ACTIVE FACILITATION: WHAT DO SPECIALISTS NEED TO KNOW AND HOW MIGHT THEY LEARN IT?

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Abstract

Sustained, innovative professional development is now widely acknowledged as essential to the improvement of mathematics instruction in the nation's schools. In recent years, this recognition has prompted the production of a variety of materials designed to support new teacher development programs. However, with the availability of such materials, serious concerns arise as to the kinds of knowledge required of professional development providers, often teachers who have been assigned Mathematics Specialist roles, and the means by which this knowledge is to be acquired. The authors of this paper address such questions in the context of one professional development seminar, *Developing Mathematical Ideas* [1]. Our paper builds on the research of Remillard and Geist who identify the potential for learning in those moments of discontinuity—"openings in the curriculum"—in which the beliefs, knowledge, and commitments of seminar participants diverge from those of facilitators or materials developers [2]. By looking closely at several such moments, we establish how successful facilitation entails deep content knowledge, awareness of seminar goals, and appreciation of the beliefs and understandings of seminar participants. We then describe the kinds of supports available to *DMI* facilitators to help them cultivate the skills and knowledge needed to exploit these openings productively. While the paper focuses particularly on professional development seminars, we suggest that our conclusions apply to Mathematics Specialists' tasks more generally.

Introduction

One considerable obstacle to improved mathematics instruction in the United States is that many teachers simply do not have the necessary understanding of mathematics, of the process of learning mathematics, or of children's mathematical thinking [3,4]. Themselves the products of traditional mathematics education, these teachers doubt their own abilities to think mathematically and view mathematics as no more than a given sequence of facts, definitions, and rule-governed procedures [5,6]. Without having had opportunities to construct new visions of mathematics, mathematics learning, and the mathematics classroom, many teachers may adopt mathematically ambitious curricula, but use them in ways that subvert the intentions of their developers. Furthermore, some may never even *try* to use such materials in their classrooms because they cannot picture how their students might work with them.

If America's students are to leave school as developed mathematical thinkers, continuing teacher education is critical. However, the staff development crucial to improved mathematics instruction may be blocked for lack of necessary resources. Mathematics educators at all levels are thus challenged to build the capacity for supporting teacher change in resource efficient ways.

One option for support of large-scale staff development is the design of tools—professional development materials—that provide structure and content for in-service programs, and that can be used by a wide range of teacher educators, including teachers who become Mathematics Specialists. Further, these tools must underwrite systemwide, long-term, and ongoing staff development.

However, if school systems are to assign Specialist roles to teachers who, in turn, provide professional development to their colleagues, the next question involves the kinds of knowledge required of those Specialists. What must such Specialists know and understand in order to provide effective professional development and how might they acquire it? These are the questions addressed in this paper.

We explore these issues in the context of a professional development curriculum called *Developing Mathematical Ideas* (*DMI*) [1]. These materials were designed in response to the widely recognized need of elementary and middle school teachers to understand more deeply the subject-matter content they teach. However, rather than offer that content "cleansed" of reference to classroom context, these materials present the mathematics as embedded within those tasks of teaching which require teachers daily to call upon their own mathematical understandings [7,8]. Thus, seminars are designed around a set of print and video cases that particularly focus on children's articulation of their mathematical thinking and ways of solving problems. Along with these cases, the materials offer mathematical explorations, analyses of mathematical activities from K-5 curricula, assignments for teachers to conduct with their own students and classes, and readings about related research.

The *DMI* materials were produced in the context of the teacher enhancement project, Teaching to the Big Ideas, co-directed by Deborah Schifter, Virginia Bastable, and Susan Jo Russell. The five modules published thus far are: *Building a System of Tens*; *Making Meaning for Operations*; *Examining Features of Shape*; *Measuring Space in One, Two, and Three Dimensions*; and, *Working with Data*. We intend to produce two modules on early algebraic thinking: 1) functions and the mathematics of number systems; and, 2) generalization and justification about number systems. Each module, containing a casebook, a facilitator's guide, and a video cassette, is designed for eight three-hour sessions.

The Questions

To frame our approach to issues of facilitation in professional development settings, let us start with this scene: Having read a set of cases involving kindergarten and first grade children who solve various problems by counting, a group of teachers now comes together to discuss what they see in these cases. Their facilitator describes what happens next.

