

Summary

What have we learned about professional development that works?

The many illustrations from actual professional development that we included in this monograph are an indication of the large number of successful professional development initiatives currently supporting school mathematics reform. The literature on mathematics teacher education reports positive outcomes for these initiatives, showing that high quality professional development can make a difference in the future of mathematics instruction. Yet, it is more difficult to pinpoint the role that specific professional development activities play in the effectiveness of different programs.

No single model of professional development emerges from the many successful examples reported in the literature on mathematics teacher education. Instead, we find many examples of worthwhile experiences that address the multiple needs of teachers engaged in school mathematics reform. In Chapter 1, we identified and discussed these needs, categorizing them as follows:

- Developing a vision and commitment to school mathematics reform.
- Strengthening one's knowledge of mathematics.
- Understanding pedagogical theories that underlie school mathematics reform.
- Understanding students' mathematical thinking.
- Learning to use effective teaching and assessment strategies.
- Becoming familiar with exemplary instructional materials and resources.
- Understanding equity issues and their classroom implications.
- Coping with the emotional aspects of engaging in reform.
- Developing an attitude of inquiry toward one's practice.

In Chapter 3, we argued that in order to address these teachers' learning needs effectively, professional development programs need to have the following characteristics:

- Be sustained and intensive.
- Be informed by what we know about how people learn best.
- Center around the critical activities of teaching and learning rather than focus primarily on abstractions and generalities.
- Foster collaboration.
- Offer a rich set of diverse experiences.

These characteristics can be embodied in a number of different *types of professional development experiences*. We found it convenient for our analysis to categorize the many forms of professional development activities suggested in the literature into five main categories:

- Engaging teachers in mathematical experiences-as-learners.
- Having teachers analyze in-depth exemplars of student work and thinking.
- Using “cases” as the catalyst for reflections and discussions on important issues related to school mathematics reform.
- Supporting teachers as they engage in structured and scaffolded attempts at instructional innovation.
- Empowering teachers to gather and make sense of information.

Our explanation and discussion of each type of professional development experiences in Chapters 4 through 8 make clear that these categories are not mutually exclusive. Rather, these five types sometimes overlap. For example, certain experiences-as-learners may provide a scaffold for instructional innovation, and many “cases” may involve the analysis of student thinking among other things. However, distinguishing these five major types of professional development experiences allowed us to study each in depth. Thus, we have been able to identify the characteristic elements of each type, consider the theoretical and empirical support for it and discuss the variations and conditions that may maximize its effectiveness. In our analysis, we also show how each type of professional

development experiences may be used to address several of the teacher learning needs we identified in Chapter 1. We summarize the results of this analysis in Figure 11.

Figure 11
Teacher learning needs addressed by each type
of professional development experience

Professional Development Experience:	<i>Experiences as learners</i>	<i>Analyzing students' thinking</i>	<i>Case Study Method</i>	<i>Scaffolded instructional innovation</i>	<i>Gathering & making sense of information</i>
Teacher Learning Need:					
1. <i>Developing a vision and commitment to math reform</i>	●	●	●	●	●
2. <i>Strengthening knowledge of mathematics</i>	●	●	●	●	●
3. <i>Understanding pedagogical theories that underlie reform</i>	●	●	●	●	●
4. <i>Understanding students' thinking</i>	●	●	●	●	●
5. <i>Learning to use effective teaching and assessment strategies</i>	●	●	●	●	●
6. <i>Becoming familiar with exemplary materials/resources</i>	●	●	●	●	●
7. <i>Understanding equity issues and their implications</i>	●	●	●	●	●
8. <i>Coping with emotional aspects of engaging in reform</i>	●	●	●	●	●
9. <i>Developing an attitude of inquiry towards one's practice</i>	●	●	●	●	●

NOTE: In this chart, a large dot indicates that the teacher learning need can be effectively addressed by at least some variations of the corresponding type of professional development experience. A small dot indicates that the teacher learning need can be met somewhat, but it is not a primary goal of that type of professional development experience.

This analysis suggests that certain types of professional development experiences are more appropriate than others to further specific goals. It also shows that whether a type of professional development experience addresses any specific goal effectively depends to a great extent on the choices providers make in its implementation.

The analysis in this monograph supports the principle that professional development programs should include a variety of experiences. Furthermore, it suggests that programs should be comprised of a combination of the types of professional development experiences we have described, carefully selected to meet specified teacher learning needs.

While there are significant differences in the preparation, mathematical background, teaching experience and attitude of elementary and secondary mathematics teachers, we found nothing to suggest that any type of professional development experience is more or less appropriate for one or the other group of teachers. Indeed, illustrations showed successful implementation of a strategy with both levels of teachers. Working with elementary or secondary teachers, however, may affect some important choices within each implementation; for example, the mathematical content of experiences-as-learners or cases, or the exemplary instructional materials used in scaffolded field experiences. Despite these differences it is both possible and valuable to provide opportunities – at least occasionally – for elementary and secondary mathematics teachers to participate together in professional development experiences (as shown by the teachers’ inquiry on area reported in Illustration 1, and the case discussion on rational numbers reported in Illustration 5).

Effective professional development may take a variety of formats, including intensive Summer Institutes, a series of workshops held during the school day or after school, study groups of teachers who meet on a regular basis, one-on-one interactions between a teacher and a teacher educator, and independent work done by the teacher. Most successful programs combine different formats to respond to the needs and constraints of their audience. They must also make sure that the chosen formats are appropriate for the type of professional development experiences planned.

