



## Mathematics Reform POLICY BRIEF

Supporting Teachers in  
the Transfer of Content  
Training to Classroom  
Instruction

### Structured Teacher Collaboration

*This policy brief was  
developed by Public  
Works and Downey  
Unified School District*

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## TEACHING MATHEMATICS

Public education has undergone a series of sweeping reforms in the last decade that have increased expectations and accountability for schools, teachers and students. Demographic trends indicate higher numbers of minority students, second language learners and increasing levels of poverty among students served in public education.

## PROFESSIONAL DEVELOPMENT IN THE CONTEXT OF TRANSITIONING TO THE COMMON CORE STATE STANDARDS

In most districts, the delivery of professional development occurs within the context of a fragmented system of governance in which schools and districts are meeting multiple demands for accountability from state and federal initiatives. This emphasis has had the effect of a narrowed curriculum and a push toward instruction that relied on textbooks and high stakes assessments as the only measures of success. At the same time, research revealed more clearly how students learn mathematics and the limitations of what typically prevails in American mathematics classrooms—instruction that relies first on memorization and algorithms and the tendency to “jump” quickly to the “shortcut” and correct answer, without allowing time to work in depth on challenging problems.

A growing body of evidence encouraged deeper conceptual understanding and problem solving *combined* with computational fluency and factual knowledge.<sup>1</sup> These shifts are reflected in the Common Core State Standards (CCSS) for mathematics and English Language Arts, an initiative which began with federal funding in 2009 as a state-led effort coordinated by the National Governors Association (NGA) and the Council of Chief State School Officers (CCSSO).<sup>2</sup> These standards were adopted by California in 2010.

## WHAT WORKS IN MATHEMATICS PROFESSIONAL DEVELOPMENT

Solid evidence of the link between content-focused professional development for teachers and improved student outcomes has begun to transform high quality professional development to center on the importance of the teacher as well as the classroom context, often delivered through university mathematicians and others with content expertise. More recently, another aspect of professional development has gained prominence—professional development that encourages individual and collective responsibility for student outcomes in order to achieve long-term success. Improving student achievement more broadly requires professional development that (1) strengthens teachers’ knowledge of specific subject matter, (2) provides information about how students learn a particular subject matter and (3) teaches the instructional practices that engage students and are specifically related to the subject matter and a students’ understanding of it.<sup>3</sup>

## STRUCTURING OPPORTUNITIES FOR TEACHER COLLABORATION IN CALIFORNIA

Under the California Mathematics and Science Partnership (CaMSP) initiative, the Downey Unified School District (DUSD) partnered with the UCLA Mathematics Content Program for Teachers (MCPT) in the Downey Opportunity through Mathematics Partnership (DO Math) to empower forty-three 3rd grade through Algebra I teachers to become a cohesive community of accomplished mathematics professionals.

The DO Math project used structured opportunities for teacher collaboration through adapting and customizing of models for professional development including Lesson Study and Professional Learning Communities to better connect content-based training to classroom instruction. The information in this policy brief is based on the evaluation conducted by Public Works (PW), which served as both the state evaluator for CaMSP and the local evaluator for the DO Math partnership.

1 The Teaching Gap, James Stigler and James Hiebert, Free Press, New York, NY (2000); National Mathematics Advisory Panel, Final Report (2008); The Misplaced Math Student: Lost in Eighth-Grade Algebra, Brookings Institution (2008).

2 [www.corestandards.org](http://www.corestandards.org)

3 Professional Learning in the Learning Profession: A Status Report on Teacher Development in the United States and Abroad, R.C. Wei, L. Darling-Hammond, A. Andree, N. Richardson, and S. Orphanos, National Staff Development Council, Dallas, TX (2009); Improving Impact Studies of Teachers’ Professional Development: Toward Better Conceptualizations and Measures, Educational Researcher (38(3), L.M. Desimone (2009).

## THE DO MATH APPROACH

- During three summers, teachers completed 60 hours of intensive content-based training through the following UCLA MCPT courses: Number Power 2, Perspectives on Algebra and Perspectives on Geometry. The MCPT curriculum emphasizes problem solving, multiple solution strategies and communicating solutions in multiple ways (i.e., the “fourfold way”) while incorporating concepts and operations of real numbers, algebraic and geometric thinking, data and probability and preparation for the California High School Exit Exam (CAHSEE). The “fourfold way” uses numbers, pictures, symbols and words to solve and explain answers to mathematical problems.
- Teachers were assigned to a Professional Learning Communities (PLC) group in which they planned, created and conducted a mathematics lesson. Each year, DO Math teachers completed two cycles of Lesson for Study, a customized model of teacher collaboration derived from the Japanese Lesson Study model.
- To address the needs of English Learners, both UCLA courses and DO Math classroom follow-up activities incorporated elements of the Sheltered Instruction Observation Protocol (SIOP) model.

