CHAPTER 2

What Does Effective Professional Development Look Like?

Before analyzing in more depth *how* the teacher learning needs identified in the previous chapter might be addressed, we would like to provide some images of professional development projects that have been successful in supporting school mathematics reform.

It was difficult to select just a few out of the many creative professional development programs of the last two decades (as featured, for example, in Friel & Bright, 1997; Fennema & Nelson, 1997; Loucks-Horsley, Hewson, Love, & Stiles, 1998; Eisenhower National Clearinghouse [ENC], 2000). We eventually chose the two projects featured in this chapter because they differ considerably in terms of scope, goals, complexity, audience, context and grade levels. Therefore, we hope these examples will begin to show how the teacher learning needs described in Chapter 1 can be met in many diverse and viable ways.

In this chapter, we describe each project in some detail to convey a sense of its vision and complexity. Space constraints do not allow us for detailed descriptions of specific professional development activities within each project, although some of these will be described in more depth in vignettes reported in later chapters.

An implementation of the Cognitive Guided Instruction (CGI) program

We derived this first illustration from one of the many implementations of the CGI program as reported in Fennema, Carpenter, Franke, Levi, Jacobs and Empson (1996). The same article also provides evidence of the effectiveness of this specific professional development program in addressing teachers' beliefs, changing practices and increasing student achievement.

In this four-year project, a group of first-third grade teachers from four different schools volunteered to participate for minimal compensation and the option of receiving graduate credits for their work. The main goal of this program was to "help teachers develop an understanding of their own students' mathematical thinking and its development and how their students' thinking could form the basis for the development of more advanced mathematical ideas" (Fennema, Carpenter, Franke, Levi, Jacobs, and Empson, 1996, p. 406), as a main vehicle to improve mathematics instruction in their classes.

During the first two years, the teachers attended a series of workshops: A 2 1/2-day workshop in late spring of the first year, a 2-day workshop in the summer and 14 three-hour-long workshops during the following academic year. The workshops introduced the teachers to a research-based model of how young children understand basic number concepts and operations (for empirical research on this issue, see Carpenter, Fennema & Franke, 1994; Fuson, 1992; Greer, 1992). This approach is based on the assumption that increasing teachers' knowledge of students' thinking helps them design better instructional tasks, ask better questions during mathematics lessons and support individual students' learning more effectively.

The project purposefully made the decision NOT to provide teachers with any instructional materials or guidelines. Rather, they encouraged the teachers to use their growing knowledge of students' mathematical thinking to inform their instructional decisions.

Although the teachers read articles explaining the basis of the model in research, they primarily focused on analyzing students' mathematical thinking from samples of written works or videotapes of problem-solving sessions. Participants did not receive an explanation of each child's solution; rather, they examined the similarities and differences among different children's approaches and generated hypotheses about the mathematical concepts underlying them. Facilitators often asked participants to validate the research model by observing students in their own classes and discussing the results with the rest of the group.

The project purposefully made the decision *not* to provide teachers with any instructional materials or guidelines. Rather, they encouraged the teachers to use their growing knowledge of students' mathematical thinking to inform their instructional decisions. However, participants did receive support in translating their new knowledge into instructional practice from a project staff member and a mentor teacher assigned to each school. These teacher educators attended all workshops, visited each participant's classroom about once a week and worked individually with teachers to support their instruction.

In the following two years, teachers continued to participate in some workshops during the school year (four 2 1/2-hour workshops and a 2-day reflection workshop in year three, and one 3-hour reflection workshop and two 2 1/2-hour review workshops in year four). These workshops, however, did not introduce new information about the research model. They focused instead on helping teachers observe the mathematical thinking of their own students' and make instructional decisions based on what they had learned. Participants continued to receive on-site support, but the classroom visits were reduced gradually (once every two weeks in year three and only occasionally in year four).

Making mathematics reform a reality in middle schools

Making Mathematics Reform a Reality in Middle School (MMRR) was one of the Local Systemic Change projects that the National Science Foundation (NSF) funded to promote school mathematics reform in whole schools or districts. This three-year project was aimed at beginning the process of systemic reform in four suburban middle schools that had not adopted – nor yet decided to adopt – one of the new NSF-funded curricula for middle school mathematics. As such, the project involved *all* the teachers responsible for teaching mathematics at these school sites, which included teachers certified to teach secondary mathematics, special education teachers and even a few elementary teachers. Professional development, as the core of this project, consisted of several initiatives designed for teachers at different stages of development. In a recent national study (Killion, 1999), this program was cited as one of only eight in the country that have demonstrated a positive effect on students' mathematical learning in middle school.

Teachers joined the project by attending a one-week introductory Summer Institute and participating in related field experiences during the following year (as described in Borasi, Fonzi, Smith & Rose, 1999, and in even more detail in Borasi & Fonzi, in preparation). In the Summer Institute, teachers learned about an inquiry approach to teaching mathematics as a way to teach *all* students better. In the spirit of the NCTM Standards, the Summer Institute and its follow-up field experiences invited teachers to rethink their mathematical and pedagogical beliefs from a constructivist/inquiry perspective. It also enabled them to experience the power of learning mathematics themselves through inquiry activities and helped them actually begin the process of instructional innovation in their classes. Finally, it fostered a need to continue in the reform process.

