Chapter 40
A Framework for Developing Robust Online Professional Development Materials to Support Teacher Practice under the Common Core

Theodore Kopcha
University of Georgia, USA

Keri Duncan Valentine
University of Georgia, USA

ABSTRACT

The purpose of this chapter is to present a framework for developing online professional development materials to support teachers as they adopt the Common Core standards. The framework builds conceptually from the principles associated with successful mathematics professional development on the teaching practices that support productive mathematical discourse in the classroom. The framework was applied to online materials developed from an emergent perspective (Cobb & Yackel, 1996) in the context of the Common Core fractions standards at the elementary level. Implications for the use of the framework to guide the selection, development, and implementation of mathematics professional development are discussed.

PROBLEM STATEMENT

With the impending adoption of the Common Core standards and assessments in the majority of states, there is a tremendous need for resources and professional development (professional development) materials that support elementary teachers as they transition to a standards-based approach to teaching mathematics. The new standards emphasize conceptual understanding of mathematics through problem solving rather than learning mathematics as isolated computational procedures. Specifically,

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the Common Core standards promote instruction that creates opportunities to learn mathematical content as it is used in real world practices. These practices draw heavily on the National Council of Teachers of Mathematics (NCTM) (2000) process standards, such as promoting mathematical reasoning and communication, using mathematical representations, solving problems, and connecting across mathematical concepts.

One way in which these standards can be met is by teaching with cognitively demanding tasks (CDTs). CDTs are rich tasks that create opportunities for teachers and students to explore and discuss mathematics, develop multiple solution strategies, connect across mathematical concepts, and often embed computational practice within the larger context of higher-order thinking (Boston & Smith, 2009; Franke, Kazemi, & Battey, 2007; Smith & Stein, 1998; Stein, Grover, & Henningsen, 1996). The NCTM (2012) strongly promotes teacher use of problem solving activities with the characteristics of CDTs in an effort to increase student understanding of mathematical concepts. Teaching with CDTs has the potential to meet the goal of the Common Core to bring mathematical content and practice together in the context of authentic problems.

There are key teaching practices associated with successful implementation of CDTs in the classroom and in a manner that meets the Common Core standards. Generally, these practices facilitate rich mathematical discussion that sustains cognitive demand throughout the exploration or solving of a problem. Stein, Engle, Smith, and Hughes (2008) identified five practices that support effective mathematical discourse in the classroom. Those practices are described briefly:

- **Anticipating:** Anticipating involves teachers predicting possible student responses as they explore mathematical tasks. This includes anticipating appropriate mathematical thinking around a task, misinterpretations of a problem, and possible misconceptions that students might hold. An important aspect of this practice is anticipating the questions that a teacher might use to address possible student responses to sustain cognitive demand.
- **Monitoring:** Monitoring involves listening to students' mathematical thinking during classroom activity and determining appropriate responses to that thinking. Teachers may circulate the classroom as they monitor to assess the types of thinking that are present, introduce questions to sustain cognitive demand, and begin to plan the focus of the later practice of connecting.
- **Selecting:** When selecting student responses, the teacher assesses the variety of strategies used in the classroom with the goal of determining which strategies to make public to the class. This is an opportunity for teachers to probe the mathematical thinking underlying each solution strategy to determine which types of thinking help support the objectives of the task. When selecting, a teacher may choose strategies that expand on a given concept or expose common misconceptions in a way that the students are capable of dealing with as a group.
- **Sequencing:** Once specific student strategies are selected, the teacher then determines a sequence for making those strategies public to the entire class. The sequence purposefully conveys mathematical ideas in a way that supports the goals of the task. In some cases, this may be to expose similar types of thinking, while in others it may be to expose students to multiple representations or contradictory strategies in an effort to better understand an underlying concept.
- **Connecting:** Finally, the teacher must help students make deliberate and specific connections among the ideas that are presented to the class. This may include