> I began, "What did you find interesting in [the case,] 'Insects and Spiders'?"
>
> Tomi offered the first response: "I have kindergarteners and this is first grade. I was looking at how, if they were given 5 spiders and they had 9 more to count, they were able to start counting on from 6. My children aren't at that level yet. I've tried to get them to do it on their own, but they don't. I even try to do it with them, but they still don't do it."
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> As Tomi was talking, I had the sense this wasn't a complaint; she didn't seem to be reporting a problem. Rather, this was something she had noticed about the way people learn.
>
> Carla commented, in support of Tomi, "I think the issue is developmental. I have third graders who still start from 1."
>
> Even though, on the face of it, Carla's comment is valid and a worthwhile contribution to the discussion, I get a little nervous when I start hearing teachers say, "That's developmental." Too often, I've seen people use that label to get themselves off the hook. If "it" is developmental, there isn't anything the teacher can do. The child just has to grow into "it." The word *developmental* can mark the end of discussion and the end of thought. But at the same time, I think there *is* something developmental about the issue Tomi and Carla were talking about.
>
> I chose to steer the conversation toward the mathematics of counting on.

> "Whether this is developmental or not, what is 'it'? Can you put into words what the math is we're talking about? What ideas are in here, what mathematics has Tomi been working on with her kindergarteners?" [9]

In this short scene, the facilitator begins with a general question—"What did you find interesting?"—but from there, she works to shape the discussion. Choosing to steer it away from talk about whether a particular skill is "developmental," she asks instead that the group think about the mathematical ideas children must put together in order to move from "counting all" to "counting on."

In this paper, we will examine this and other episodes drawn from our professional development work to consider these questions: Does facilitation necessarily entail an active role? If so (and our answer is yes), what are the facilitators' interventions aimed to do? What must a facilitator know or understand in order to select appropriate interventions? What, in our project, do we offer facilitators to help them develop such knowledge and understanding?

Facilitation Is an Active Role

A first question to consider is whether a group of adults coming together to study the mathematics in tasks of teaching requires active facilitation at all. Might they not simply gather as a study group, each member offering ideas to stimulate the thinking of others? Of course, there may be the rare group of teachers prepared to learn together in this way. However, where the nature of the activity being aimed for sharply departs from current practice, most groups will not find their way without determined and knowledgeable leadership. For example, in scenes like the one illustrated above, if teachers were to be satisfied with the comment "that's developmental," and in the absence of skilled facilitation, would they be likely to press on to examine the mathematical ideas raised in Tomi's observation? Or more generally, will a group of teachers seriously interrogate children's mathematical ideas if they are used to thinking of mathematics in terms of computational routines?

Evidence for our initial proposition, that teacher professional development requires active facilitation, is provided by a research study conducted in 1996-97, the first year of *DMI* field tests. In "A Case of Classroom Teachers Becoming Teacher Educators," an unpublished manuscript (1997), Susan Jo Russell traced the issues faced by a group of teachers who were stepping into their first teacher leadership roles, facilitating *DMI* seminars for their colleagues.

Granted, Russell's subjects were not typical teachers. They had spent three years studying mathematics and student thinking in a program led by the *DMI* developers. Indeed, these same teachers had written the cases that form the basis of *DMI*. Yet, although their knowledge of the content of *DMI* was considerable, they were very apprehensive about becoming their colleagues' teachers. In order to cope with this anxiety, many of these neophytes started out by telling themselves that their role was "merely" to facilitate. As they explained it, their task was to bring teachers together, set up the activities, and then let discussion go where it would.

The thrust of Russell's findings was that once the seminars got underway, this stance of "mere" facilitation could not long be sustained. Having studied mathematics and student thinking for three years, these Teacher Leaders had a vision of the potential for learning the *DMI* materials offered, but their colleagues were not taking up the important questions on their own. These fledgling facilitators realized that seminar discussions would not move in what they knew to be fruitful directions without active intervention. After the first session, which included playing a mathematics game, one facilitator wrote,

> Most ... teachers thought that this was a fun game. . . . I was disappointed with that. I wanted them to think more about their strategies and relate their strategies to the work of the students in the cases. I still look back and wonder how (or if) I could have pushed the teachers' thinking along.

Later in the seminar, a team of facilitators who had been afraid to take strong leadership in discussions realized that participants had also become frustrated. The team had opted for a passive role in order not to anger their colleagues, but now that those colleagues were angry anyway, they decided they might as well take a different tack.

> I made a resolution that if they were going to be mad at me I wanted them to be mad for a good reason. By this I mean that all fall we never really got the questions about 'Where's the math?' . . . [Now my partner and I were] absolutely resolved to continually bring the discussion back to that question, "So what are the mathematical ideas here that this child is pushing on or bumping into?"

At that point, the entire tenor of the seminar began to shift. A few weeks later, one of these facilitators wrote:

> I could see layers and layers of complexity and that is what I was trying to add to the discussion....complexify it up! and that . . . felt right and legitimate and interconnected and important.

