MATH IN COMMON®

Roadblocks and Routes

Professional Development in Math in Common Districts

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Introduction

In their proposals to join the Math in Common (MiC) initiative, staff from each of the 10 participating districts acknowledged that the shifts required to implement the Common Core State Standards for Mathematics (CCSS-M) (NGA Center & CCSSO, 2010) would be a huge lift for teachers. They knew that mathematics teachers would be required to take up new, sometimes foreign ways of doing their work with students. Learning to provide useful, impactful professional development (PD) to support teachers in this process would become a primary focus of MiC.

Unfortunately, even before the challenge of supporting teachers' classroom instruction to implement the new, demanding standards, teacher PD had been shown to be only minimally impactful (Garet, Porter, Desimone, Birman, & Yoon, 2001; Garet et al., 2001; Gersten, Taylor, Keys, Rolfhus, & Newman-Gonchar, 2014). Because of teachers' very different experiences and expertise, districts can find challenges in providing the types of support that all teachers want, need, and find useful, and that will ultimately have positive impacts on student achievement. With regard to the CCSS-M, an even larger challenge was the scale of the shifts. The new standards meant that staff at every level of each district system, regardless of their experience, would need to build new understandings about mathematics content and about teaching and learning — teachers as they supported their students, coaches and principals as they supported teachers, and district staff as they supported coaches and principals.

In working to build the understandings of all of these different staff groups about implementing the CCSS-M, districts faced several common "roadblock" conditions — specific challenges related to how to provide effective, scalable PD to staff, administrators, and teachers in support of CCSS-M implementation. Despite the challenges that they presented, these roadblocks also created rich environments for innovation, problem solving, and learning across the MiC community of practice.

> Standards do not teach; teachers teach. New standards provide guidance and direction, and help focus and clarify common outcomes . . . But these standards do not tell teachers, coaches, administrators, parents, or policymakers what to do at the classroom, school, or district level or how to begin making essential changes to implement the standards."
> — National Council of Teachers of Mathematics (2014, p. 1)

This report describes some of the more common roadblocks that MiC districts faced in their early years of CCSS-M implementation, and routes that the districts took around the roadblocks in order to support teacher and student learning. These descriptions of district PD efforts are not meant to provide comprehensive reporting of all PD offerings across all 10 MiC districts over the five-year initiative. Moreover, districts may have, and probably did, take multiple other routes to bypass similar roadblocks. However, we hope that other districts can learn from and adapt some of the more widely adopted and successful routes taken in the MiC districts. This report also includes brief vignettes, in *The View from the Field* text boxes, of districts' practices, to more clearly illustrate some of these roadblocks and the routes around them.

Roadblock 1:
New standards demand deep changes to instructional practice

U.S. teachers have been prepared, through both their own American K–12 education experiences and their pre-service training, to teach math in a very different way than what the CCSS-M require. One of the most demanding shifts required by the CCSS-M is a new emphasis on conceptual knowledge, alongside the procedural and applied knowledge that are more familiar in American math classrooms. This shift may be particularly difficult for U.S. teachers, as their own education and teaching have typically followed a more procedural than conceptual instructional template (Stigler & Hiebert, 1999; Nesmith, 2008). For example, U.S. math teachers have typically relied on worksheets and lectures that focus on students' memorization of mathematical procedures, instead of focusing on student-driven inquiry into mathematical concepts. In addition, some research has questioned the extent to which U.S. mathematics teachers have received the support that they need in order to develop a "profound understanding of fundamental mathematics" to support students' conceptual understanding (Ma, 1999).

Another big shift required by the CCSS-M is in the way that the mathematics content has been reorganized across grades, with mathematical ideas developing from year to year. Given the reshuffling of concepts between grades and the standards' emphasis on developing concepts across grades, teachers now need to understand a broader array of mathematical concepts than they might have before the CCSS-M. In addition, the CCSS-M demand that students display their knowledge and thinking in multiple formats, both written and verbal.

Although the ideas underlying the CCSS-M Standards for Mathematical Practice (SMPs) have long been part of educators' senses of what "good mathematics education" should be (National Research Council, 2001), the CCSS-M turns these ideas into concrete standards for teachers to implement. One result is that districts have had to figure out how to support teachers in shifting their instruction toward both new math pedagogy and new math content.

MiC participants thought deeply together, as a community and in district teams, about how to support teachers in understanding new mathematical content and implementing new instructional practices. The remainder of this section describes three observed routes around this roadblock.

Route: Build knowledge of the mathematical standards, pedagogy, and content — and of how they connect

Not surprisingly, given the demands of the CCSS-M, the content provided for teachers'

PD during the years of the MiC initiative was broad and varied. At the beginning of the initiative, most MiC districts provided teachers with a general introduction to the CCSS-M. This helped teachers understand the primary instructional shifts defined in the CCSS-M (coherence, focus, and rigor) and the new emphasis on balanced instruction supporting students' conceptual understanding, procedural fluency, and application of mathematical understanding to real-world usage.

