prepared" beginning teacher of mathematics to provide ambitious mathematics instruction (AMTE, 2017). By definition, ambitious teaching facilitates a learning environment that is accessible to all students because it requires that teachers teach in response to students' thinking and actions (Kazemi et al., 2009; Cawn, 2020). Beginning teachers are increasingly expected to teach ambitiously from day one (Anagnostopoulos et al., 2020), which requires teachers to engage deeply with each student's thinking and adjust their instruction accordingly to promote student learning—actions that are predicated on creating an environment that is accessible, strengths-based, and community oriented (Yeh et al., 2017). Creating such equitable spaces and enacting such practices is challenging. In particular, learning to listen effectively and respond to the variety of factors specific to students' thinking "is surprisingly hard work" (Empson & Jacobs, 2008, p. 257) requiring immense amounts of support during teacher preparation. We, along with others (Ball & Forzani, 2011) argue that attending, interpreting, and responding appropriately to students' mathematical thinking is a specialized pedagogical skill that needs to be explicitly taught within teacher preparation programs.

To meet this challenge, we re-envisioned our own mathematics content and methods courses, modeling our approach on the practice-based "third spaces" (Zeichner, 2010). In each of our respective initial certification programs, we as mathematics teacher educators (MTEs) now accompany our teacher candidates (TCs) into authentic classroom settings to prepare, enact, and reflect on practice in shared classroom spaces. These *mediated field experiences* (MFEs) have provided incredible opportunities for TCs to learn with and from children (Billings et al., 2021; Billings & Swartz, 2019; Campbell, 2012; Campbell & Dunleavy, 2016; Horn & Campbell, 2015; Knapp et al., 2018; Lynch et al., 2019). MFEs are intentionally structured opportunities for beginning teachers to (1) learn about core practices in teacher preparation coursework, (2) implement those practices during a facilitated K-12 classroom experience, and (3) debrief the classroom experiences as a whole group with teacher educators and at times with the partner teachers to build a shared vision of ambitious and accessible mathematics instruction. MFEs address a critical need for supporting TCs to develop ambitious teaching practice through partnerships with local K-12 schools, while embracing the power of appropriate struggle as an opportunity for learning and growth. When MTEs support and engage TCs in productive struggle to make sense of and develop the skills of ambitious teaching through their work with K-12 students, an opportunity for TCs' development occurs that they would not experience in a university classroom setting alone. This paper presents our findings from a descriptive pilot study investigating TCs' perceived learning from our MFE courses that supported TCs in this productive struggle of learning about and enacting ambitious mathematics teaching.

Conceptual Framework

This research team joins a growing body of educational research (e.g., Ball et al., 2014; Ghousseini & Herbst, 2014; Lampert et al., 2010; McDonald, et al., 2014; Santagata & Yeh, 2014) that explores what has been characterized as "the turn to practice-based education" (Zeichner, 2012). The premise of these studies is based on the belief that in order to better support TCs to learn to *do* ambitious teaching we, as MTEs, need to teach them both the interactive skills required to engage students in meaningful mathematics work, and flexibility to use this knowledge in particular moments of practice. Like others, we argue preparing TCs for doing the complex work of ambitious mathematics teaching requires we implement *different* pedagogies of teacher education in *deliberate* ways that make the practice of teaching a central focus.

Practice-based learning describes types of field experiences that situate TCs' learning in K-12 classrooms coupled with coursework focusing explicitly on the work of teaching (Forzani, 2014). Grossman et al. (2009) describe how a core-practice approach in teacher education necessitates organizing coursework and fieldwork around core practices of the teaching profession while simultaneously providing TCs ample opportunities to "practice" enacting these teaching practices in structured and supported ways. Other research within the teacher education community has identified "core" or "high-leverage" teaching practices that effective teachers use while teaching (i.e., Ball & Forzani, 2009; McDonald et al., 2013; NCTM, 2014) and we draw on these in this paper. By purposefully designing teacher preparation coursework to include the pedagogies of enactment that have MTEs side-by-side with TCs in a K-12 school setting, we are working to develop TCs' understanding of such core teaching practices and know how to enact them skillfully.