Two illustrative inquiry units (i.e., the unit on area formulas informing our classroom vignette in Chapter 1 and another unit on tessellations) played a critical role in this program. These units modeled how middle school students could learn key ideas in geometry and measurement through inquiry. A team of mathematics education researchers and teachers had previously developed these units and successfully field-tested them in a variety of middle school settings (Borasi, Fonzi, Smith & Rose, 1999). They had also created a set of materials to support teachers in implementing each of these units (Borasi, 1994 a&b; Borasi & Smith, 1995; Fonzi & Rose, 1995 a&b). To participate in the Summer Institute, teachers had to commit to teaching one of the inquiry units in the following school year.

During the Summer Institute, teachers first participated, as learners, in two 5-hour mathematical inquiries on tessellations and area similar to those in the illustrative units. During these mathematical learning experiences, the facilitators modeled several inquiry-based teaching practices recommended by the NCTM Standards. These "experiences as learners of mathematics" served as the catalyst for teachers to reflect on the nature of mathematics and on teaching and learning, as each inquiry was followed by one or more sessions in which participants discussed these experiences from different perspectives. These inquiry-based experiences also introduced teachers to the unit they had committed to teach as part of their follow-up field experiences. The Summer Institute supported teachers in their first experience of instructional innovation in other ways. Teachers watched a video and read an accompanying narrative that documented the implementation of these units with middle school students. They were also introduced to the supporting materials accompanying each unit, and they participated in an initial planning session for their own unit.

As participants planned and implemented their chosen unit, they were supported by a lead teacher or a mathematics teacher educator assigned to be a facilitator in their schools. They could also participate in a follow-up meeting where other teachers who had implemented their first inquiry unit shared and discussed these experiences. Then, facilitators introduced teachers to some of the NSF-funded exemplary mathematics curricula for middle school as resources to support their planning of additional innovative instructional experiences. Teachers were encouraged to try at least a unit from one of these series in their classroom before the end of the school year.

Teachers who participated in this year-long component were then eligible to participate in a second, 5-day Advanced Summer Institute and its related field experiences. This second Summer Institute focused on the teaching and learning of algebra in middle school and on helping teachers become familiar with two of the NSF-funded curricula for middle school: the *Connected Mathematics Project* (*CMP*) and *Mathematics in Context* (*MiC*). As follow-up field experiences, teachers committed to implement at least one algebra unit from one of these curricula during the school year.

The first three days of the Advanced Summer Institute occurred at the beginning of the summer and the final two days near the end, as a follow-up. In the first part, teachers participated again as learners in mathematical experiences followed by focused reflective sessions. This time, however, the experiences focused on algebra rather than geometry and measurement, and they were designed around activities derived from *CMP* and *MiC* units. In analyzing these experiences, teachers focused mostly on the mathematical content and curricular implications. This activity invited a rethinking of the key ideas in algebra and, consequently, the main goals of teaching algebra in middle school. Participants then read articles on algebra and analyzed in depth at least one unit from either the *CMP* or the *MiC* curricula. During the last two days of the Advanced Summer Institute, participants presented their analyses of the assigned units and discussed each curriculum and the choices each represented in terms of mathematical content, learning priorities and sequencing of activities.

During the following school year, teachers implemented their chosen *CMP* or *MiC* unit. The instructional materials themselves provided the main support for these implementations. In most cases, a group of teachers chose to work together on the same unit and thus established a “study group” that met a few times after school. At first, a mathematics teacher educator facilitated these study groups, but the teachers eventually met independently. Later in the project, after one school had decided to adopt the *CMP*, its teachers continued to hold these collaborative sessions as a way to support the use of this curriculum.

Throughout the three years of the project, a subgroup of teachers who had taken leadership roles in their schools also participated in a monthly Leadership Seminar. The facilitators organized activities in this seminar in response to the needs of the participating lead teachers. The activities were designed to expand the lead teachers' personal understandings of school mathematics reform, to improve teaching practices and to develop leadership skills. For example, the group discussed a few cases of teaching mathematics through inquiry in order to develop a shared understanding of what characterizes such an instructional approach. Later on, teachers' need to rethink the teaching and learning of geometry in middle school led to a series of different group experiences, such as discussing several articles, analyzing the units developed by NSF-funded middle school curricula and hearing a presentation by a research mathematician.

Facilitators organized additional professional development opportunities in response to the needs of smaller subgroups. For example, some meetings were held for special education teachers only, in order to address issues they had raised about their unique role and responsibilities. New teachers were advised to observe their more experienced colleagues' classrooms regularly as a form of professional development. Curriculum writing groups and department meetings, often initiated and facilitated by the lead teachers themselves, also occasionally became sites for professional development.

Summary

The two examples of professional development reported in this chapter support the claim we made in the introduction to the monograph: There is no one model of professional development that works for all. Rather, professional development is about decision making in context. At the same time, the creative solutions generated by the projects described in this chapter suggest that professional development providers and consumers can make *informed decisions* about the kinds of experiences mathematics teachers need. Furthermore, those decisions should be made in light of what we know works best to address specific goals or teacher learning needs, however tentative that knowledge might be. The remainder of the monograph is dedicated to uncover and examine such knowledge.