While educators have long been inspired by the ideas driving the SMPs, putting all of these ideas into daily practice was a new challenge for many. MiC district staff learned that selecting a few focal SMPs at a time to dig into deeply was more productive than asking teachers to study them all simultaneously. SMP 1, "Make sense of problems and persevere in solving them," and SMP 3, "Construct viable arguments and critique the reasoning of others," were common early focal SMPs across the districts, in part because these standards aligned with districts' concerns about supporting students' social and emotional learning (i.e., perseverance, as called for in SMP 1) and English language development (as related to SMP 3).

The districts also offered PD that connected math pedagogy to the standards. For instance, teachers learned instructional strategies that would support students' development of both the content standards and the SMPs. These strategies included many of the strategies identified in the Mathematics Framework for California Public Schools (California Department of Education, 2013), such as using tape diagrams, guiding collaborative conversations via "Number Talks," class norm-building strategies such as the "Participation Quiz," and student engagement strategies such as "Find My Rule."

In addition to requiring teachers to learn new instructional strategies, the CCSS-M required them to learn new content. For example, compared to prior standards, the CCSS-M give much more attention at the early grade levels to number and operations. Elementary administrators in one district noted a need for their elementary educators to learn more about number decomposition. To address this concern, the district offered a series of after-school trainings, in which teachers read and reviewed instructional resources on decomposition, the importance of the base 10 system, and how to use base 10 manipulatives. The district also provided instructional coaching to develop teachers' facility to use common instructional strategies, such as Number Talks and bar models, to emphasize number decomposition while also touching on the SMPs (e.g., by enabling students to hear how other students make sense of problems [SMP 1] and to be able to use that information to critique the reasoning of others [SMP 3]). The PD supported the development of teachers' content and pedagogical content knowledge and of their ability to integrate complex instructional ideas in practice.

Route: Focus on a manageable set of goals and track progress toward them

As MiC participants, district math teams were supported in setting goals for their PD activities and regularly monitoring progress toward these goals. District teams prepared grant reports each year to document their progress toward goals. At the end of each school year, like staff in every school district, MiC district leaders looked ahead to PD for the next year, reviewed their PD activities for the year just past, and examined evidence about how well their PD efforts went. Data sources that informed these reviews included district administrator feedback, teacher reflections, classroom observations, and discussions with principals.

As the teams' understandings of the standards developed, and as they honed their specific visions for which elements of the standards to bring to the forefront of implementation efforts, the character of their planning sessions changed. The goals for

their PD became more specific — shifting from helping all teachers "understand the standards" to supporting teachers in using specific instructional routines or materials to focus on one or two SMPs over the course of a year. To create these more narrowly specified goals, and to develop PD supports for particular conceptual ideas or instructional practices, they drew on resources such as the Mathematics Framework for California Public Schools, the CCSS-M progressions (Arizona Board of Regents, 2007), and *Principles to Actions* (NCTM, 2014).

Districts' shift toward specifying which elements of the standards to prioritize was accompanied by a related shift: using evidence for decision-making about PD. In the later years of the initiative, as achievement data from the California Assessment of Student Performance and Progress (CAASPP) became available, district leaders could develop PD activities informed by students' results, by, for example, reviewing CAASPP claim-level student data and aligning PD to claim areas that students were having greater difficulty with. (For more information on CAASPP claim levels, see California Department of Education [2016].)

To track progress toward their PD goals and whether their efforts were having an impact on classroom instruction, districts conducted classroom observations, using rubrics aligned to the PD, and analyzed the resulting data in order to answer questions such as "After teachers learned a routine in PD, were they using it in their classrooms? Did it look the way we [district staff] thought it would?"

Route: Increase teachers' access to mathematics expertise

Because the CCSS-M required significant changes in both math content and pedagogy, districts needed to increase mathematics expertise at all levels of their systems. This

The View from the Field

Sacramento City's Evolving PD Plan

The PD plan in Sacramento City Unified School District's MiC grant proposal included three foci: mathematical practices, instructional shifts, and content standards. These foci were to be addressed in district PD in the first two years of MiC. The first year focused on three SMPs (2, 3, and 7), two instructional shifts (deep understanding and application), and one or two foundational content standards for each K–8 grade band (e.g., for grades 6–7, Ratios and Proportional Relationships and The Number System). The district's plan for the second year was to continue and deepen the emphasis on the same foundational content, and also to add some new content for each grade band (e.g., adding Expressions and Equations for grades 6–7 teachers), to add an additional instructional shift ("dual intensity"), and to shift focus onto two new SMPs (5 and 8).

Years later, the district's PD plan evolved to focus more narrowly, not just on SMPs or on particular content focus areas, but on how to use high-quality tasks and teacher questioning to enable student academic discourse within a content focus (such as proportional relationships). In other words, as the district learned more through its implementation process, district leaders were able to provide suggestions that were more specific for their teachers on how to achieve these student academic goals in their classrooms. The evolution of Sacramento City's PD is a helpful example of how a PD plan was refined over several years.

was accomplished by developing expertise in their teachers and in those who support them, by hiring new math specialists and coaches, and by bringing in outside thought partners.

The MiC grant funding enabled districts to increase the numbers and spread of their district staff with specialized knowledge of mathematics content and pedagogy. It also enabled districts to develop connections to external technical assistance providers. These providers supported mathematical knowledge building for district staff. In some cases, such as county office of education math specialists demonstrating and co-teaching in teachers' classrooms, they also provided direct support to schools and teachers. (The roles of coaches and technical assistance providers in MiC are discussed more fully in another report in this series [Perry, Marple, & Reade, 2019a].)