While Russell's study illustrates the need for active facilitation, a second study, conducted that same year, characterizes the situations that require determined intervention. Janine Remillard and Pamela Geist observed three *DMI* seminars facilitated by a Teacher Leader, a university faculty member, and a staff developer who worked for a school district, respectively [2]. In these three settings, the researchers were particularly drawn to examine the instances, prompted by participants' questions, observations, challenges, or resistant stands, that required facilitators to make judgments about how to guide the discourse. These moments, they argued, arose from conflicts among the goals and commitments of the facilitators, the expectations of the participants, and the agenda of the curriculum. Initially struck by the awkwardness occasioned by such moments, the researchers ultimately came to refer to them as "openings in the curriculum"; "openings" because they held significant potential for inquiry and learning.

Often initiated by the concerns and observations of participants, including the facilitator, these openings invite opportunities for facilitators to structure conversations and explorations that can extend or challenge participants' knowledge and beliefs.

The "counting all/counting on" case illustrates just such an opening: the facilitator sees that discussion of Carla's observation that her students' difficulties are developmentally determined could interfere with a goal for the session—examining the mathematics of children's counting strategies. Aware that many teachers use the phrase, "that's developmental" to put an end to deeper inquiry, the facilitator navigates around that language—"Whether this is developmental or not, what is 'it'?"—to bring the group's attention to the mathematics. Similarly, the teachers in Russell's study learned to ask their participants, "So what are the mathematical ideas here that this child is pushing on or bumping into?"—a question these participants were not conscious needed investigation.

Remillard and Geist identify a set of skills required of facilitators in order to take advantage of the potential for learning offered by such openings in the curriculum: to recognize openings as they occur, to interpret the tensions that underlie them, to consider responses and possible consequences, and to take action. They further comment:

> Well-navigated openings allow facilitators to take deliberate action to foster the kind of learning intended by DMI developers even when doing so involves "veering" from the plans suggested in the curriculum. In a sense, openings may be signals that the curriculum is working [2].

What Knowledge is Required to Navigate "Openings"?

Russell's research has provided support for the principle that facilitation is necessarily active. Remillard and Geist have characterized those moments that require a facilitator to respond with determined action as "openings"—moments that "invite facilitators to structure conversations and explorations that can extend or challenge participants' knowledge and beliefs" [2] . This then invites the question, What is it that a facilitator must know and understand in order to identify an opening, unpack the tensions that underlie it, and choose a response?

Our own analyses point to three areas in which facilitator understanding is called upon in order to navigate openings: seminar content, learning goals for teachers, and participants' perspectives. In this section of the paper, we present examples to illustrate how facilitators mobilize their understandings in each of these areas. Of course, in any seminar event, a facilitator is likely to be calling upon all three strengths. However, we have chosen occasions that particularly highlight each in turn.

<u>Facilitators Must Understand Seminar Content</u> — Just as classroom teachers must understand the mathematics they are responsible for teaching, so too, must teachers of teachers. As in the classroom, so too in the professional development setting, the form that such mathematical knowledge must take in order to be useful differs from the manner in which it is conveyed in the typical mathematics class. Certainly, to understand an idea as presented in a conventional textbook may be helpful. However, in addition and more to the point, a facilitator must be able to recognize that mathematical idea as it is situated in a classroom case, or how it plays out in a variety of mathematical activities. As shown in the example below, a facilitator must also

recognize when an important idea is being broached by a participant—and be able to respond with questions or suggestions that help move the seminar into that idea.

One issue explored in the seminar *Measuring Space in One, Two, and Three Dimensions* (*MS123*) is the effect of scaling the sides or edges of two- and three-dimensional objects: double the sides of a rectangle, say, and the perimeter also doubles, but the area quadruples; double the edges of a rectangular solid, and the surface area quadruples, but the volume multiplies by eight [10]. These ideas are new to most of the teachers who participate in *MS123*. Indeed, we suspect that few teachers anywhere in the United States have had much experience envisioning spatial relationships. Thus, a seminar facilitator is frequently called upon to help sort out such matters.

In one homework assignment, teachers solve the following problem: *How much sand is needed to fill a sandbox 2 yards long and 4 feet wide to a depth of 6 inches?* Although the problem is first about how cubic units are structured from linear units, exploration of the relationships among cubic inches, cubic feet, and cubic yards brings participants back into ideas of scaling. In one seminar, participants initially offered the following answers, which the facilitator duly listed on the board:

4/9 cu. yd.

144 cu. ft.

12 cu. ft.

1728 cu. in.