An important factor in redesigning our teacher preparation courses, we drew on McDonald et al.'s (2013) learning cycle (Figure 1) to illustrate how core practices are embedded into the MFE design and developed across the four phases. The four phases of the learning cycle provide structured supports to develop TCs' understanding and enactment of such teaching practices by: (1) learning about the instructional activity (including envisioning the practice), (2) preparing for enacting the activity (including rehearsing), (3) having opportunities to enact that practice via the activity in authentic classroom settings and (4) analyzing those enactments as a way to connect the educational theory to the classroom practice. The learning cycle puts core practices into conversation with a vision of professional learning (McDonald et al., 2013) and gives a structure for MTEs to support TCs learning to understand and skillfully enact core practices.

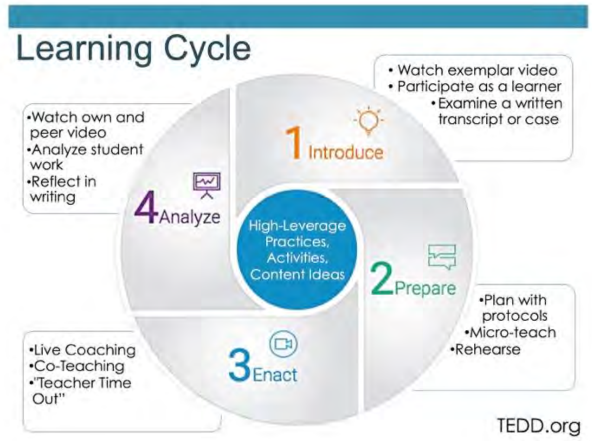

Figure 1. Cycle for learning "core" or "high leverage" teaching practices

To support TCs' understanding of ambitious teaching in each of our courses, we focused on at least one of the National Council of Teachers of Mathematics (NCTM, 2014) eight research-informed effective (core) teaching practices. These practices represent "a core set of high-leverage practices and essential teaching skills necessary to promote deep learning of mathematics" (NCTM, 2014, p. 9), examples include: facilitating meaningful discourse, supporting productive struggle, and eliciting and using evidence of student thinking.

Methods

In this paper we present the findings from a multi-institutional descriptive pilot study investigating the impact of MFEs on TCs' learning. This work is a collaboration between five different colleges and universities where MTEs teach either integrated content-pedagogy or methods courses implementing MFEs. To document the shared learning outcomes of the TCs enrolled in our courses implementing MFEs, we analyzed TCs' written reflections. The research question guiding this study was: What do TCs report in their end-of-course reflections, where MFEs were enacted, as most impactful for their learning to teach mathematics?

Context and Participants

Data collected included TCs' written reflections of the MFE experience. Each institution had a different context for the course and grade level focus for the MFE. Two institutions situated MFEs in elementary methods courses, while one university incorporated the MFEs in an integrated content and pedagogy course for elementary teachers. The other two universities placed MFEs in middle-grades methods courses. Additionally, the MFE at each institution focused on a different subset of core practices. This data collectively represents 97 TCs and their responses to culminating course assignments related to MFEs.

Data Collection and Analysis

The data collection spanned one to three terms of the courses across the five institutions, comprising a collective repository of written artifacts from each course. These end-of-term written assignments asked TCs across all institutions to share the most impactful aspects for their learning during the term and what aspects of this learning they plan to bring to their future classrooms. We aggregated all TC responses across institutions to have a reasonable sample size (97 TCs) and to look for themes across the MFE and independent of the institution/instructor.