Additionally, the grant funding enabled districts to increase their staff expertise by bringing on more math coaches, or by training coaches whose primary expertise was in other subjects, such as English language arts, how to support math instruction, and often by providing further administrator training (Perry, Reade, Heredia, & Finkelstein, 2017; Perry & Reade, 2018). With their improved mathematics knowledge, these coaches and administrators could be

The View from the Field

Sanger's District Coaches Support Site-Based Lesson Study

Math coaches in Sanger Unified School District had facilitated lesson study (a form of collaborative professional development) with teachers prior to implementation of the CCSS-M, under Math/Science Partnership grants, but lesson study had never taken hold in the district as a central form of teacher PD. After hearing experts Akihiko Takahashi, Catherine Lewis, and Tad Watanabe share their research on lesson study at an MiC convening, the district's mathematics staff adopted lesson study as the district's primary mechanism for site-based PD.

Drawing on their own learning from their county office of education partner, district staff re-introduced lesson study slowly, starting in willing school sites and grade levels. By the 2017–18 school year, the district had expanded its lesson-study PD to include all K–8 mathematics teachers. District math coaches facilitated grade-alike lesson-study teams of teachers from two or three different school sites. The main focus for each team's work was on using higher-level cognitive demand tasks around particular mathematical content, incorporating a greater level of academic discourse, and using Universal Design for Learning strategies to provide more access and equity for all students.

School-based Curriculum Support Providers (CSPs) participated in at least one lesson-study effort alongside teachers from their sites. This enabled the CSPs to build their familiarity with lesson study so that, going forward, they could facilitate and monitor the effectiveness of lesson-study teams. These coach-supported lesson-study opportunities enabled teachers and CSPs to integrate what they were learning about teaching and learning mathematics with other provided PD, such as after-school trainings related to particular mathematical routines or book studies. Additionally, site leadership was encouraged to observe the lesson-study process, and several principals participated in lesson-study activities at their own sites to learn and build their own knowledge and capacities.

deployed to help spread the district's message about math instruction. We observed that this sort of communication from coaches and administrators created a "buzz" and supported a unified message about math implementation in the districts.

Another report in this series, *Educators Collaborating to Improve Mathematics* [Perry, Marple, & Reade, 2019a], describes this use of math staff as a critical support for standards implementation, because these staff members' expertise can help other district staff understand what is required in order to align the dynamics of classroom instruction with the CCSS-M. One district math administrator, in Long Beach, reported that schools that were supported by coaches with math expertise were able to build stronger collaborative structures and show greater gains in student math achievement, increases in teachers' confidence, and more frequent use of common instructional practices, such as engaging students in "productive struggle," academic discourse, and higher-level tasks, than schools without this support. She added, "It's invaluable to have someone onsite with math expertise."

Most MiC districts also built online repositories of math standards information, links to useful resources, and/or online PD modules that teachers could access on their own to support their learning outside of district-provided PD opportunities.

Roadblock 2:

High-quality standards-aligned instructional materials are not available when the CCSS-M are adopted

Unfortunately for educators and students, the arrival of the new math standards was not accompanied by a concurrent arrival of high-quality instructional materials aligned to those standards. During the initial implementation of previous standards, districts often closely connected professional learning about new standards implementation with aligned instructional materials, as described in another report in this series [Perry, Marple, & Reade, 2019a].

In the case of the CCSS-M, the challenge of supporting teachers toward the standards' new conceptual ideas and instructional practices was compounded by the fact that aligned instructional materials were not available in many districts until several years after CCSS-M implementation began (see Perry, Marple, & Reade [2017] for more about instructional materials in the MiC districts). This lack of instructional materials at the onset of implementation impacted the PD that districts provided, and in some cases may have been part of the reason that preliminary PD focused on the structure and instructional shifts of the standards (i.e., "this is what the Common Core asks of students"), leaving teachers and schools to figure out what the standards look like in classrooms and how teachers' current practice, standards, and materials were connected to them. The remainder of this section describes three different routes that MiC districts took around this instructional-materials roadblock.

Route: Review existing materials and adapt them as part of PD

Common district responses to this roadblock were to organize PD to support teachers' review and critical use of their existing instructional materials (e.g., so that teachers didn't always need to have students do every problem in a lesson) and to provide additional resources for teachers in areas where instructional materials did not quite align with the standards. In offering these supports, district staff sought other aligned materials to be the primary source for PD content, such as the Mathematics Framework for California Public Schools, the standards progressions documents (Arizona Board of Regents, 2007), or free online instructional materials such as EngageNY (EngageNY, n.d.). These materials provided supporting ideas alongside teachers' current textbooks, filled in gaps, or served as "replacement units." For example, Garden Grove Unified School District wrote in its MiC grant application about its plan to assess and adapt available materials, commenting:

> *"To develop instructional materials and build capacity, the math coaches and designated TOSAs [teachers on special assignment] will facilitate a summer project related to the launch of the Common Core with teacher leaders. These efforts will include the review of the CCSS-M along with current instructional materials*

(Harcourt [K–6] and Pearson [7–8]) in order to determine what adjustments will need to be made to pacing and instruction [and] . . . supplemental lessons needed."

