Teachers Empowered to Advance Change in Mathematics (TEACH MATH)

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The overall goal of the TEACH MATH project is to transform preK-8 mathematics teacher preparation so that new generations of teachers will be equipped with powerful tools and strategies to increase mathematics learning and achievement in increasingly diverse public schools. To this end, the TEACH MATH project has focused on designing and researching the impact of a set of instructional modules for mathematics methods courses on prospective teachers' (PST) knowledge, dispositions, and practices.

Learning to be an effective mathematics teacher for diverse learners requires developing *knowledge, dispositions,* and *practices* that support capitalizing on children's cultural, linguistic, and community-based knowledge and experiences in mathematics instruction (e.g., Civil, 2007; Leonard, 2008). Teachers need to understand how children's *funds of knowledge* – the knowledge, skills, and experiences found in children's homes and communities – can support children's mathematical learning (Civil, 2002; González et al. 2001). Yet a gap often exists between the lived experiences of predominantly White and middle-class teachers and their ever more diverse students (Howard, 1999; Wiggins & Follo, 1999).

The Teachers Empowered to Advance Change in Mathematics (TEACH MATH) project has focused on designing a set of instructional modules for mathematics methods courses and researching their impact on PSTs' knowledge, dispositions, and practices. The research has occurred at six university sites that reflect a range of

geographic, demographic, and program contexts.

Instructional modules were created and implemented in elementary and middle school mathematics methods courses. These modules were informed by research and professional development materials on *Cognitively Guided Instruction* (Carpenter et al., 1999), community-based funds of knowledge for teaching mathematics (Civil, 2002, 2007), and Villegas and Lucas's (2002) six-strand framework for preparing culturally responsive teachers. More specifically, we designed the modules to include opportunities for PSTs to a) identify and build on children's mathematical thinking (CMT) and home/community funds of knowledge (CFoK), or together what we call children's multiple mathematical knowledge bases (MMKB), b) notice instructional and community practices that support preK-8 students' mathematical learning, and c) adapt curriculum materials and lesson plans to incorporate rich mathematical content, and children's MMKB (see also Bartell et al., 2010).

Brief Descriptions of Instructional Modules

In the *Community Mathematics Exploration (CME) module,* PSTs visited community locations and conducted community walks, at times guided by students and/or community members and then designed a problem solving–based mathematics lesson plan that built upon mathematical funds of knowledge in students' communities. The *Analysis of Classroom Practices (ACP) module* involved PSTs in using multiple lenses—teacher, learner, mathematical task, and power and participation—to critically evaluate mathematics lessons in various forms (e.g., written cases, video clips, curriculum materials, lesson plans, and enacted lessons). Finally, the *Mathematics Learning Case Study (MLC) module* was designed to support PSTs in expanding their thinking about children as mathematical learners. PSTs conducted problem solving interviews and interest inventories with individual children to learn about their experiences, interests, competencies, and perceptions about mathematics in the different contexts of their lives (school, after school, home, and community).

Key Results

Entry Points for PSTs

Across all sites, analysis revealed that many PSTs entered methods courses with the belief that connecting mathematical funds of knowledge was a valued teaching practice. Despite this initial agreement, we saw movement across the semester, with substantial percentages of PSTs voicing stronger agreement with this belief. Analyses of instructor reflections and PSTs' written work also suggested that while PSTs were very supportive of these ideas in the abstract, they tended to be vague, particularly initially, about what teachers might actually do to draw on these home and community resources. For example, when asked about how children's families and communities impact their of planning mathematics lessons, the majority of PSTs alluded to "making lessons students could relate to" without any specification of how one might learn about students' communities and their out-of-school experiences, or how one might use that knowledge to plan a lesson. We conjecture that, through their participation in TEACH MATH modules, PSTs acquired specific knowledge about mathematical resources available in children's homes and communities as well as specific ideas for using these resources in instruction (Foote et al., 2013).

Analysis of Lesson Planning Based on a Community Mathematics Exploration

Our analysis of CME projects found that PSTs entered the practice of making connections to children's MMKB in various ways and with varying specificity. For example, many lessons evidenced clear attention to children's mathematical thinking *or* children's funds of knowledge, but not both, suggesting that PSTs may have different entry points into this practice. We conjecture that some PSTs follow a trajectory in which they begin considering children's mathematical thinking joined with less demanding components of the practice, such as incorporating community contexts in problems, and then advance to identifying mathematical practices in the setting and considering

ways to connect to those practices in their instruction. Other PSTs connect to children and family practices in the community and yet include problem-solving tasks that require little mathematical reasoning, suggesting another possible path. An implication of this work is to consider, given a range of entry points, how mathematics teacher educators can help PSTs develop the practice of making connections to both CMT and CFoK (Aguirre, et al., 2013).

Analysis of Classroom Practices Through Multiple Mathematical Lenses

As part of the ACP module, PSTs engaged in a video lens activity four to five times during the semester, using a set of four "lenses" (teaching, learning, task, power and participation) to analyze representations of teaching and learning in videos. Results indicated that PSTs increased their depth and expanded their foci in noticing equitable instructional practices. In small group and whole class discussions, PSTs (a) shared their observations (often clarifying their own thoughts as they explained), (b) heard what their peers observed (often different from their own observations), and (c) posed and responded to questions (from both peers and MTE). We found that taken together, these experiences supported PSTs in noticing more details and becoming aware of the significance of these events (Roth McDuffie et al., 2014).

Analysis of PSTs' Instructional Suggestions

The MLC module engaged PSTs in learning about a single student from their practicum classroom. Through various activities they learned about the students' mathematical thinking and their interests, competencies, and resources. The PSTs then made instructional suggestions for furthering their student's growth in mathematics. Results indicated that there were a variety of ways that PSTs made connections to one or more of students' knowledge bases, including (a) assumptions about familiar or relevant contexts, (b) knowledge of familiar objects or activities, (c) mathematizing family practices, (d) identifying mathematics in activities that the child engages in,

and (e) specific details about children's mathematical thinking. PSTs' attention to these knowledge bases indicates that they were attending to particularities about students, and thus developing the powerful disposition to continue to do so (Turner, et al., 2015).

Concluding Comments

TEACH MATH attempts to support PSTs in exploring the social and cultural dimensions of children's knowledge and experiences and to connect these to their mathematical thinking in instruction. In this way teachers are better prepared to understand students' MMKB and design instruction that builds on them.

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