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We utilized the six phases of thematic analysis (Nowell et al., 2017) to create and apply codes to the entire data set. For the first phase of thematic coding, familiarizing ourselves with the data, we met weekly to discuss theoretical perspectives of the data set and brainstorm potential themes and codes by looking at the common reflection prompts in course assignments as well as elements of the NCTM effective teaching practices. After examining our own data sets and drafting initial themes of each individual data set, we used peer debriefing to generate initial codes (phase two) and utilized our theoretical framework to organize our codes into logical clusters. Using elements of analytic induction (Erikson, 1985), we used confirming and disconfirming evidence to verify the existence of each emerging theme. In phase three, we searched for themes, documenting any excerpts from the data that seemed problematic for the next phase of peer debriefing. At this point the group entered phase four and five, reviewing themes and defining and naming themes. In this process, we cross examined data sets both collectively and individually, discussing examples from all data sets to determine working definitions to accurately depict the data and align with our theoretical framework. We then divided the data by codes and individually re-examined individual code applications. The group continued to reconvene for peer debriefing addressing any anomalies in the data and reconciling codes as needed. In this iterative process, code application was triangulated by individual researchers taking on different codes in each analysis. Finally, in phase six of thematic analysis we present our final analysis. For the purposes of this paper we are using a subset of our codes utilizing findings related to TCs' reporting related to ambitious teaching and the number of TCs referring to these practices within our data set. The coding scheme was further expanded as other themes and elements emerged from the data (e.g., TCs' attribution to distinct phases in the learning cycle).

Findings

In this descriptive pilot study, we sought to identify any common learning outcomes identified by the TCs in our courses due to the common implementation of MFEs. TCs reported that they deepened their understanding of the targeted core teaching practice(s), developed a vision of ambitious mathematics teaching that aligns with NCTM's vision, recognized the importance of cultivating a positive classroom environment, and identified the importance of knowing students and building on students' knowledge when planning and/or teaching along with an increase in confidence when teaching. The common learning outcomes identified by a threshold of at least one-quarter of all TCs in the study are presented in Table 1.

Table 1: TC's Self-Reported Most Impactful Aspects of Learning in Courses with MFEs

TCs' Learning as Reported in Open-Ended Reflection Question	**# of TCs**	**%**	**Representative Quote**
Core teaching practice that was a focus of MFE	82	85%	*This class has taught me the importance of asking purposeful questions to students to elicit deeper thinking and to help connect the math.*
Teaching mathematics in ways that align with NCTM's vision	56	58%	*Another one of the eight practices that really change[d] my mind about math was facilitating meaning for mathematical discourse. Instruction that is focus[ed] on mathematical discourse engages students as active participants and making sense [of] mathematical ideas and raising of a mathematical relationship.*

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Importance of creating positive classroom environment	55	57%	*..I will be important to create a community among my students, sharing the idea that it's okay to not understand, and we can support each other in the process of learning through respectful discussion, and sometimes debate.*
Importance of knowing students as people/learners	34	35%	*I learned that in order to understand your students, you must get to know them. I had the opportunity to get to know my math buddy well, along with several other students we worked with when co-teaching some of the math lessons. Getting to know these students gave me insight to how they each learned and what I could anticipate from them in order to prepare in a way that would support their learning.*
Importance of building on students' knowledge in planning or teaching a lesson	34	35%	Planning: *I feel as though my lesson planning has improved. Anticipating student strategies and misconceptions has helped me figure out in advance the kinds of questions I might ask, what student work might look or not look like, and what group conversations might sound like.* Teaching: *Another important aspect of math that I have learned throughout this semester is allowing students to work through their thoughts before jumping in and correcting/helping them. I have a tendency to interrupt students as soon as they start to make a mistake, but this course has taught me that these mistakes are crucial to student thinking.*
Confidence in teaching or teaching mathematics	27	28%	*Reading the textbook and putting the concepts into action at* [site of MFE] *has raised my own confidence about teaching math as I have watched my math buddy overcome his own hurdles and enjoy problem solving.*

Core Teaching Practices and Additional Learning

Across each of our courses, all five MTEs focused on a subset of NCTM's (2014) eight effective teaching practices as our "core practice." Given the variety of the courses and MTE's learning goals for each of their respective courses, no particular core practice emerged as key. However, it is notable that 83% of the TCs highlighted the importance of at least one core practice for students' learning or self-reported they improved in their enactment of the practice: the specific core practices named corresponded to those that were a focus of the iterative MFE cycle in their respective course. For instance, in a methods course that focused on the connections across all eight ETPs, a TC wrote:

> Often, you can utilize multiple teaching practices by doing one thing. Using mathematical representations helps elicit thinking, which they then use to engage in discourse. While this is all being done, they might be engaging in productive struggle. Seeing how everything ties in together makes it far less intimidating.

