

## Engaging in Scaffolded Instructional Innovation

Many successful programs working toward school mathematics reform include scaffolded field experiences. That is, opportunities for participating teachers to experiment with instructional innovation while receiving support. However, there is great variation in the kind of innovative instructional experiences that teachers undertake and in the kinds of support that can be offered. As we examine this kind of professional development experience we will often refer to it as “scaffolded instructional innovation.”

### Theoretical rationale and empirical support

Research conducted in several areas supports the value of scaffolded instructional innovation. First, studies of teachers’ beliefs point out that the relationship between pedagogical beliefs and practices is not unidirectional (Thompson, 1992). That is, while teachers’ beliefs clearly inform their practices, we might also expect experiencing “alternative practices” to challenge their existing beliefs. This change is especially apparent when teachers observe their own students demonstrating a higher level of learning and thinking in non-traditional instruction than they did in traditional instruction.

The importance of scaffolded field experiences is also emphasized in Simon’s (1994) learning cycles model of teacher development introduced in Chapter 3. Simon identified the planning and implementation of innovative instruction as a possible catalyst for the fifth and sixth stages of a teacher’s learning cycle.

At the same time, putting novel instructional techniques into practice presents a considerable challenge for most teachers, and many may fail in their first attempts unless they are supported appropriately. Some initial scaffolded practice is indeed recognized as a key component in the model

developed by Collins, Brown, and Newman, (1989) to shed light on the process of learning complex tasks, which we introduced earlier in Chapter 1.

While it is difficult to evaluate the effect of scaffolded field experiences alone, many successful professional development programs have used this strategy extensively. The changes in teachers' beliefs and instructional practices reported by Simon and Schifter (1991), Schifter and Fosnot (1993), and Borasi, Fonzi, Smith, and Rose (1999), for example, document the success of combining experiences-as-learners with scaffolded field experiences. Furthermore, the latter two studies include case studies and anecdotal evidence that point to the specific contributions of scaffolded field experiences.

Indirect evidence in support of scaffolded field experiences is found in the positive outcomes reported by projects that implemented one of the NSF-funded comprehensive curricula (these data can be found in each project website, listed earlier in Figure 7). These projects showed long-term gains in student achievement in schools that implemented these curricula, especially when high-quality professional development helped teachers use these exemplary instructional materials appropriately (Russell, 1997).

### **Illustration 7: A scaffolded implementation of an illustrative inquiry unit**

We derived this illustration from the Making Mathematics Reform a Reality (MMRR) project described in Chapter 2. As teachers joined the program, they agreed to participate in a week-long Introductory Summer Institute and to implement one of two illustrative inquiry units in at least one class at the beginning of the following school year.

Both illustrative units highlight fundamental features of teaching mathematics through inquiry and present “big ideas” in geometry and measurement while focusing specifically on the topics of tessellation and area. A team of researchers and teachers created and field-tested these units in a variety of middle school settings. Based on careful documentation and analysis of these experiences, instructional materials were created to support the planning and implementation of each unit at different grade levels and in different school contexts. The materials include an overview and discussion of the key components of the unit, a mathematical essay highlighting the “big ideas” addressed in the unit, a

timeline, and selected artifacts (e.g., hand-outs and assessment tools) from implementations of the unit in different settings.

Scaffolding teachers' implementation of these illustrative units began as early as the Summer Institute. First, participants engaged in two experiences-as-learners lasting 5 to 7 hours each. The activities were designed to highlight key components of the two illustrative units, both of which were adapted to challenge adult learners. The inquiry on area reported as Illustration 1 in Chapter 4 was one of these experiences. These experiences, together with the reflection on the mathematical content and pedagogy that followed, gave teachers a personal understanding of the goals, rationale and overall design of the two units. Several participants reported that the positive feelings they experienced as learners in these inquiries motivated them to take the risk to try them in their own classes.

These experiences-as-learners were then supplemented by images of what the two units might look like in middle school classrooms. Excerpts of an implementation of the tessellation unit were presented in a 2-hour-long video while a 50-page narrative provided a detailed story of an implementation of the area unit. After participants watched the video and read the story, they had opportunities to share their impressions and to question teachers who had already implemented the units. Their concerns ranged from the management of materials and group work to information about student outcomes and potential pitfalls. Mostly, participants emerged from these conversations with more experienced teachers reassured that these experiences could work in middle school and encouraged by their colleagues' enthusiasm.