## BEST PRACTICE #1: ADAPTATION OF LESSON STUDY TO RESPOND TO TEACHER FEEDBACK

In partnership with UCLA MCPT, DO Math teachers participated in two Lesson for Study cycles where a small group (two to five) of teachers (usually within the same grade) created a lesson together, taught the lesson to a group of students, debriefed, taught a modified or revised lesson and debriefed again.

In the first year of the Lesson for Study planning session, DO Math teachers were introduced to PLCs and what was expected from each PLC member. DO Math selected two SIOP strategies to frame teaching: (1) a variety of techniques to make the content clear and (2) opportunities for interactions and discussions between teachers, students, among students and elaborated responses. As the process evolved, DO Math teachers were provided with additional planning time for lesson development in response to the concerns expressed by teachers about the limited time they had to prepare. In year 2, Algebra I standards and two additional SIOP strategies were also included: (1) ample opportunities for students to use strategies and (2) question types that promote higher-order thinking skills. For the final and third year of the grant, each PLC group lesson focused on the recently adopted California Common Core State Standards for Mathematics (CCSS-M) for Geometry, the same SIOP strategies and added three Standards for Mathematical Practice (SMP) from the CCSS-M including: (1) make sense of problems and persevere in solving them; (2) construct viable arguments and critique the reasoning of others; and (3) attend to precision.

### **Evolving Lesson for Study Norms**

*At first, norms focused on listening, decision-making and resolving conflicts; encouraging all to participate; and team member expectations.*

*By the end, norms expanded to include full participation in lesson creation, implementation and group decisionmaking; how observers collect data that demonstrated student learning processes; and ensuring that all debriefs are teacher driven.*

## BEST PRACTICE #2: COMMITMENT TO USE OF STUDENT DATA TO EMBED TEACHER ACCOUNTABILITY FOR STUDENT LEARNING

The PLC planning sessions were separated by grade levels: secondary PLC groups had one session and two to three sessions for the much larger elementary group. Although teachers met to plan their lesson by grade level and worked briefly as a whole group, teachers worked within their small PLC groups to create a grade level lesson that would promote student learning. Teachers used common assessment and CST data to help identify a topic for their lesson. Teachers also worked to clearly identify goals for their students. This helped ensure that PLC members worked towards the same objective when creating, implementing and evaluating the lesson. Teachers collected data (i.e., ticket-out) from both teaching sessions of the lesson to review at the debrief to analyze student understanding.

### **Group Accountability and Quality Control**

*Two key changes helped to improve the experience for teachers in Lesson for Study and make a more explicit connection to summer coursework. These included:*

- *Elimination of the role of the recorder to encourage all teachers to gather specific information on student learning and ensure observer accountability.*
- *Assignment of district math coach and a UCLA colleague to serve as mentors to assigned PLC groups.*

In the third year, teachers were asked to complete a worksheet specifying the SIOP strategies and the Mathematical Practices used to create the lesson. After



creating the lesson, teachers provided information focused on what they expected students to learn from the lesson. In the final planning session, teachers were given an opportunity to share out what was learned from teaching the lesson by recalling (1) topic revisions; (2) analysis of student data; and (3) the effectiveness of the revisions between the first and second time teaching the lesson.

On the day of the Lesson for Study, each PLC group reviewed the lesson with the UCLA representative and/or the math coach before they conducted the lesson. During the hour before the lesson, teachers: ran through the lesson to make sure that the teacher who is instructing the students understands the lesson; made copies and gathered materials; and set-up their classroom. In the first year, teachers were assigned various roles for the lesson, including one teacher as designated “recorder.” In the second year, the DO Math partnership eliminated the role of recorder to encourage all of the teachers who were not teaching the lesson to focus on observing student learning. Teachers identified specific students and observed their learning process throughout the lesson and reported their findings in the debrief.

## **EVIDENCE OF SUCCESS IN DO MATH CLASSROOMS**

As part of the evaluation, Public Works observed 28 Lesson for Study cycles encompassing grades 3 to Algebra I. Based on these observations, DO Math has had the most impact on mathematics instruction in the following areas:

### **Direct Instruction**

- **Highlighting pre-requisite skills prior to delivery of new content.** The vast majority of teachers provided sample and practice problems to refresh content specific vocabulary (e.g., terminology used in describing surface areas; symbols to make comparisons; and terms such as equals, same as, and equivalent).