Districts' partnerships with external support providers were particularly useful in reviewing existing resources. External providers often had greater, more extensive knowledge of the relevant source materials, which defined and elaborated the important standards-aligned content that students at each grade level should be learning, than district staff did, and they could pass that knowledge on to district coaches, teacher leaders, and teachers in PD sessions. Two examples of how districts worked with external providers on their instructional materials are provided in the text box *The View from the Field: External Partners Help District Teachers Use Multiple Instructional Resources to Guide Instruction*.

Route: Adopt new materials and help teachers see how materials reflect the standards

When districts adopted new instructional materials, later in the MiC initiative period — or further altered their adopted materials — this transition presented both an opportunity

The View from the Field

External Partners Help District Teachers Use Multiple Instructional Resources to Guide Instruction

Elk Grove Unified School District's site-based Regional Collaborative Days, facilitated by district mathematics coaches and/or a county office of education consultant, served as a model for the site- and grade-level work of Elk Grove's professional learning communities (PLCs). These experiences were intended to provide PD to teachers by allowing groups of teachers to use different resources to research instructional ideas, and to develop and practice lessons and techniques that have direct impacts on students.

In this model, a grade-level PLC leader would identify a lesson and two classes in which it would be taught. The grade-level PLC team would plan the lesson in the morning, using the Mathematics Framework for California Public Schools and a Go Math! curriculum unit (Houghton Mifflin Harcourt, 2012). Then the team would observe the lesson (often taught by district office mathematics coaches or by the county office consultant), taking notes on the evidence of student learning. Finally, the team would discuss how to improve the lesson, and would then make changes to the lesson, before it was taught again. After the lesson had been taught twice, the team members would reflect on their learning from the activities.

Similarly, math coaches in Santa Ana Unified School District worked with their Irvine Math Project partners to provide cross-grade (e.g., grades 7 and 8 together) training sessions to help teachers in consecutive grades understand mathematical content trajectories across the grades. In these sessions, teachers discussed successes, and struggles or frustrations, in implementing the CCSS-M; read and compared portions of the CCSS-M progressions and California framework documents (for example, both provide information on Expressions and Equations); discussed the "big ideas" of the standards and the similarities and differences between the grade levels; and reviewed activities and example problems, from their district's pacing guide, that might be used at each grade level to teach the big ideas.

and a challenge for ongoing PD about the standards. Some districts were able to use the piloting of new materials as a professional learning opportunity for teachers, since the piloting process required deep reflection from teachers as they considered whether and how the materials supported the standards and new instructional practices.

District leaders voiced concern about whether teachers' understandings that were built from early PD on the standards themselves (e.g., helping teachers understand the idea of rigor as defined in the CCSS-M) and on other resource materials would be retained when they transitioned to using the newly adopted materials. To address this concern, later PD often touched specifically on how teachers should use instructional materials in their planning and instruction to support the goals in the standards. For example, Santa Ana mathematics coaches told us that, because Santa Ana teachers had previously often followed their curriculum materials very closely, the coaches conveyed to teachers that they were primarily responsible for teaching the standards, and that the newly adopted instructional materials were to be used as an additional tool.

The View from the Field

Oceanside's PD to Balance Out Gaps in Instructional Materials Aligned to the CCSS-M

In shifting to the CCSS-M, Oceanside Unified School District staff recognized the dramatic shift in practice required for teachers. The district wrote in its MiC grant application:

> *"Implementing [the] CCSS-M cannot be thought of as just swapping one set of standards for another. The culture of mathematics classrooms in OUSD must change in order to create mathematically proficient students . . . [In the past,] classroom instruction focused on adopted instructional materials and was aligned to [California Standards Test] preparation, and did not lead to student achievement."*

District math leaders initially recommended that teachers in K–5 Oceanside schools use online Georgia and New York units of instruction, while middle schools were initially encouraged to use their previous curriculum materials (Connected Mathematics, or CMP3). As in many districts across the country, Oceanside leaders reported that the district's teachers were struggling with their curriculum materials — that they were having trouble balancing the amount of content that they were responsible for (much of it new) and the gaps in the curricular materials that they were being asked to use.

To counteract these difficulties with the materials, at the end of the first year of the MiC initiative, the district contracted with outside experts from the Silicon Valley Mathematics Initiative (SVMI) to organize PD focused on some of the central CCSS-M ideas that teachers felt were missing from their materials, including "instructional shifts and instructional strategies." The district also organized teacher workgroups to produce lessons, curriculum, and assessments, and, as described in its 2014 grant report, to "assess, try-out, and ultimately decide upon instructional materials for grades K–8." Oceanside continued its contract with SVMI for PD

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through the end of the MiC grant, helping teachers build their understanding of the standards and its requirements. However, when the district began using newly adopted elementary instructional materials, during the 2016–17 school year, they found surprising results: successes that teachers had demonstrated in supporting students' academic discourse — based on what they had learned from studying the standards and participating in the PD — diminished when teachers followed their new instructional materials too closely.

This phenomenon, in which teachers' use of instructional materials was very closely guided by the curriculum, was not uncommon across the initiative. Oceanside's experience taught MiC district leaders that they needed to provide support for teachers to flexibly use their new materials, by helping teachers to connect the materials directly to key CCSS-M instructional shifts and incorporate their pedagogical content knowledge when using the instructional materials.