During the Summer Institute, the facilitators introduced participants to the instructional materials created to support the implementation of the two units. Selected readings from these materials were assigned for homework and later discussed. When facilitators asked teachers to comment on the value of these readings, they said that encountering the materials for the first time when trying to plan their unit would have been truly overwhelming because of their unusual content and structure and might have easily discouraged them from using them. Thus, assigning the readings in the Summer Institute was an important way to enable teachers to benefit from the instructional materials intended to support their first field experience.

As teachers began to plan their unit at the beginning of the school year, facilitators encouraged them to consult individually with mathematics

teacher educators on the project staff or with a lead teacher at their school site. Although not everyone took advantage of these opportunities, those that did found them very helpful. In some cases, especially when the teacher felt overwhelmed by the novelty and complexity of the task, these sessions involved brainstorming and writing an overall plan together. In addition, the teacher received help writing lesson plans for the first few days of the unit. In other cases, teachers came to these meetings with drafted lesson plans that were then discussed and refined. In all cases, these consultations made it possible to address teachers' possible misconceptions and resulted in lessons that offered much better learning opportunities for the students.

As teachers began to implement their units, they could request further support from project staff or lead teachers. This support usually took the form of classroom visits followed by debriefing meetings. Whenever possible, support staff visited classrooms for a few consecutive days in order to observe how suggestions and decisions made during previous debriefing meetings played out. The teacher educator's role in the classroom visits and the nature of the follow-up meetings varied considerably, depending on the personality and needs of each teacher. In most classroom visits, the teacher educator simply observed the class, moving around to help individuals and small groups during the lesson. This strategy allowed the classroom teacher to spend more time with other students and enabled the teacher educator to report observations about students' work and thinking that the teacher might not have known otherwise. Other times, the teacher educator played a more direct role in the instruction, perhaps introducing selected activities, demonstrating the use of certain materials or recording on the board the key points of a discussion the teacher was facilitating. In either case, the debriefing meetings that followed the lesson played a key role. These meetings focused not so much on providing feedback on the teacher's performance, but rather on discussing students' work and what had been observed about their learning and thinking. This kind of knowledge helped teachers to consider in more depth the mathematical concepts they were working on and to plan for future lessons.

Occasionally, two or three teachers from the same school who were teaching the same mathematics courses worked as a team. In that case, they usually planned the units together and met regularly to discuss the outcomes of specific activities and to make revisions to the original plan. These teams were encouraged to observe each other if possible, but few

managed to put this suggestion into practice.

Finally, in November, after everyone had concluded the implementation of the first inquiry unit, all Summer Institute participants were called back together for a day-long meeting. To prepare for the meeting, teachers were asked to look back at their experience and to identify at least one success and one concern that they would like to share with the rest of the group. The meeting began with each teacher briefly sharing these reflections.

Overall, the reports were quite positive, and in most cases, even enthusiastic. Most of the successes had to do with student accomplishments; several teachers reported their surprise at seeing some of their weakest students blossom during this unit and reveal abilities they had never imagined!

This sharing also revealed some common concerns and challenges. Several teachers reported feeling panicked when students came up with solutions they could not understand or questions they had no idea how to answer. Others were worried about being able to follow through, given the enormous amount of time and energy this way of teaching requires. In the second half of the meeting, these common concerns were addressed in small groups. While the small groups did not always reach satisfactory solutions, teachers generally agreed that it was helpful just to know that other people had encountered similar problems or worried about the same issues.

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### Illustration 8: Creating a study group to support a new curriculum

This second illustration occurred during the third and final year of the MMRR project. It involved a group of teachers who had been participating in teacher enhancement experiences for 2 to 5 years. At the end of the previous school year, the mathematics department in their school had decided to adopt the *Connected Mathematics Project (CMP)* series. All the teachers of the seventh-grade mathematics courses had agreed to implement several *CMP* units in their classes the following year. Since several of these units were new to the teachers, they decided to create a study group to become familiar with the units and prepare to implement them.

