CHAPTER 2

SITUATING PROFESSIONAL DEVELOPMENT IN PRACTICE

The first chapter argued that professional development as we now know it will not transform teachers' knowledge, beliefs, and habits of practice. In this chapter, we turn our attention to describing a program of professional development that has the potential to build teachers' capacity for innovative practice and ultimately to impact student learning. As indicated in the introduction, this book takes the stand that the professional development of teachers should be situated in practice. In this view the everyday work of teaching would become the object of ongoing investigation and thoughtful inquiry (Ball and Cohen 1999). Teachers would develop an understanding of subject matter, of pedagogy, and of students as learners—critical components of a teacher's knowledge base for teaching (NCTM 1991; National Board for Professional Teaching Standards 1997; Shulman 1986)—by investigating tasks that are central to teaching. Rather than learning theories and applying them to the practice of teaching, theories or general principles emerge from closely examining practice.

Hence, "samples of authentic practice"—materials taken from real classrooms—would become the curriculum for teacher education by providing opportunities for critique, inquiry, and investigation. For instance, a mathematical task along with

a carefully selected set of student responses is one such example (Stylianou and Smith 2000). Teachers could be asked to complete the task, share various approaches that could be used to solve the task, and identify the mathematical ideas that are central to the task. The examination and analysis of student responses to the task could center on determining what students' responses reveal about students' mathematical understandings and misconceptions, the type of feedback that could be provided to specific students, and the questions that teachers could ask a particular student in order to better understand his or her way of thinking. Such a discussion is likely to enhance teachers' knowledge of mathematics content and of students as learners of mathematics.

These practice-based materials, however, are not self-enacting (Ball and Cohen 1999). Rather, they provide the raw material around which "professional learning tasks" (PLTs) can be designed (Ball and Cohen 1999, p. 27). PLTs, tasks that engage teachers in the work of teaching, can be developed in order to meet a specific goal for teacher learning and to take into consideration the prior knowledge and experience that teachers bring to the activity.

The Work of Teaching

The central tenet of this approach is that it is "centered in the critical activities of the profession—that is, in and about the practices of teaching and learning" (Ball and Cohen 1999, p. 13). One way to design professional learning tasks is to consider the cycle of teachers' work and the nature of the activities in which teachers engage as they move through the cycle.

The cycle begins with planning for instruction. Here the teacher decides what mathematical knowledge and processes she wants students to learn; determines the relevant prior knowledge and experiences on which students can draw to construct new knowledge; and creates, finds, or adapts tasks or activities that build on prior knowledge and experiences and have the potential to foster the intended learning.

The cycle continues with teaching—enacting the plan that has been developed. It is during the act of teaching that the teacher must engage students' in the task or activity, make midcourse corrections as needed to fit the needs of the students, provide "scaffolding" for students' learning so as to sustain their engagement in worthwhile mathematical activity, and formally and informally assess what students are learning.

The teacher completes the cycle with reflection. During this process, teachers must consider the level and kind of thinking in which the majority of students engaged during the lesson and what students did and said that suggested understanding of important mathematical ideas. They must also consider the ways in which the teaching may

have supported or inhibited students' engagement with the task as intended. Based on an appraisal of the lesson and knowledge of the overarching mathematical goals, the cycle begins again with planning the next lesson.

Although this description may oversimplify the components of the teaching cycle, it serves to highlight the types of activities that are foundational to teachers' work and suggests potential PLTs that use authentic practice. For example, a videotape of a classroom episode could serve as the basis for several tasks that embody the work of teaching. Teachers could begin by analyzing the task that was used during instruction and by asking questions such as the following:

- What opportunities to learn mathematics are afforded by the task?
- What prior knowledge and experience would students need in order to engage in the task successfully?
- How would you expect students to go about solving the task?

Teachers could then move on to watching the video and analyzing the learning environment, responding to questions such as these:

- What decisions did the teacher make during the course of the lesson?
- What decisions were made by students?
- Who validated answers?
- Who asked the questions?
- What was the nature of the questions asked by students? By the teacher?

The investigation could continue with teachers analyzing what students seemed to be learning and how they learned it. Questions such as these might frame the analysis:

- What were the mathematical ideas with which students appear to grapple?
- What do students' solutions tell about what they know and understand?
- What factors appeared to support students' engagement in mathematical activity?
- What factors seem to hinder such engagement?

The discussion could conclude with actually planning the subsequent lesson, focusing on questions that include the following:

- What should be the mathematical target of instruction in the next lesson?

- What knowledge have students demonstrated that will serve as a foundation for constructing new knowledge?
- What task would accomplish the learning goal?