Route: Create new instructional materials, curriculum maps, and pacing guides

A third route that districts took around the roadblock of lacking standards-aligned materials was engaging teachers and math coaches in the development of customized instructional materials, teaching toolkits (i.e., guides on instructional practices), and pacing guides.[1] Developing these materials could be an intensive process. For example, San Francisco Unified School District math staff, (see the text box *The View from the Field: San Francisco's Creation of Standards-Aligned Instructional Materials)* unhappy with the curriculum options that were available when they began implementing the CCSS-M, spent significant time and effort to develop and iteratively revise an entire "homegrown" curriculum over three years, incorporating ongoing user feedback from teachers (San Francisco Unified School District Math Department, 2015).

An upside of districts' efforts to develop custom curricula was the learning that these efforts enabled for participating teachers and coaches as they worked together to understand what would make a particular unit of instruction mathematically powerful and aligned with the standards. In San Francisco and in Oakland Unified School District, which also developed significant curricular resources in-house during the MiC initiative, the curriculum development process enabled the district development teams to work closely with mathematics experts such as Phil Daro, one of the authors of the CCSS-M, and David Foster of the Silicon Valley Mathematics Initiative.

Similarly, other MiC districts, such as Santa Ana and Garden Grove, relied on support from expert providers who worked with district coaches to inform the development of the districts' curriculum pacing guides, which were based on a mix of off-the-shelf instructional materials. This work proved to be excellent PD for the coaches from these districts — by helping to develop materials that were aligned to the CCSS-M, they improved their own ability to support teachers' CCSS-M implementation.

1 Also see Cobb, Jackson, Henrick, Smith, & the MIST Team (2018), which describes how other districts have engaged staff in developing these sorts of materials as a form of professional learning.

The View from the Field

San Francisco's Creation of Standards-Aligned Instructional Materials

San Francisco's math team reported that the district had previously had a culture of voluntary adoption, rather than mandated adoption, in relation to curricular change efforts. But because the district put significant effort into developing CCSS-M–aligned curriculum, it approached implementation of this curriculum with a different mindset. From the school board and the superintendent to school-site principals and teachers, there was a clear message and expectation in the district that all classrooms would be using the newly developed task-based core curriculum and signature pedagogies.

Initially, district PD efforts were organized to help teacher leaders learn, use, and share information about these new instructional materials. Later, the focus of district PD shifted to district coaches working with teachers at school sites to use the core curriculum materials to collaboratively plan units of instruction. The district math team also developed unit podcasts to enable teachers to learn about the main ideas of the units in a brief, easily accessible, and portable podcast format.

Roadblock 3:

Districts need strategies to reach every classroom teacher with PD about the shift to the CCSS-M

Faced with the extensive demands of the CCSS-M and the resource constraints that most districts in California operate under, district mathematics staff may often feel pressure to organize PD in order to touch as many teachers as possible in one fell swoop.

However, with their significant grant funding, MiC districts were given much more flexibility to think about various different options and formats through which to provide professional learning support to their teachers. Most of the smaller and medium-sized MiC districts initially organized centralized PD for all K–8 teachers, and also used other formats such as weeklong summer institutes, after-school trainings, or "math Monday"–type events focused on particular content or strategies. These districts also organized book study groups, lesson-study or lesson-study-inspired activities, and site-based professional learning communities (PLCs). However, while relatively small districts can find it challenging to provide useful PD when grade-level staff can all fit into the same room together, providing PD to large groups of educators in some of the largest districts in the state can be an even more daunting challenge.

Because of the MiC districts' very different sizes, this roadblock challenged the districts to somewhat different extents in reaching all of the teachers that they wanted to support.

In districts' annual reports and monthly phone calls with the grant program officer and WestEd, three barriers to providing PD at scale were mentioned most frequently: scheduling time within the contracted workday, finding substitutes to cover teachers' release time so that the teachers could attend PD, and sparking teachers' interest in participating.

Districts that attempted to provide after-school, weekend, and summer training for all teachers reported sub-optimal teacher attendance, especially if the PD was scheduled outside of the contracted workday.[2] For example, Garden Grove organized summer institutes that all teachers were expected to participate in, but, inevitably, not all teachers were able to attend. Thus, to meet its expectation of providing PD to all teachers, the district had to organize other mechanisms — such as onsite coaching or one-day "catch-up" options during the school year — to ensure that all teachers were exposed to the ideas from the summer institute. Sacramento City administrators had to cancel a PD series after the first day, despite participating teachers' desires to continue, due to the district's contract with the teachers' union. Other smaller districts reported low attendance for PD held during out-of-contract time. For example, in one district, less than half of the district's teachers attended a particular summer institute.