### **Scaffolding/Differentiation**

- **Teachers used scaffolding to make the subject matter accessible (e.g., use of visual aids, hands-on activities and applications of real life context).** The majority of teachers employed hands-on activities and interactive small group learning approaches to engage students in mathematics content and foster conceptual understanding.
- **Building on prior knowledge of students.** For the activities, teachers built new lessons around prior lessons or activities by recalling student memory of concepts. Many teachers reviewed prior knowledge through warm-ups. Examples included re-examining how to find a pattern in a sequence, using equivalences ( $2+2+2+2=4+4$ ), and area of a quadrilateral and a circle.

### **Check for Understanding**

- **Higher-level questioning and dialogue in the classroom to check for understanding.** During the first two years of DO Math, classroom instruction primarily focused on discussions of mathematical procedures with some differentiation and relevance intended to promote a more holistic understanding of mathematical concepts. Teachers did ask their students questions but student responses tended to provide short one-word answers rather than elaborate on mathematical thinking or reasoning. By the third year, it was far more common to observe teachers challenging students in terms of meta-cognition (i.e., thinking about thinking) or pushing students to explain mathematical concepts verbally and in writing.

### **Student Interaction**

- **Collaborative grouping.** In DO Math classrooms there was clear evidence of students working in small collaborative groups (sometimes in pairs). In these classrooms, the lessons incorporated scenarios for problem solving and encouraged students to work together.
- **There was some evidence of UCLA’s “Four Fold Way” used as a tool for “scaffolding” the delivery of mathematics and for differentiating instruction.** While not very widespread, some teachers employed the four-fold way to represent concepts and/or encourage students to move between different learning modalities. Teachers have improved tremendously in including this concept in their teaching over the past three years.

## **EVIDENCE OF TEACHER AND STUDENT MATHEMATICS GAINS**

- **Gains on the Mathematics Knowledge for Teaching (MKT) continue to indicate positive gains in pedagogical content knowledge, particularly for elementary teachers.** Each year, participants and a group of control teachers from Downey have been assessed using the MKT (also referred to as the LMT). In 2011-12, participating primary and secondary teachers had higher mean scores on the Patterns, Functions and Algebra from the pre- to the post-assessment.



- **Outcomes on the matched comparison group of teachers and participating teachers are beginning to indicate positive results after the conclusion of the second year of training.** PW examined the performance of DUSD students on the California CST by comparing the scores of students who took mathematics from DO Math trained teachers to students who took math from teachers who did not participate in CaMSP-related professional development. In 2012, students of DO Math teachers scored significantly more often proficient or advanced in 6th grade, compared to their non-DO Math peers. Performance in grades 3-5 indicated similar performance between treatment and comparison groups.
- **An analysis of student outcomes is showing results in particular grades and subpopulations district wide.** District wide, DUSD has experienced growth of the percent of students performing proficient and advanced on the mathematics CST in the 3rd to 8th grades, with the range of improvement between 4% to 10% from 2010 to 2012. The grades with the largest improvements included 3rd grade (from 62% proficient and advanced in 2010 to 71% in 2012) and 5th grade (from 44% proficient and advanced in 2010 to 54% in 2012). Trends in Algebra I for both 8th graders and 9th graders is also positive.

#### **About the Downey Unified School District**

The Downey Opportunity through Mathematics Partnership (DO Math) includes the Downey Unified School District (DUSD) and the UCLA Mathematics Content Program for Teachers (MCPT). DUSD serves the city of Downey and is located in Los Angeles County, serving just over 23,000 students and employing nearly 900 teachers. DUSD includes 13 elementary schools, 4 middle schools and 3 high schools.

#### **About the California Mathematics and Science Partnership**

The California Mathematics and Science Partnership (CaMSP) program began in 2004. CaMSP is funded by a statewide competitive grant program administered by the California Department of Education (CDE) under the Improving Teacher Quality (ITQ) component of the No Child Left Behind Act of 2001. Since that time, eleven separate cohorts of partnerships have been authorized by CDE involving hundreds of school districts and several thousand teachers. More information can be found at: [www.cde.ca.gov/pd/ca/ma/camsintrod.asp](http://www.cde.ca.gov/pd/ca/ma/camsintrod.asp)

#### **About Public Works**

Public Works is a non-profit corporation dedicated to working with schools, government agencies and the non-profit sector by providing services and resources to organizations that educate and inform children, youth and families. Our mission is to put data into action, transforming statistics into information that informs decisions, improves accountability and communicates the impact of public policy.

Public Works has served as the statewide evaluator for the CaMSP program and for DO Math. More information can be found at: [www.publicworksinc.org](http://www.publicworksinc.org) or contact [patty@publicworksinc.org](mailto:patty@publicworksinc.org)



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