Whereas in a course that emphasized a subset of NCTM's core practices, and one core practice was the focus of multiple iterations of the MFE so TC could have multiple ongoing opportunities to hone and enact this core practice, TCs reflected about learning specific to that core practice. For example, where posing questions was the targeted core practice, this representative quote highlights TCs' self-reported learning:

> My observation of [our partner classroom teacher], along with my new found knowledge of the power of questioning, has encouraged me to implement questioning into my own practice. I have put an emphasis on using questions as a tool to uncover student understanding, much like [partner classroom teacher]. This small change has dramatically changed my interactions with students. Instead of telling students how to fix their mistakes, I ask students to take me through their thought process.

In addition to reporting on their deepened understanding of the targeted core teaching practices of the course, TCs wrote that they learned about the importance of the classroom environment, knowing their students, and incorporating their students' thinking into their lessons. They also envisioned a supportive and productive mathematics classroom that included positively framing students as capable mathematicians, providing access for all students to learn mathematics including choice, and incorporating a growth mindset where mistakes are viewed as essential aspects of learning. Almost 60% of the TCs across all five institutions described their vision for teaching mathematics in ways that align with NCTM's vision (when they chose to describe that vision; not all TCs described their vision in this open-ended question). In these end-of-the-term reflections, many TCs described what a positive mathematics classroom environment looks like, sounds like, and feels like for every student and reflected on how important these aspects are for ambitious mathematics lessons. Lastly, almost 30% of the TCs mentioned an increase in their confidence in teaching after just one term of a course implementing MFEs.

Impact of the MFE Structure

85% of the TCs specifically named at least one aspect of the learning cycle structure as impactful for their learning, and roughly one-quarter explicitly pointed to the specific feedback received, including peer, partner classroom teacher, and MTE feedback, as reported in Table 2. Collectively, TCs specifically named each phase of the learning cycle as important for their learning. For approximately one-fifth of the TCs, the impact of experiencing the lesson themselves, before enacting with students during the *Introduce Phase*, was highlighted. Approximately one-third of the TCs pointed to the *Prepare Phas*e, and co-planning with peers and/or receiving feedback from the MTE in preparation for teaching, or *Analyze Phase*, where TCs reflected about their experiences and debriefed about their experiences working with students both through discussion and individual writing assignments facilitated by the MTE, as essential. The phase identified the most often as impactful was the *Enact Phas*e of the learning cycle. TCs attributed their experiences of teaching and working directly with students as key for connecting theoretical (course) learning with the practice of teaching.

Table 2: TC's Self-Identified Impact of the MFE Structure on their Learning

TCs' Attribution of Learning to MFE Structure	# of TCs	%	Representative Quote
TCs attribute learning to at least one aspect of the learning cycle	82	85%	*Having the opportunity to put my teaching into practice within [partner classroom teacher's]class has helped me to grow and adapt to become a better teacher in the future. Three areas that I have grown throughout this semester are planning and organizing lessons, creating*

			and implementing student-centered learning experiences and creating a positive learning environment.
Introduce Phase	18	19%	*I found it useful putting ourselves in the student position first in doing the lesson we were about to teach to the students, it helped us become flexible, intuitive, and help to predict student reactions and areas of struggle.*
Prepare Phase	29	30%	*During our own planning of the Three Reads Lessons, my team was able to determine what materials to provide students that would be the most helpful. For example, one of our problems had numbers that were too big to use cubes like we had done the week before. If we had not planned out the lesson, then we might have given students manipulatives that made the problem harder for them instead of helping them make sense of the problem. In short, a solid plan makes a solid lesson.*
Enact Phase	53	55%	*I think the aspect of being able to apply what we learned every week by physically teaching it to our students had a heavy impact on my learning.*
Analyze Phase	30	31%	Live: *We were able to debrief after every lesson … and that really helped bring everything we did and learned together.* Written: *As much as I didn't honestly enjoy doing math reflections every week, they were actually very helpful. They helped me not only analyze what students were understanding and how they came about the answers that they had gotten, but it also helped me know what things I should add to the next lesson in order to ensure better understanding and more successful instruction. It helped me to see what parts of my instruction were successful, unsuccessful, or what I needed to include in my next lesson to better reach the students.*