The teachers in the seminar were challenged to reconcile these different answers: Are they all equivalent and, if not, which ones are correct? [The correct answers are 4/9 cu. yd., 12 cu. ft., and 20,736 cu. in.] The facilitator later wrote an account of what transpired in response to those questions:

> Corinne explained how she got 12 cu. ft. "I changed all the dimensions to feet: 6 feet times 4 feet times 1/2 foot; that comes out to 12 cubic feet."...
>
> "Oh, right!" Laura exclaimed. "I forgot to change the 6 inches to feet. I multiplied 6x4x6, but that's wrong, 144 cu. ft. is wrong. But if 12 cubic feet is the right answer, then it's 144 cubic inches."
>
> When asked how she came to that conclusion, Laura thought it was obvious. There are 12 inches in a foot, so you multiply the 12 cubic feet times 12. But

> Andrew disagreed. "You have to go to inches in all dimensions. It's 48 inches times 72 inches times 6 inches."
>
> I wrote out "(4x12)x(6x12)x6" so people could see where Andrew's numbers were coming from. Now everyone set to work, some with calculators, others with pencil and paper. In the middle of all this calculation, Jean blurted out, "Oh, I did 12x12x12 and got 1728. That's the number of cubic inches in one foot, so that can't be the answer. Multiply that by 12 and you get 20,736."
>
> On our list I had crossed off 144 cu. ft. and 1728 cu. in. and now added 20,736 cu. in. "How can we think about whether this is the right answer?" I asked.
>
> Andrew was busily figuring numbers on his paper and declared, "It can't be right. Look, 4/9 cu. yd. is close to 1/2 cu. yd. So you take 18x18x18 and that doesn't get you close to 20,736."
>
> It took me a few seconds to see what Andrew was doing, but I quickly realized he was making a fruitful error, one that would give us an opportunity to work on the ideas behind the exercise. I asked him to slow down and explain again what he was thinking.
>
> "Well, I said the volume is 4/9 cu. yd., and I'm sure that's right. If you change all the dimensions to yards, you get 2 yards x 4/3 yards x 1/6 yard, and that gives you 4/9 cu. yd." I stopped him there for a moment to allow everyone to do that calculation; then I asked him to continue. "But 4/9 is close to 1/2, so I was thinking I needed to find what 1/2 cubic yard is. Well, 18 inches is half a yard, so it would be 18x18x18, and if you round 18 up to 20 you get 8000. So 18x18x18 doesn't get you anywhere near 20,736."
>
> The issue here was exactly what we had worked on last session—what happens when you double the edges of a solid—except that Andrew was talking about halving the edges. But since the images are not so accessible—spatial visualization in three dimensions is so new for them—it wasn't clear to everyone (anyone?) that Andrew had made an error. To help the group picture what was going on, I drew a picture of a cube on the board [10].

The discussion continued with more wrinkles to it, and the facilitator remained active in slowing the pace, emphasizing particular questions, and introducing spatial representations, first as diagrams drawn on the board and then with cubes. The main idea here was for them to see that when each of the three dimensions of a cube is 1/2 yard (18 inches), you end up with 1/8 cubic yard, not 1/2. Halving just one dimension, 18x36x36 inches, will give you 1/2 cubic yard (close to 4/9).

It is important to note that the mathematical strengths called upon by the facilitator are not limited merely to knowing the effect of scaling the edges of a three-dimensional object. They also include understanding seminar participants' ideas, recognizing how scaling is at issue, posing questions that bring the results of scaling into focus, and offering representations that help participants visualize the relationships for themselves.

Once the teachers could picture the relationship between 18 inches cubed and one cubic yard and then showed that 20,736 cu. in. was a correct answer to the original problem, they could work with images of one cubic foot in relation to one cubic yard in order to see how 4/9 cubic yard is the same quantity as 12 cubic feet.

The example given here highlights how a facilitator calls upon a deep understanding of subject-matter content. However, it should be clear from the examples included in this paper that issues of learning and pedagogy are equally central to the seminars' ambitions. Certainly, facilitators must know this content, as well.

<u>Facilitators Learn to Think in Terms of Seminar Goals, Not Just Planned Activities</u> — In planning and in interactions with participants, facilitators must learn to think in terms of the goals of the seminar, and not merely in terms of getting through planned activities. It may *seem* obvious that, in order to identify openings in which participants' expectations conflict with the agenda of the curriculum, the facilitator must understand that agenda. However, the importance of entering each session with a set of learning goals is honored more often in the breach than in the observance. At the level of day-to-day classroom routine, many teachers view their charge as taking students through a series of prescribed activities, unaware that these activities are intended to serve the development of underlying mathematical concepts. Similarly, some teachers of teachers tend to treat the session agenda as a timetable of activities, rather than a conceptual road map.

However, without intervention from the facilitator, the purpose of an activity is likely to be missed often even after clear instructions have been articulated. In the scene presented below, a facilitator acts on her knowledge of the specific learning agenda for the session, as well as for the course as a whole, in order to bring to participants' attention issues otherwise outside their field of vision.

In the seminar *Building a System of Tens* (*BST*), teachers explore the many-faceted idea of place value: how our number system represents quantity and how this idea is employed when calculating with whole and decimal numbers [11]. Conceptual issues that are challenging to children of different ages are identified, and ways teachers and particular curricular activities can support children facing such challenges are explored.