The study group met weekly after school. The teachers worked independently, but they followed a format that had been modeled the previous year by a mathematics teacher educator assigned to support instructional innovation at that school site.

To prepare for teaching each new *CMP* unit, the teachers first read the introductory information at the beginning of the teacher's guide and then

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worked through the mathematical investigations comprising the unit on their own, doing the same tasks they would ask their students to do. Then they met a few times to share their results and discuss the mathematics covered in the unit. They devoted the remaining sessions to planning how to introduce and pace each investigation. They read the relevant "Teaching the Investigation" sections of the materials to glean valuable tips for orchestrating classroom activities. During the group

planning sessions, teachers divided up the tasks of preparing the necessary materials, such as handouts, manipulatives, assignment sheets, tests and so on, in order to accomplish them in the most efficient way.

As they implemented lessons, the teachers also sought opportunities in and even outside their regular weekly meetings to share what was happening in their classes. This sharing focused primarily on how specific activities developed. Occasionally, however, the teachers also discussed students' responses that had puzzled them.

Overall, the teachers found this experience extremely beneficial and decided to continue it the following year. They continued to add new *CMP* units to their repertoires and to refine the implementation of units they had already done.

## Main elements and variations

Variations in scaffolded field experiences are many and substantial, but most successful implementations of this type of professional development experience have the following elements in common:

- ***Some scaffolding occurs at BOTH the planning and implementation stages of the innovative teaching experience.*** Both stages present unique challenges for teachers engaging in instructional innovation and call for different kinds of support.
- ***Teachers are provided opportunities to reflect on their field experience and share these reflections with others.*** Not only do teachers learn from reflecting on their experiences, but sharing is one way to address the emotional challenges of taking on instructional innovation.

Within these parameters, scaffolded field experiences can vary a great deal, depending on *the nature of the innovative teaching experiences* and *the kind of support* that is provided.

With respect to the first point, the nature of the innovative teaching experience is affected both by the *duration/extent* of the field experience requirement and by the *teacher's role in its design*. For example, teachers may be expected to do the following:

- Design and implement one or more isolated lessons consistent with a proposed innovation.
- Design an innovative unit independently and implement it.
- Implement a replacement unit (i.e., a unit that experts have designed and field-tested and for which supporting instructional materials are available) adapted appropriately to the setting.

- Gradually implement an entire “reform curriculum,” that is, a comprehensive curriculum informed by the NCTM Standards, which experts have designed and field-tested to ensure appropriate student learning outcomes.

While it is certainly a valuable learning experience for any teacher to design his or her own lesson or unit, there are limitations to this practice. First, it is unlikely that the first efforts of a teacher new to reform will incorporate fully the desired mathematical content or pedagogical practices. Second, shortcomings in the design of the instructional experience are likely to produce negative outcomes, and the teacher might feel unimpressed or even discouraged by what the students gain from the experience. Finally, the time and effort required to design an innovative instructional experience may take precious resources away from other aspects of implementing that experience, such as attending to the introduction of new teaching strategies or analyzing students’ responses. On the other hand, when teachers experience the complexity and challenges of designing quality instructional units, they may appreciate more fully the value of pre-made exemplary instructional materials and may develop more effective ways to use such materials.

Professional development projects that incorporate scaffolded field experiences may also differ widely according to the kind of support provided to teachers. As projects struggle to meet their participants’ needs in cost-effective ways, many kinds of support strategies have been developed. We report the most commonly used ones here, organizing them according to the four different stages at which support can be offered.

***Support provided prior to planning:***

- Facilitators introduce teachers to the exemplary instructional materials they are going to use. The goal is to empower teachers to use these materials effectively as they start planning their experience, by becoming familiar with their overall scope, philosophy, contents and structure.
- Teachers engage as learners, independently or with a group of colleagues, in the same mathematical tasks their students are going to experience. In this way, they become familiar with the mathematics covered in the unit and personally engage with the “big ideas” they are expected to incorporate.