In addition to attributing their learning to the specific phases of the learning cycle, 27% of the TCs identified feedback during at least one aspect of the learning cycle as impactful. Most notable, TCs highlighted feedback during the *Enact Phase*, when a teacher time-out was called and the TC conferred with either their TC partner, the MTE, or the classroom teacher to solicit support and confer about what to do next, in that moment. Others pointed to the specific feedback received during the *Analyze Phase*, either (1) during the debrief as they shared instructional moves and received verbal feedback from their partners/peers or the MTE or (2) written feedback on assignments given at the conclusion of the cycle for TCs to continue reflecting and analyzing their learning. Because MFEs provide that *shared* and authentic teaching experience, TCs are able to receive feedback across all phases of the learning cycle (e.g., on their planning, teaching, *and* reflecting) from the MTE, the partner classroom teacher, and their peers, to which many credit their deepened understanding and improved enactment of these core teaching practices and other important aspects of the course (e.g., positive classroom community).

Discussion and Implications

Working in authentic classroom environments within the MFE structure, where TCs' productive struggle was supported through the iterative structure of the MFE and feedback across all phases of the learning cycle, provided TCs with a working vision of ambitious mathematics instruction. In addition to identifying how their understanding of core teaching practices and their impact are essential for teaching and learning, they reported this approach impacted their appreciation and aspiration of a productive mathematics classroom environment where students are central, viewed as capable learners and where the teacher actively plans and teaches lessons to build upon their students' ideas.

The MFE structure offers unique means of supporting the development of beginning teachers' practice and awareness of ambitious mathematics teaching (Campbell, 2012; Campbell & Dunleavy, 2016; Horn & Campbell, 2015). The TCs' self-reported understanding or growth in enacting targeted core teaching practices and cited how various phases of this iterative learning cycle supported their understanding and enactment of these practices. This suggests the MFE structure is effective for developing TC's knowledge and awareness of the importance of these core practices for teaching mathematics. Further study is needed to ascertain how effective this instructional approach is for their proficiency in enacting these teaching practices.

The MFE provides a promising pedagogical approach for preparing beginning teachers. TCs, through this structured learning experience, identified at the end of the course, without explicitly being prompted, specific core teaching practices and characteristics of a classroom that provide access, support and challenge for their students, an essential standard in the preparation of math teachers (AMTE, 2017, p. 13-Indicator C.2.1). In addition, the learning cycle and structure of the MFE provided iterative opportunities for TCs to: "plan for effective instruction" (p. 14, Indicator C.2.2), "use a core set of pedagogical practices that are effective for developing students' meaningful learning of mathematics" (p. 15, Indicator C.2.3) and "analyze teaching practice" (p. 16, Indicator C.2.4) as the MTE provided feedback and support to TCs at all phases of the learning cycle. The MTE served to mediate tensions arising as TCs were asked to apply and integrate their theoretical learning about mathematics and ambitious teaching through the practice of teaching (Billings et al., 2021). What we are asking TCs to do is a challenging way of teaching: it is notable that more than one-quarter of TCs self-report they developed confidence to teach this way. We attribute this in part to the highly supportive MFE environment.

A limitation of this study is that TCs self-identified aspects of their learning, and thus areas of learning may not have been reported. The open-ended nature of the questions did not guide the TCs to reflect on specific course learning objectives. Consequently, TCs may have acknowledged growth in an area, such as confidence, if directly asked, but may not have reported a growth in this area due to the nature of the questions posed. Revision of the data collection tools, explicitly asking TCs to report about specific areas of learning, are needed for future study about the impact MFEs have on TCs' learning. Looking forward, we hope to document TCs' perceptions of the impact MFEs have on their learning during their preparation and follow TCs into the field to investigate their enactment of the ambitious teaching practices into their own classrooms.

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