In the second session of *BST*, teachers read a set of cases depicting children working hard to put together the ideas they need in order to use numbers flexibly. The introduction to the cases points out that many of the children are confused, and "that's what makes these good cases to study. That is, when children are doing everything correctly, the hard thinking they have done is often invisible. On the other hand, if we examine their thinking when they are confused, the ideas they are working on are often easier to identify" [11]. As teachers read the cases, they are asked to consider: "In what ways does the children's thinking make sense? What are the ideas they are putting together?"

In order to follow what happens in the second session, the details of one of the cases up for discussion are relevant: Sarah, a third grader who already knows the "carry" algorithm for addition, as well as several other procedures, chooses to represent 45 + 39 with yellow cubes for tens and black cubes for ones. Thus, after adding, she has 7 yellow cubes and 14 black cubes. "There are way too many to keep on the ones side, so I try to carry them," she says as she moves 10 black cubes to join the 7 yellow cubes. But now having lost track of the fact that 10 black cubes are to be counted as 1 ten (thus, the 7 yellows and 1 group of 10 blacks yield 8 tens), Sarah reckons she has 17 tens and 4 ones: 174. Yet she knows from the other procedures that the correct answer is 84. In the case, the teacher poses questions to Sarah that eventually enable her to find her mistake. Thus, toward the end of the exchange, she points to the 10 black cubes and explains, "It equals 10 ones. It's 10. Not 100.... It is *a* ten." In this way, she reconciles her cube representation with the other procedures she knows, all now yielding the answer, *84 [11]*.

With the story of this case in mind, let us turn to a teachers' seminar. One facilitator reported on how her group of teachers seemed unable to examine Sarah's thinking.

> I was … struck by the group's need to find a simple fix; several people talked about what they would have done with Sarah to prevent her from making mistakes. Mainly, they said that Sarah needed to have a larger block for the quantity 10; she shouldn't have represented tens with a different color block the same size as a one. Despite my questions to the small groups, few teachers noticed that, in the course of the episode, Sarah had corrected herself. They skipped over this evidence and did not ask if she was developing a deeper understanding of multidigit addition.
>
> So at this point [now in whole group], I stopped the discussion and had someone in the group act out how Sarah had come up with 174 when combining 45 and 39. Once everyone agreed with the demonstration, we turned back to the text to read together what happened next; I actually asked someone to read it aloud. Then my next question was, "How did Sarah change her model to come up with 84, the answer she already knew was correct? What did she understand to begin with, and what did she figure out in her interaction with [her teacher]?"
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> Marta was looking back at the first page of the case and shared what the teacher had written about Sarah: "She understood all the various methods that had been presented." [Now, following Marta's lead, the teachers began to discuss the evidence in the case, taking a closer look at what Sarah does and says to consider what she might have been thinking and what she might have figured out.] [12]

In this example, participants who initially dismiss the case with the comment that the teacher shouldn't have allowed Sarah to represent the numbers as she did are operating from the premise that confusion is best prevented. However, one of the facilitator's goals is to convey the insight that avoidance of confusion is not necessarily a useful goal. She wonders, "Can they come to see that confusion is a necessary part of the learning process? That a person who has come up against a point of confusion now has an opportunity to learn?" [12].

In order to move the group toward these insights, the facilitator takes a strong lead in whole-group discussion. First, she asks the teachers to repeat Sarah's demonstration with the cubes. Then, she asks the teachers to read a section of the case aloud. In this way, she draws their attention to the elements of Sarah's representation that do make sense, to the knowledge that

Sarah already brings to the task, and to the specific idea that Sarah needs to put into place to make her representation work. By bringing teachers back to the particulars of the case, the facilitator *opens* up opportunities for them to address the larger issues of the mathematics of the problem, the learning that took place, and the interactions that supported that learning.

<u>Facilitators Must Work to Understand Participants' Perspectives While Provoking Deeper Reflection</u> — Facilitators must work to understand participants' perspectives—their deeply held ideas and commitments. Interactions with seminar participants must be based at once on genuine appreciation of those ideas and commitments, but also on the determination to provoke deeper reflection and new insights. Remillard and Geist remark that skillful navigation of openings requires an understanding of the tensions that underlie them [2]. In order to know where the discontinuities lie between participants' goals and those of the curriculum, facilitators must constantly work to identify the ideas and commitments held by participants which, if they are learning, are in flux. In the previous examples, the facilitator was acting not only on the learning goals she held for teachers, but also what she understood about the ideas and dispositions held by those whom she was addressing.