- Teachers participate in facilitated experiences-as-learners that mirror the kinds of learning experiences they will be offering their students. In this way, they can personally experience the impact of some new pedagogical practices, as well as gain an understanding of the goals, rationale and design of the experiences they are getting ready to teach.
- Teachers read stories or watch videos that provide a detailed account of the kinds of experiences they are going to implement in their classes. These activities give them a sense of how the experience might play out in a classroom and help them anticipate possible student responses.
- Teachers look at samples of student work for the tasks they are going to use in their classes. Looking at these artifacts can help them anticipate their own students' responses and outcomes.
- Teachers attend presentations by, and/or have conversations with, teachers who have already implemented similar experiences in their classrooms. They thus benefit from others' experiences and insights. Hearing from other teachers can also allay some of their fears before they try their first innovative experience.
- Teachers observe a colleague's implementation of the same unit on a regular basis. This can provide a concrete image of one implementation, which can serve as a model. Teachers also get a sense of the pacing, begin to anticipate students' possible responses and learn some useful tips.

***Support provided during planning:***

- Teachers brainstorm ideas for their unit with a small group of colleagues interested in developing a similar unit. They get feedback on their own ideas and learn from listening to the ideas of others.
- Teachers work in teams with one or two other colleagues to develop daily plans for the unit and prepare all the necessary materials to implement it. Here teachers benefit from the feedback received and from dividing up the time-consuming task of preparing instructional materials.

- Teachers (or teams) capitalize on exemplary instructional materials to create their daily plans for the unit and prepare materials for the implementation. They thereby benefit from the thinking and field-testing that went into the design of these materials. They also save time in preparing the necessary handouts, assessments and so on.
- Individual teachers (or teams) meet with a mathematics teacher educator to review and refine their plans. This enables them to benefit from an expert's feedback and provides the opportunity to brainstorm more ideas.

***Support provided during classroom implementation:***

- A mathematics teacher educator or more experienced colleague teaches (or co-teaches) a few demonstration lessons in the teacher's classroom at the beginning of the unit. The demonstration provides a model and helps establish a supportive classroom climate.
- A mathematics teacher educator or more experienced colleague observes a few classes and then meets with the teacher. These debriefing meetings provide the teacher with the opportunity to gather feedback, reflect on students' thinking and learning and revise their lesson plans.
- A mathematics teacher educator or more experienced colleague provides some in-class support, so that the classroom teacher can focus on selected aspects of an innovative instructional approach.
- Members of the team that planned the unit together observe each other and debrief these observations on a regular basis. All members benefit from each other's feedback and can use the discussions as a starting point to plan future implementations.

***Support provided after the classroom implementation:***

- The teacher records key concerns, observations and insights in a journal that is shared and discussed with a mentor or a colleague.
- The teacher collects and examines artifacts from the field experience (e.g., handouts, assignments, assessment instruments, lesson plans, student work, etc.) to create a record of the implementation that can

be used in the future. The record can also be used to evaluate the outcomes of the experience.

- The teacher participates in facilitated meetings with other peers in which they all share and discuss their field experiences. In these meetings, teachers can benefit from articulating their experiences and hearing other people's experiences and insights without having to engage in any writing.
- The teacher participates in an ongoing peer support group in which field experiences are shared and discussed informally. Again, these opportunities for reflection do not involve writing, yet teachers benefit from sharing and reflecting on their experience and from hearing other people's experiences and insights. The peer support group can also provide immediate feedback and help when facing a problem, as well as on-going emotional support.

All the options listed above can support the efforts of teachers engaging in instructional innovation. The choice of specific options, however, will depend for the most part on the available personnel and financial resources and the expressed needs of the teachers.

The variations discussed in this section show that supported field experiences do not just take place in the teacher's own classroom or in one-on-one interactions with a teacher educator. Rather, important scaffolding can occur before and after the field experience in different settings, such as Summer Institutes or other large group meetings and in small groups, too.

Scaffolded field experiences are probably one of the most challenging forms of professional development because the provider must have high levels of expertise in multiple areas. In order to evaluate and guide other teachers' efforts toward instructional innovation, teacher educators facilitating these experiences need to have a good understanding of mathematics in a wide variety of areas and considerable pedagogical expertise. Specific training in classroom observation and mentoring strategies is also advisable.