Although large-scale, centralized, and mandatory PD can theoretically enable all teachers to hear the same message

2 Teachers' attendance at PD could have been complicated by districts' collective bargaining agreements, which sometimes limit the allowable number of PD hours for union members if the PD is deemed not useful.

simultaneously — sometimes from a paid external support provider brought in specifically to share mathematics knowledge — such large events are not ideal. They require overcoming the logistical complications of gathering teachers from entire grade bands or subject areas together for pull-out PD days. Larger districts, in particular, reported challenges due to lack of substitutes, finding adequate sites to contain large groups of teachers, and delayed start times complicated by teachers' commute requirements. Furthermore, these large pull-out days can be more likely to utilize a "sit and get" model, disconnected from teachers' day-to-day work in the classroom. Without structures for coaches and teacher teams to revisit the ideas from these events together at their sites, the learning is unlikely to take root in teachers' daily practice.

Route: Start PD with the ready and willing, and scale it up over time

Some districts have what one MiC administrator described as an "opt-in [PD] culture," for multiple reasons. For example, districts may not have been able to offer what teachers see as high-quality professional learning in the recent past, leading teachers to assume that new PD will not be a good use of their time. Districts may also be constrained by the terms of union contracts. Many districts haven't been able to build the kind of robust PD follow-up structures that would lead teachers to believe that their peers or site leaders are working together to implement ideas from PD on a wide scale with all teachers. In districts where teachers view PD as optional, for any of these reasons, district administrators who want to offer valuable PD have found that first offering PD experiences to teachers who are willing and excited about the learning can help to build word of mouth about the benefits of the PD, and thus increase interest and participation.

For example, Garden Grove started small by piloting its PD with the intention of scaling up the PD over time, because the district has long had a culture of successfully building large-scale initiatives in this way. In larger, more decentralized districts, where district staff did not have reliable contact with every site, small-scale PD offerings were sometimes the district's best hope for reaching at least some teachers with a new idea, as a way to build energy for broader involvement. In large districts, such as San Francisco and Oakland, where mass PD offerings for all classroom teachers (especially at the elementary level) were not possible due to the district's size, district staff invited grade-level teacher leaders to centralized PD to build their knowledge, in the hopes of creating a cadre of teacher leaders for CCSS-M implementation efforts. These teacher leaders were then expected to share their learning with school-site grade-level colleagues, in a train-the-trainers PD model.

More than half of the MiC districts incorporated a train-the-trainers strategy to share information across the district. This strategy is a common approach to professional learning, for several reasons. Organizing high-quality PD experiences (those that provide teachers with access to individuals with greater mathematical or pedagogical content knowledge) for a small group of teachers is relatively easy and economical, since fewer substitutes and less coaching time are required for these experiences than for more sizable PD efforts. Subsequently, larger groups of teachers can receive information from a teacher leader at their school site, who may be perceived as a more trusted information source than a district coach or outside expert is.

As several of the MiC districts found, two challenges of such train-the-trainers models were that the teacher leaders often still did not feel adequately prepared to guide their colleagues after their training and that these teacher leaders were not perceived by their peers as having the requisite expertise. In

other districts, the message that teacher leaders delivered to teachers was sometimes diluted or translated inaccurately, compared to the original message of the PD, as in a game of "telephone." Thus, the knowledge that districts intended to share with all teachers was not being adequately communicated. At least two districts — Elk Grove and Garden Grove — tackled this problem by piloting PD to scale, as described in the text box *The View from the Field: Starting with Small Groups of Teachers*.

Route: Create structures for site-based PD connected to teachers' everyday practice

Regardless of the MiC districts' initial PD approaches, a consensus eventually developed among them that one of the best means for supporting teachers in making deep shifts in their daily instructional practice was to offer PD in the context of that practice. This could be accomplished by shifting the locus of professional learning from the district's central office to school sites and classrooms. This PD took many forms and went by many names, including lesson study, unit study, and math-focused PLCs.

Shifting to site-based PD meant deploying district coaching staff to school sites, which required district staff to make careful decisions about how to allocate coaches to sites, especially in districts too large to put a coach at every site. In some districts — notably, in Long Beach — district central office staff directed coaching resources toward particular school sites where data showed that there were more struggling

The View from the Field

Starting with Small Groups of Teachers: PD Discourse Cohorts in Garden Grove and Elk Grove

For many of the MiC districts, student academic discourse was a primary topic of PD, not just for teachers, but also for principals. The specificity of this PD focus enabled district math staff to develop a coordinated PD system to "go deep" into a particular problem of practice. In other reports, we have described Garden Grove's approach to building a "discourse collaborative" — a group of teachers who volunteer to receive PD on the topic of peer-to-peer academic discourse throughout the school year in a variety of opportunities (Perry, Reade, Heredia, & Finkelstein, 2017; Reade & Carroll, 2018). The district started with a small cohort of teachers in one year, built energy and knowledge around the idea with this group, and then, in subsequent years, expanded the PD offerings to include another cohort of teachers.

Elk Grove learned about the idea of having small cohorts of teachers learning deeply about discourse, and liked the idea so much that the district put it into action, starting its own discourse cohort project in the 2016–17 school year. Classroom observation data gathered by district math coaches in cohort teachers' classrooms indicated that teachers had made progress in engaging students in academic discourse. Accordingly, in the following school year, the district expanded its effort to two cohorts of elementary teachers. Teachers in the new cohort received the training offered in the first year, while the PD offering for prior participants was differentiated to go even deeper into instructional strategies to support discourse. This deeper treatment of discourse not only aimed to improve teachers' ability to engage students in spoken discourse, but provided support for teachers to assist their students in mathematical writing.

students. In others, district teams offered coaching support and gave site principals decision-making authority to use coaching resources for site-staff PD as the principals saw fit. In other words, the coaching that was offered at school sites was not a one-size-fits-all approach, but was tailored and differentiated according to the needs and interests of site-based staff.