This work of identifying participants' commitments and dispositions is explicitly illustrated in the following excerpt from a facilitator's journal, written after the fourth meeting of *BST*. In preparation, teachers had been assigned to conduct a mathematics interview of one of their students. As the session began, teachers sat in small groups to share what they had discovered.

> I went around, listening in on groups to get a sense of where people were, and I learned that they were all over the place. Despite the discussion we had at our last meeting, some teachers couldn't separate this interview task from teaching, and their vision of teaching *didn't* involve eliciting students' ideas. There were teachers who couldn't separate being successful teachers from having their students get the problem right. Tomi felt the need to report to me that she stayed with her student until she straightened him out. And Sheila seemed to be at the same place as last time—she would never ask a question of a student unless she were quite sure the student could answer it correctly; it's unfair to ask something you haven't already taught, and so forth. Her interpretation of the interview assignment was, first explain the task to the child, and then ask questions to make sure he does it right.

> So, what does it mean that it's the fourth session and some people still don't have an inkling of what it means to examine student thinking? Am I doing something wrong? Is there something I can do so that they'll get it? As I write this, I realize that there's a parallel here between how I'm feeling and the position I put them in when I assigned these interviews. Here I am, panicked (and that's only a slight exaggeration) that there are teachers in the group who just aren't getting it—they had this big assignment, and they didn't do it right. And that makes me think that maybe I'm a lousy teacher, maybe this seminar is a flop. At the same time, I am telling them to interview students and discover the ways they think about the mathematics. So they interview students and discover that they just don't get all those things they had been taught. And how does that make the teachers feel? Lousy. This isn't just an intellectual exercise. A teacher is compelled to act on what she learns about her students, and so it makes sense that some of these teachers avoid learning things they don't know how to act on.
>
> Hence, that issue comes back to me. What can *I* do? What can I do to make it safe enough for these teachers to begin to discover something about student thinking? And to make them begin to see that teaching involves listening to their students' mathematical ideas?
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> To answer my questions, I can apply exactly what I want the teachers to learn. What I can do is listen hard to what the teachers are saying—listen to their mathematical ideas as well as their ideas about teaching and learning. But where, in all that, can I find elements of strength in their ideas that can be highlighted and leveraged to help them reconsider some of their own notions? [12]

In this session, the facilitator is disturbed by the response of a handful of teachers to the assignment to conduct a mathematics interview of a student. She is trying to figure out what to do when teachers' ideas diverge sharply from her expectations. In order to decide what to do, she must first work to consider why they are behaving as they are. Assuming that the teachers behave rationally and responsibly—they care about being good teachers—what might they believe that causes them to behave this way?

As this facilitator reflects on the teachers' behavior, she actually finds a point of contact and can empathize. Understanding something of their beliefs and commitments, she is now better able to choose a course of action that can both connect with where they are and challenge them to move on.

Supports for Facilitator Learning

Thus far, we have argued that facilitation of teachers' professional development is/should be regarded as an active role. Following Remillard and Geist, if what we are calling "openings in the curriculum"—instances of discontinuity between participants' ideas or beliefs and the goals of the curriculum—are to provide fruitful opportunities for learning, then the facilitator must take determined action to exploit them [2]. In order to choose effectively among possible responses, facilitators must understand seminar content, be guided in their work by reference to their learning goals for teachers, and respond sensitively to the beliefs, ideas, and dispositions of the participants. This is a tall order. How is a facilitator, particularly a novice, to acquire such knowledge?

The *DMI* materials were written with an eye toward facilitator as learner. The casebooks themselves provide multiple supports for the facilitator, each chapter beginning with an introduction that describes the major idea on which the set of cases is threaded. The concluding essay, "Highlights of Related Research," offers another articulation of some of the major ideas to be mined in case discussion. Of course, each session will offer the facilitator new insights into content and goals, as well as new appreciation of participants' perspectives, insights, and appreciations that will be carried forward and amplified in succeeding seminars.

In addition, the *DMI* developers have created structures expressly to support facilitator learning. In this section, we describe three of them: facilitator's guides, the *DMI* Leadership Institutes, and facilitators' inquiry groups.

<u>Facilitator's Guides</u> — As the *DMI* developers prepared facilitator's guides, we looked back on our own rich experiences facilitating the seminars and tried to find ways of sharing some of what we learned. We also looked forward: What could we offer the groups of teachers with whom we were just then working closely and who were about to lead their own *DMI* seminars for the first time?

Included in the guides are such familiar features as: lists of materials to prepare, an agenda for each session that describes the activities, pages of mathematics activities, and focus questions to copy and distribute. The guide opens with a set of "tips," suggestions for how to become familiar with the module, how to prepare for a session, how to facilitate small- and large-group discussions. Mainly, these are "how to" directions.