Figure 12 summarizes the relationship between the format and the type of professional development activity that providers might consider in designing a program:

Figure 12
Acceptable formats for each type of professional development experience

Type of Professional Development Experience:	<i>Experiences as learners</i>	<i>Analyzing students' thinking</i>	<i>Case study method</i>	<i>Scaffolded instructional innovation</i>	<i>Gathering & making sense of information</i>
Format:					
<i>Series of workshops</i>	●	●	●		
<i>Summer Institutes</i>	●	●	●		
<i>Study groups</i>	●	●	●		●
<i>One-on-one interactions</i>		●		●	
<i>Independent work</i>		●		●	●

Our analysis in Chapters 4 through 8 also confirms that different types of professional development experiences call for somewhat different sets of skills and expertise in the facilitator. Interestingly, in each case we described, the provider could be a mathematics educator, a mathematician, an experienced teacher or a staff development administrator. What really matters is whether the provider has expertise in the discipline of mathematics, pedagogy, and/or mentoring, as required by the specific activity s/he is expected to facilitate.

However, with a few exceptions (e.g., sessions on developing leadership skills), some expertise in mathematics emerges as an important prerequisite for facilitating successful professional development on the teaching and learning of mathematics. At the same time, knowledge of mathematics alone is not sufficient to ensure a facilitator's success. While mathematicians with an interest in K-12 education are a powerful resource, they too need to become familiar with what helps or hinders adult learning and school reform in order to be effective professional development providers of specific professional development experiences.

Finally, our analysis also identified a number of exemplary materials for mathematics teacher educators. Each of these materials has been

developed to support teacher educators in adapting and implementing a specific professional development program with documented effectiveness in supporting school mathematics reform. Just as we encourage mathematics teachers to take advantage of exemplary instructional materials, we also urge teacher educators to take advantage of these resources to strengthen the quality of the programs they offer.

We have provided some information about these materials at the end of Chapters 4 through 8. A more extensive list of worthwhile materials that can support mathematics teacher educators, along with in-depth reviews, can be found in the database for mathematics and science teacher educators (TE-MAT) recently developed by Horizon Research with the support of the National Science Foundation. This database is available on the World Wide Web (address: www.te-mat.org).

What should we look for when evaluating professional development programs?

While our analysis has validated many alternative approaches to professional development, we clearly do not support the notion that “anything goes” in mathematics teacher education. On the contrary,

Providing quality professional development is the joint responsibility of the teacher educators who design it, the school administrators who decide what to offer or require for teachers, and the teachers who choose what programs in which to participate.

we believe that the *quality* of the professional development offered determines to a great extent whether any reform effort succeeds.

Professional development can be expensive, and resources allocated to it are usually limited. Therefore, it is critically important that consumers, decisionmakers and providers of professional development learn to evaluate the quality of available professional development programs. Too often, the decisions made about professional development – what to offer, fund or participate in – are based simply on the topic, for example, whether the

professional development is on assessment, cooperative learning, technology or high school geometry. In this monograph, we have tried to alert readers to many other aspects of professional development that should be considered when evaluating available programs.

To begin evaluating a program, we suggest identifying one's own needs, priorities and constraints in the larger context of pursuing school mathematics reform. This list should yield a sense of the *larger goals* against which the *focus* and the *structure* of a specific professional development initiative should be evaluated.

Analyzing the main *experiences* in a professional development program will show its potential to meet one's goals and needs. Throughout this monograph, we emphasize that certain types of professional development experiences are more conducive than others in addressing certain teacher learning needs. Nevertheless, since our analysis in Chapters 4 through 8 shows how widely these approaches can vary, simply knowing that a program uses case discussions or analyses of student work may not be enough information to evaluate its appropriateness for furthering one's goals.

How can different constituencies contribute to more effective professional development?

We believe that providing quality professional development is the joint responsibility of the teacher educators who design it, the school administrators who decide what to offer or require for teachers, and the teachers who choose what programs in which to participate. Therefore, we conclude this monograph with suggestions for how each of these groups can promote quality professional development aimed at school mathematics reform.

First, we believe that professional development *providers* can design more effective professional development initiatives by doing the following:

- Developing a rich repertoire of effective professional development experiences and learning to use them appropriately.
- Identifying the specific reform goals, needs and constraints of their audience.
- Selecting and sequencing appropriate professional development experiences to address the goals, needs and constraints of their audience.

- Capitalizing on relevant exemplary materials for teacher educators instead of “reinventing the wheel.”

Second, school and district **administrators** who decide which programs to offer teachers can contribute to quality professional development by doing the following:

- Identifying the main needs for professional development within the larger goal of pursuing school mathematics reform in their school or district and the constraints on providing professional development in their particular context.
- Knowing what different kinds of professional development experiences can be expected to achieve and what resources are needed to implement them appropriately.
- Maximizing the limited resources available for professional development by using them to fund programs that are most likely to effectively support school mathematics reform *and* to meet the school/district priorities.
- Ensuring that each professional development experience is offered only by providers with the required expertise and qualifications.
- Providing adequate resources for a quality implementation of the professional development program selected.

Last, but not least, professional development **participants** should become critical consumers by doing the following:

- Identifying their personal and professional goals and needs within the reform agenda of their school or district.
- Developing reasonable expectations about what professional development can and should achieve and about the time and effort required to benefit from it.
- Learning to evaluate the quality of a professional development initiative and to determine whether it can meet one’s needs.

If we all do our part in these ways, we can expect to see an increase in high quality professional development opportunities for all mathematics educators.