Because schools and classrooms are complex environments, it is difficult to understand the impact of any one intervention — including coaching — on student achievement. However, the MiC districts in which we saw district administrators making the greatest efforts to monitor the impact of coaching resources were the districts that reported the greatest success with use of these resources to provide needed PD and to increase student achievement.

Route: Encourage various forms of follow-up to sustain new practices learned in PD

Even the best PD experiences — the ones that inspire and excite teachers to try something new and valuable in their classrooms — can ultimately fall flat if there are no supports for teachers to sustain the change in the months and years that follow. In districts where principals could be "strongly encouraged" to attend PD alongside teachers, the principals could then work with their staffs, throughout the school year, to follow up on explorations of how to use the ideas from the PD. Coaches and district math staff could build PD ideas into routine classroom observations to monitor whether the ideas were taking root, and to reflect with teachers, after the observations, about how their efforts were going. PLC members could work together to try strategies learned through PD, creating a shared sense that the ideas mattered and could be discussed in peer groups. These PLCs could also mitigate the isolation that teachers sometimes feel when trying a new instructional approach on their own.

The View from the Field

The Value of Principal Support for Site-Based PD

When San Francisco offered funding to each school in the district for coach-supported teacher release time to do unit planning, most, but not all, elementary principals made use of this PD opportunity for their staffs. In some cases, the primary focus that principals chose for the unit planning was literacy or culturally relevant pedagogy. However, some principals did not opt in to this funded opportunity for coaching support, which prompted some concern from math team leaders that these principals may not have had the knowledge that they needed in order to understand the benefits of the CCSS-M for their staff.

Since principal support was handled by a different district department, the district math team members were not always sure how well their efforts to support teachers were aligned with other district departments' efforts to support principals. Accordingly, the district coaching staff tried to organize time with principals, to help them better understand the district's mathematics vision and how they might support it for teachers at their sites.

Roadblock 4:
PLCs may exist, but are not considered valuable PD

Professional learning communities (PLCs) are very common forms of collaboration at school sites. Unfortunately, research has shown that teachers do not always find them to be helpful learning structures (Boston Consulting Group, 2014; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006, Vescio, Ross, & Adams, 2008). However, given the importance of situating learning about standards and instructional shifts in teachers' own daily practice, these site-embedded structures, which are organized to provide time and space for peer collaboration, can become important change levers.

Without clarity of purpose, PLCs may drift toward undirected planning or collaboration time, or even devolve into coffee chats. While informal conversations are important to the social fabric of schools, unstructured social opportunities may not be the type of collaborative PD that will move the needle on student achievement or build collective movement among teachers toward common school-level or grade-level goals (Little, 2006). Although almost every MiC grant proposal included some mention of PLCs as part of the teacher PD plan, most of the districts described their planned PLC work somewhat loosely. After the first year of the grant, more than half of the districts reported that their PLC work needed more refinement, focus, and support.

Route: Identify structures to guide clarity of purpose for teachers' collaborative time

As CCSS-M implementation progressed, the 10 MiC districts organized their PLCs in ways that were more intentional and structured. The PLCs' structures differed across the districts. For example, some districts used lesson-study or unit-planning structures (Seago, Perry, Reade, & Carroll, 2016). PLCs consistently became a common area in which MiC districts could apply what they learned from MiC experts, external support providers, and other districts. PLCs also provided forums for "critical collaborations" that supported districts' vision-building

> Research is strengthening the case that quality collaboration leads to better teaching, [but] fostering collaboration among teachers requires changing how schools operate. It is difficult to do well and therefore is not a guaranteed path to improved outcomes." (Schleifer, Rinehart, & Yanisch, 2017, pp. 4, 6)

efforts (Perry, Marple, & Reade, 2019a and 2019b). Tightening up structures for PLCs enabled groups of teachers to focus on the dynamics of classroom instruction that they were hoping to put in place. For example, one Long Beach math administrator commented, "[Lesson study] was the only teacher PD practice we've done that really got to changing teacher beliefs about what students could do."

MiC participants had numerous opportunities to hear from, and learn alongside, Tim Kanold, a national expert who, with colleagues, provides nationwide consulting on developing PLCs, via the organization Solution Tree. Kanold not only provided strong early support for the district MiC leadership teams as they developed their district visions for mathematics, but also shared Solution Tree's High-Leverage Team Actions (HLTAs) with districts and provided summer institutes with district principals to support their site-based math implementation. The HLTAs are 10 activities for collaborative work, based on the National Council of Teachers of Mathematics (NCTM)'s *Principles to Actions* (NCTM, 2014). In essence, the HLTAs encourage both a focus on mathematics (with activities organized around a unit of study) and a process for iterative improvement of a PLC's capacity.