The major component designed to address those areas of knowledge extensively described above is a document called "Maxine's Journal," ostensibly the reflections of a facilitator written after each session of the seminar. "Maxine's Journal" was created to convey a sense of what a *DMI* seminar might look like—the types of discussions that can take place, the types of lessons seminar participants can draw from the sessions—and how it might feel to facilitate one. Maxine is a composite character and so, too, are the teachers in her seminar. Though Maxine is a fictional character, her journal entries describe events and individuals observed and recorded by the developers of the materials and by those who field tested the first *DMI* seminars. The seminar scenes depicted in the previous sections of this paper are all excerpted from "Maxine's Journal."

A primary purpose of "Maxine's Journal" is to portray a seminar in which participants' ideas take center stage, but where the facilitator actively steers discussion, persistently drawing teachers' attention to a set of ideas or issues. The seminar is neither a lecture nor merely a free-form discussion. Entries, as in the excerpts above, depict a facilitator who pays careful attention to what participants say and do, and who tries to choose responses that convey an appreciation of their ideas, but who is committed to pushing them to think harder.

Through the specificity of Maxine's references, the reader can gain insights of a more general nature. By reporting on the events that take place in each session, she conveys how, guided by the facilitator, seminar curriculum translates into participant discussion. By elaborating on the mathematical confusions and insights that arise, she provides an opportunity for facilitators to work through that same content.

Maxine is constantly trying to understand the perspectives her participants bring to the seminar. As she learns more about her group and the teachers who comprise it, some of her goals become individualized. For example, after the second session, Maxine writes:

> What do I want the teachers to learn? I guess one thing I want them to appreciate is that avoiding confusion is not a useful goal. Can they come to see that confusion is a necessary part of the learning process? That a person who has come up against a point of confusion now has an opportunity to learn? But that is not my immediate goal for Amira, Tony, and Shannon. Instead, for Amira it is simply that she become comfortable enough in this class to be able to think! And for Tony and Shannon, my goal is that they begin to expand their ways of thinking about mathematics.

Participants come with many different perspectives and beliefs, contributing to the richness of seminar discussions. As individuals exchange their ways of interpreting an event described in a case, their methods for solving a mathematics problem, or their connection to a finding presented in the research literature, then opportunities to explore mathematics, learning, and teaching become more complex.

Accompanying "Maxine's Journal" in the number and operations modules is a document called "Two Portraits of Change," tracing the learning of a pair of individual teachers [9] . Drawing on reflections these teachers recorded in regular writing assignments (prepared for each session), their facilitator tells how these two, who began the seminar with very different perspectives and despite having completed it with very different ideas, were each changed in significant ways through participation in the same set of activities.

However, the fact that participants come with different perspectives, beliefs, and personalities can make for complicated group dynamics. Hence, Maxine writes about her efforts to temper dominant personalities who present their ideas with authority, to draw out others who are thinking hard but are too timid to volunteer their views, and to manage those whose exasperation threatens to disrupt a lesson.

Maxine is by no means the "perfect" facilitator—occasionally frustrated or angry, at times confused, unsure about how to interpret what has happened. This, too, is part of the facilitator's experience, and we want new facilitators to understand that. Nonetheless, in spite of self-doubt and confusion, Maxine carries on with a sense of commitment to seminar participants and to the ideas on which they work.

Users of the *DMI* materials report that, prior to each session, they read the relevant section, saying that it gives them an image of what is possible. Even though inevitably their own seminars will take a different turn, "Maxine's Journal" provides a referent that helps them guide their group, as Lee and Buonopane wrote in their unpublished 1998 manuscript. Over time, facilitators' own store of experiences joins those of Maxine.

Leadership Institutes — Two-week institutes were created to help facilitators deepen their understanding of the mathematics, become aware of participants' perspectives, and expand and refine their repertoire of facilitation strategies. These institutes include opportunities for participants (future facilitators) to go through the *DMI* modules by experiencing mathematics explorations, engaging in case discussions, analyzing tasks from elementary and middle school curriculum, and gaining familiarity with relevant educational research. For some participants, this is an opportunity to encounter new ideas about mathematics, learning, and teaching. Those who are more familiar with seminar content take on the role of participant observer—as they move through the material with the group, they are positioned to take note of facilitators' moves and register how their fellow participants react.

Once curriculum content has been carefully discussed, goal setting becomes possible. In particular, by identifying session-to-session mathematical goals, participants become aware of the ways ideas are connected throughout the curriculum.

In order to focus on participants' perspectives, we examine one teacher's trajectory over the course of a seminar: careful reading of "Two Portraits of Change" and "Maxine's Journal" allows us to identify specific instances of movement toward seminar goals, highlighting moments of confusion that open opportunities for learning [9].