A videotape of teaching, therefore, could serve as the basis for engaging teachers in an investigation and analysis of all phases of the teaching cycle.

The videotape and students' work discussed so far represent two specific samples of practice-based materials that can serve as the basis for PLTs for teachers. The remainder of this chapter will focus on three broad categories of such materials—mathematical tasks, episodes of teaching, and illuminations of students' thinking. These materials will provide the foundation for PLTs that involve exploration and analysis.

Mathematical Tasks

Tasks used in the classroom form the basis for students' learning (Doyle 1988). Tasks that ask students to practice paper-and-pencil computations are likely to offer students one type of opportunity for thinking; tasks that require students to think about a situation rather than to follow a prescribed procedure offer them very different opportunities. According to Hiebert and his colleagues, "tasks that encourage reflection and communication are tasks that link up with students' thinking" (Hiebert et al. 1997, p. 20).

In planning for instruction, teachers must determine the mathematical concepts and processes they want their students to learn and then select tasks and activities that have the potential to promote the intended learning. Thoughtful planning requires (at a minimum) that teachers understand what mathematics children need to know in order to solve a task, recognize the mathematics embedded in a task, and match their goals for the students' learning with tasks that have the potential for achieving the goals.

The exploration of mathematical tasks provides teachers opportunities both to consider issues of the students' learning and to construct or reconstruct their own understanding of what mathematics is and how one does it. Consider, for example, the task shown in figure 1, adapted from the *Visual Mathematics Course* (Foreman and Bennett 1996). The task provides an opportunity for teachers to look for the underlying mathematical structure of a pattern, to use that structure to continue the pattern, and to develop a rule that can be used to describe and build larger figures. The task provides an interesting context for discussing what algebra is and how algebraic reasoning can be developed. (Teacher-generated solutions to this task can be found at www.cometproject.com.)

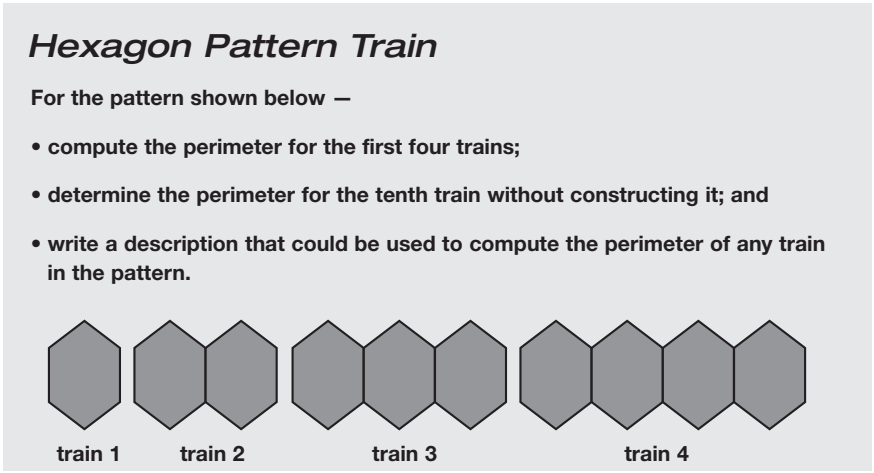

Fig. 1. An example of a task that could be the basis for exploration and analysis. (From Linda Foreman and Albert Bennett, *Visual Mathematics Course*. Copyright © 1996. Adapted by permission.)

Teachers might be asked to engage in several different professional learning tasks that involve the hexagon-pattern task. For example, teachers might—

- solve the task, discuss different strategies and approaches, and relate different methods to one another and to the visual representation;
- determine what prior knowledge and experiences students need to complete the task and what they might learn from it; or
- discuss how the hexagon-pattern task might contribute to the development of algebraic reasoning and how teachers might build on or extend the task.

Tasks can be drawn from challenging mathematics curricula (see Appendix A) appropriate to the grade level of the teachers, from assessments, or from a plethora of available instructional materials. Tasks can be selected so as to highlight specific processes (i.e., problem solving, reasoning and proof, communication, connections, or representations) or organized to show the development of mathematical ideas in a particular content area (i.e., number and operation, algebra, geometry, data analysis, and probability).

Episodes of Teaching

According to *Professional Standards for Teaching Mathematics* (NCTM 1991), a primary factor in teachers' professional growth is the extent to which they "reflect on learning and teaching individually and with colleagues" (p. 168). It is through reflection that teachers can gain insights into how their actions and interactions in the classroom influence students' opportunities to learn mathematics.

In order to develop the ability to reflect on their own teaching, teachers need opportunities to analyze and critique episodes of teaching, whether captured on videotape or CD, observed directly, or portrayed