## Teacher learning needs addressed

Our discussion thus far suggests that, depending on the nature of the innovative teaching experience and the support provided for it, scaffolded field experiences may effectively address several of the teacher learning needs we identified in Chapter 1:

- ***Developing a vision and commitment to school mathematics reform.*** For many teachers, seeing a non-traditional approach to teaching mathematics succeed in their classrooms and witnessing their students' enthusiastic responses may be the most powerful way to grasp what school mathematics reform is all about. Indeed, once teachers see what their students can do when given the opportunity to explore and make sense of mathematics, they are hooked!

Nevertheless, certain conditions need to occur for this to happen. First, the innovations that teachers implement in their classes need to truly enact school mathematics reform. Second, they have to be sufficiently well-designed and implemented, so that students actually have new opportunities to learn and thus to show their teacher what they can do. Either conditions are difficult to ensure in the case of teacher-designed experiences. Therefore, having teachers begin with field-tested materials, in addition to receiving sufficient in-class support, may be advisable to ensure that teachers' first attempts at innovation are successful.

It is also critical to offer opportunities for individual reflection and sharing so that teachers can recognize the significance of the changes they witness in their classrooms and the implications for school mathematics reform. Such cognizance is illustrated by the conversations that took place when teachers shared their first experience with inquiry in Illustration 7.

- ***Strengthening one's knowledge of mathematics.*** From years of offering scaffolded field experiences, we know that the maxim, "You learn something best when you have to teach it," is really true. After they use open-ended problems and a student-centered approach in their classrooms, teachers regularly report learning new solutions and strategies from their own students! Even more substantial opportunities to learn new mathematics occur when the scaffolded

field experience entails implementing replacement units or units from one of the new Standards-based comprehensive curricula. Since these materials have been designed to address new learning standards and to highlight “big mathematical ideas,” they offer new perspectives and insights on familiar – and not so familiar – mathematical topics for both teachers and students. Again, opportunities to learn new mathematics and to challenge dysfunctional mathematical beliefs are enhanced when providers build time for reflection and sharing into the field experiences that focuses on mathematical issues.

- ***Understanding the pedagogical theories that underlie school mathematics reform.*** While scaffolded field experiences by themselves are not sufficient to teach teachers the theories that underlie the teaching and learning practices of mathematics reform, they can help further this goal. First, scaffolded experiences can motivate teachers to learn more about pedagogical theories not only as a way to make sense of what they witness in their classes but also to justify their instructional choices to other teachers, parents and administrators. Consequently, teachers may be more willing to attend presentations or read articles they may have previously dismissed as “too theoretical” and, therefore, irrelevant to classroom practice. Second, these classroom experiences can provide an experiential base for teachers to interpret and critically examine competing pedagogical theories.
- ***Understanding students’ mathematical thinking.*** Scaffolded field experiences can provide teachers with multiple opportunities to understand their students’ thinking. This understanding occurs to some extent any time teachers listen to their students’ explain how they solved complex and open-ended tasks, which is one of the key practices promoted by school mathematics reform. However, this teacher learning need is supported best when the scaffolded field experience includes opportunities to examine students’ work systematically with other teachers.
- ***Learning to use effective teaching and assessment strategies.*** Addressing this teacher learning need is probably the most obvious goal of scaffolded field experiences, especially at the beginning of

a professional development program. No matter how effectively a new teaching practice is modeled in an experience-as-learners or in a classroom video, it is only when teachers try it out in their own classrooms that they really understand what it takes to make it work. However, the extent to which this happens depends once again on the *design* of the innovative teaching experience and teachers' opportunities for receiving *feedback* on their implementations of the new teaching practice.