The View from the Field

High-Leverage Team Actions to Structure Dinuba PLCs

Tim Kanold's introduction of the High-Leverage Team Actions (HLTAs) at a 2014 MiC convening and at the 2015 summer principal institute had an immediate impact on the Dinuba Unified School District. Over the next year, Dinuba district and site administrators worked to share the HLTAs with their teachers and teacher leaders. The math leads provided Kanold's book *Beyond the Common Core: A Handbook for Mathematics in a PLC at Work, Leader's Guide* (Kanold & Larson, 2015) to the teachers and had focused discussions on a few (not all) team actions related to high-cognitive-demand tasks and formative assessment processes. During the first year of applying the HLTAs in PLCs, the district also organized a daylong training for district and site administrators and teacher leaders, led by Kanold and focused on high-cognitive-demand tasks.

As sites continued to work with the HLTAs in the 2015–16 school year, the district's chief academic officer perceived that the HLTAs could be used more effectively. To do so, the district math team's PD plan for the next school year included multiple components to support PLCs in using the HLTAs more effectively, and the chief academic officer held herself accountable for "doing a better job of following up [with principals] once the new school year starts." The multipronged PD plan revolved around a very targeted focus on lesson planning, and included:

- A district math coach working at school sites to guide teacher teams
- Two voluntary meetings for PLC leaders to build their leadership capacity
- Principals' meetings with 3–4 sessions focused on building principals' capacity to support PLCs to use HLTAs
- Creation of a "process map" (of how HLTAs are currently being used) to share with teachers, PLC leaders, coaches, and administrators

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- Development of a rubric to support teachers' reflection on the process of using HLTAs in the fall and spring

In 2017–18, Dinuba added monthly PLC lead huddles. At these huddles, teacher PLC leaders from each site and from each grade came together for 90 minutes to reflect on their use of the HLTAs and to build capacity to use protocols that support the HLTAs. The huddles emphasized the specific HLTAs for setting up and reviewing a unit of instruction.

The district team also identified ways in which it would monitor the district's success with this PD plan, including reviewing teachers' reflection data; having principals collect, share, and review PLC team logs from two grade levels at their meetings; and following up with principals or with coaches if additional needs were identified for teacher teams. In describing the overall impact of this work on the district PD, the district team reported, "Dr. Tim Kanold has greatly impacted our thinking about leading our mathematics work and supporting our teacher teams. He has helped us refine our thinking around the structure of PLCs and has provided a framework for better understanding the cycle of an instructional unit and what HLTAs can take to improve student learning."

Conclusion and Recommendations

Although the MiC districts used many different forms and structures of PD, most of the routes described in this report nurtured deep learning for teachers in some way — for example, by allowing teachers more time for learning and reflection on the dynamics of classroom instruction, by narrowing and targeting the focus of the learning, by enabling teachers to interact more regularly with others with greater content expertise, or by supporting teachers to build deeper understandings of available mathematics resources and of their own instructional materials by comparing and contrasting multiple sources of information.

An important lesson from the MiC districts was that the districts' understanding of what PD teachers needed was not static. Rather, their understanding evolved in response to new information, new district policies (e.g., adoption of instructional materials), and newly identified needs. District leaders were able to pivot and plan changes in PD because they themselves were increasingly involved in examining the dynamics of classroom instruction (Perry, Marple, & Reade, 2019a), which enabled them to better assess how well the PD was aligning with teachers' actual classroom practice.

Although time will always be a constraint when working to support teachers' professional learning, we found that the shift to site-based PD was beneficial because the PD became more accessible and relevant to teachers, as it was grounded more closely in their daily practice. That shift, especially when supported by site principals who were willing to work with staff to build learning into school schedules, kept teachers from having to find time outside of their contracted workday to continue their learning and enabled teachers to stay motivated through working more closely with colleagues from their schools or grade levels.

Based on our observations of the MiC districts over the past five years, we offer a few recommendations for other districts about providing effective PD that supports teachers as they implement the CCSS-M:

- **Develop an array of PD strategies for differentiating in-service support, to enable useful learning for all teachers.** MiC districts demonstrated the importance of following multiple routes to providing effective PD, rather than using one-size-fits-all PD. Because teachers' prior experience and training (including pre-service training and credentialing) may not adequately prepare them for successful CCSS-M implementation, districts will need to organize many different PD formats and experiences, reflecting the diverse ways in which people learn.
- **Examine ways to reallocate or augment funding in order to provide additional time and resources to support teachers' collaborative**

work. Building educators' capacity and professional capital is one of the most time-intensive, and therefore expensive, undertakings in education. Yet, we saw, in the MiC districts, how enabling teachers to take the necessary time to understand and practice specific instructional strategies can help teachers implement what they have learned through PD.

- Build greater math expertise across the district to support deeper learning for teachers. The MiC districts demonstrated the value of having staff with math expertise at all school sites. It is also critical to build math expertise more broadly in staff across the district — in coaches, principals, teacher leaders, and teachers, and with input from others outside the district — so that these staff can serve as resources to their colleagues and provide clear, consistent messages about math standards implementation.
- Consider how to evaluate the impact of PD activities, to ensure that they are helping staff to implement the district's mathematics vision. Careful documentation enables a district to keep track of and learn from its own implementation story — what worked, what did not work, what changed, and why it changed. Without documentation, it may be unclear which PD strategies are working for whom, or how. PD is a particularly fruitful area to document, because of both the scale of learning required and the need for differentiation among teachers.

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