As participants gain confidence in their understanding of seminar content and goals, and in identifying participants' perspectives, the actual work of facilitation itself comes into focus. What is the facilitator's role in group discussion? When should the facilitator intervene? When should the facilitator listen quietly and move on? How might the ideas of the participants be used to raise the level of the discussions?

Our attention then turns to developing a repertoire of strategies to support more effective facilitation. We begin with hypothetical seminar scenarios, considering multiple strategies for dealing with common, but complicated, situations. In addition, we work on formulating questions that, while building on the ideas shared in small groups, raise the level of the whole-group discussion. We also analyze samples of participants' writing, focusing on the ideas being conveyed, identifying "openings" registered in their work, and creating responses both respectful and challenging.

An opportunity to co-facilitate a *DMI* session for other institute participants is the final synthesizing experience of the two weeks. Now responsible for actually setting goals, formulating questions that bridge the mathematics and the cases, and running whole-group discussions that build on and challenge the ideas of the group, institute participants are able to test their strengths in anticipation of their work as facilitators and leaders in their workaday settings.

<u>Facilitators' Inquiry Groups</u> — In addition to the annual institutes, a variety of networks and inquiry groups have been established over the years. During the first year of field tests, project staff met monthly with 35 Teacher Leaders who were, for the first time, taking on leadership roles in their systems. During the second year, an electronic discussion was established linking facilitators at various sites around the country who were working through sixteen *DMI* sessions at approximately the same pace. During these meetings or over the electronic network, facilitators described their successes, as well as dilemmas they faced. They shared strategies that worked for them, as well as those that didn't; and, they talked about the emotional challenges of the work. While these groups offered support to participating facilitators, they also provided a mechanism for feedback to the *DMI* developers responsible for the final revisions.

Now that the materials have been published, we are aware of other projects that structure opportunities for facilitators to work together on their practice. There are two such projects, in particular, that we are watching. In Boston, Amy Morse works with a group of coaches who, among their other responsibilities, facilitate *DMI* seminars. To ground discussions about their practice, coaches write their own cases—much like the cases in the *DMI* materials—about facilitation moments they choose to reflect on with their colleagues. In the Seattle area, Gini Stimpson and Christopher Fraley direct a project to cultivate a cadre of 300 *DMI* facilitators.

Conclusion

In this paper, we have described facilitation of *DMI* seminars: discussing the role of facilitator, the knowledge required to facilitate well, and the supports offered to develop strong facilitation. By confining the discussion to our own work, we are left with the question, how generalizable are our conclusions? Is active facilitation of the kind we posit for the *DMI* seminars—that facilitators use their considerable knowledge and skill in order to realize the goals of the materials—solely a function of the nature of those materials?

Although the empirical work presented here is all *DMI* related, the logic of the argument for active facilitation strongly suggests that whether these conclusions can be generalized depends on the distance between the beliefs and understandings of practicing teachers, and the goals of any particular professional development program. It is precisely when there is a conflict, a gap, or in Remillard and Geist's words, "an opening," between the understandings of the participants and the goals of the facilitator and the curriculum that determined action on the part of the facilitator is needed [2].

The general goals of the *DMI* seminar—that teachers come to recognize that mathematics is about ideas; that they and their students actively entertain mathematical ideas; that teaching involves listening to, interpreting, and analyzing what children express about their mathematical thinking; that teachers' moves be based upon their understanding of the mathematics to be learned and analyses of what students understand—tend not to be widely shared among K-12 teachers. To induce teachers to adopt these goals for themselves, professional development activities must not be easily assimilative into current frames of reference. However, even where assignments are explicitly stated (e.g., to figure out the sense in a child's mathematical mistake), teachers will tend to interpret them in familiar terms (to explain what the teacher should have done to prevent a child from making that mistake). Without a facilitator who acts with determination to draw teachers' attention to what they otherwise would not see, teachers are unlikely to commit to change their practice.

Indeed, although in this paper we have focused on facilitation of professional development seminars, the same considerations apply to other kinds of tasks a Mathematics Specialist might take on; for example, coaching teachers in their classrooms or leading discussions of demonstration lessons. Here, too, if teachers are to be helped to move forward, Specialists will need to identify and navigate openings—bringing teachers' attention to the mathematical ideas of students, or encouraging them to dig more deeply into the mathematics at hand. This work, as well, will call upon the same three areas of knowledge described above.

Responding to openings for teacher learning, however, is not just a matter of having the right cognitive dispositions. It is just as important to understand that effective facilitation requires courage—courage to challenge the thinking of other adults, to redirect a discussion that is moving in an unproductive direction, and to face the agitation, sometimes even tears, that result when firmly held ideas begin to crack.

This form of facilitation also demands a stance of respect for and commitment to the teachers being supported and the ideas to be explored. Perhaps this disposition is best reflected in one facilitator's injunction to herself and her colleagues: "We can do better—go deeper—than where we are now."

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