- ***Becoming familiar with exemplary instructional materials and resources.*** Scaffolded field experiences are the best way for teachers to become acquainted with exemplary instructional materials and to appreciate fully the role these materials can play in supporting instructional innovation. Many of the teachers who participated in the experiences reported in Illustrations 7 and 8 voiced the belief that they could not have come up with a unit of the same quality on their own. To a lesser extent, scaffolded field experiences based on teacher-designed units might also provide motivation and opportunities to examine exemplary instructional materials, especially when teachers are encouraged to look at these resources for ideas to adapt for their own unit.
- ***Understanding equity issues and their classroom implications.*** Scaffolded field experiences have the potential to contribute greatly to teachers' understanding issues of equality in the classroom, especially when the implementation takes place in a diverse instructional setting and strategies for differentiated instruction are explicitly introduced. Implementing a unit that has been designed to address multiple learning styles and needs can allow *all* students in the class to show what they are capable of doing. This, in turn, may surprise many teachers and invite them to critically examine their expectations and biases. Explicit reflections about equity issues and their implications in each teacher's specific context are also critical to capitalize on the potential of scaffolded field experiences to address this teacher learning need.
- ***Coping with the emotional aspects of engaging in instructional innovation.*** Teachers are likely to experience emotions ranging from elation to despair as they try innovative instructional experiences, especially the first time. Consequently, it is

especially important that *any* scaffolded field experience include ongoing opportunities for teachers to share their experiences and feelings with peers. They need reassurance that their reactions are not unique. They also need to hear from more experienced peers and mentors that there is “light at the end of the tunnel.” Scaffolded field experiences should include a reflective component to meet this teacher learning need.

■ ***Developing an attitude of inquiry towards one’s practice.***

Helping teachers become more reflective about their practice should indeed be one of the main goals of any scaffolded field experience. The extent to which such experiences can promote the habit of inquiry, however, depends on the structures and opportunities for reflecting and sharing provided to participants. The more teachers are invited to critically examine what they have done in their field experiences, whether in reflective journals, discussions with peer-support groups, or debriefing meetings, the more they can appreciate the value of such reflections and learn strategies to continue reflecting on their own.

## Summary

Scaffolded field experiences can be extremely effective in addressing many of the teacher learning needs we identified in Chapter 1. At the same time, the potential of this type of professional development for providing teachers with opportunities to learn new mathematics, to try out new teaching practices and materials, and to understand equity is greatly increased when teachers use exemplary instructional materials rather than units of their own design. Structures for teachers to talk and share with others, both peers and experts, also ensure that teachers can not only learn from their experiences but also get emotional support. The success of scaffolded field experiences also depends on sufficient resources being available to provide the support that teachers need.

## Suggested follow-up resources

Most of the new Standards-based exemplary materials now available (including all the NSF-funded comprehensive curricula listed earlier in Figure 7, along with the address of their respective websites) come together with information designed to provide support to the teachers implementing them. These may include explanations about the mathematics addressed in

various units, examples of lesson plans, suggestions about how to implement certain activities, and even recommendations about how specific tasks may be modified to meet the needs of students disadvantaged by some disabilities or limited language proficiency. These supporting materials can also be extremely helpful for teacher educators who want to support the implementation of any of these curricula.

There are not, instead, many professional development materials that have been published specifically to support teacher educators in orchestrating effective field experiences. If you are interested in learning more about ways to organize and support innovative teaching experiences, we recommend the following unpublished resources:

Fonzi, J. & Borasi, R. (2000). *Providing in-class support* (videotape + facilitator's guide) (available from the authors)

This 40-minute videotape captures a classroom experience in which a teacher educator plays a number of different roles to support the classroom teacher in implementing an inquiry unit with her sixth grade class. The accompanying guide offers additional information and a commentary on this experience and a set of questions to help teacher educators use this illustration as a catalyst for an inquiry on providing effective in-class support.

Fonzi, J. & Borasi, R. (2000). *Debriefing classroom observations* (videotape + facilitator's guide) (available from the authors)

This 40-minute videotape features excerpts from a series of classroom observations and debriefing meetings about the implementation of an inquiry unit in a eighth-grade class. The accompanying guide offers additional information, a commentary on this experience and a set of questions to help teacher educators use this illustration for an inquiry on conducting classroom observations. The goal of the inquiry is to show how debriefings can be a vehicle for professional development rather than teacher evaluation.

Borasi, R. & Fonzi, J. (in preparation). *Introducing math teachers to inquiry: A framework and supporting materials for teacher educators*. (multimedia package) (available from the authors)

These materials provide descriptions and supporting materials for orchestrating a supported field experience similar to the one portrayed in Illustration 7.