

## Learning What You're Seeing in Math Class

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The No Child Left Behind Act has placed new demands on principals for their students' achievement in mathematics. At the same time, instructional methods, texts, and many of the high-stakes tests have been changing dramatically to reflect ideas about mathematics instruction that are based on recent research in cognitive psychology and mathematics education. Such research shows that children learn mathematics best when they explore ideas in the context of solving complex problems, thereby simultaneously building mathematical understanding and integrating their learning of facts and problem-solving procedures with that understanding. (Kilpatrick, Swafford, & Finell, 2001).

The combination of new instructional methods and new accountability pressures puts many principals in a quandary. How do they evaluate the adequacy of the mathematics instruction occurring in their schools? How can they tell if teachers are using new methods well? And how can they be confident that their school has the right balance between learning mathematical facts and procedures for calculation, while also developing a good conceptual understanding of mathematics?

For about ten years we and our colleagues have been studying how elementary principals think about and work to improve mathematics instruction. We have worked closely with nearly 100 elementary principals from urban, rural, and suburban districts, and both large and small schools. The data collected in our studies include ethnographic observations and transcripts of discussions in our workshops for principals, extensive interviews with the principals, ethnographic observations of them at work in their schools, and interviews with some of the teachers with whom they worked. We presented our major findings in our recent book, *The Effective Principal: Instructional Leadership for High-Quality Learning*. [See sidebar.]

Although we have worked with principals on many aspects of their practice as instructional leaders – recruiting and hiring teachers; explaining the math program to parents and other stakeholders; supporting and mentoring teachers; creating a climate for learning in their schools; and dealing with report cards, testing, and other accountability issues; the process of classroom observation and teacher supervision seemed especially important to these principals. In visiting classrooms and talking with teachers, principals come into direct contact with instruction, judge its adequacy, and decide what help a teacher may need. If schools are to consistently provide high quality mathematics

instruction, it is critical that school administrators recognize and support the development of excellent instructional methods.

For veteran principals, understanding what is happening in today's math class, and making judgments about its adequacy, may be especially challenging, since the kind of instruction occurring there may be very different from what they experienced as students or how they taught mathematics when they were teachers.

In our studies of principals' doing classroom observation and teacher supervision in mathematics we identified three very common experiences that occurred as principals "re-learned" how to make sense of what is happening in math classes and how to make judgments about the quality of instruction.

### **An Emotional Jolt**

Many principals have assumed that if students know basic mathematical facts, like their times tables, and basic calculations, they understand mathematics. Often this is not the case – students who appear mathematically competent may, in fact, understand very little.

Mr. Bouvier<sup>1</sup> described this very well. He first saw the disconnect between facility in calculating and mathematical understanding on a videotape in a course we offered and then tested it out in his school. He said,

[The interviewer on the videotape] was asking the child different questions that queried the level of understanding the child had about mathematics. And after the first one or two [questions], [when the interviewer was] getting beyond arithmetic [procedures] to ... look at the understanding, the child had no base or foundation at all. That was an emotionally charged discovery for me. So what I did very quickly is go into a third-grade math class and mimic the same kind of questioning strategies. Lo and behold, I found a lot of our students in that class had not established a basis of understanding, but had established a series of rules. "Why do you do this?" "Because that's what I was told." "Why is the one there?" "Because that's what you do to solve the problem."

Many principals experience this emotional jolt. Students' procedural competence is not always the same as their understanding of the mathematics. Often we assume that if students can do the problems they understand the mathematics. It is often quite a shock to see how fragile the conceptual understanding is of some students who are competent procedurally. These principals say that such students would have been considered quite good mathematics students in their schools, but now they see that they might not do very well on high-stakes tests that focus on mathematical understanding. Principals are also jolted by the challenge of figuring out how to change mathematics instruction so that it provides both procedural and conceptual understanding.

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<sup>1</sup> Principals' names are pseudonyms.

## **Looking for Strategies.**

Many principals have become convinced that students' conceptual understanding is important. They realize that students need opportunities to think about and articulate important mathematical ideas and they look for classroom practices and structures that will encourage this to happen. These may include using manipulatives, having students work in small groups, asking students to describe their strategies for solving mathematics problems, asking open-ended questions, and the like.

Ms. O'Brien was especially taken with the variety she saw in children's problem-solving strategies. She appreciated that students have many different ways of conceptualizing mathematics problems, which can lead to a variety of methods of solution, and that "math with kids does not have to be [only] about one right answer."

When observing a 4<sup>th</sup> grade math class, this principal was concerned that the teacher should talk less in his mathematics class and listen to the students more. As she put it,

He's very eager to do well. But, as I keep on trying to tell him, he needs to stop talking. He needs to talk less and listen more ... That way he's going to learn more about how to be a better teacher.

Talking with us after she observed the class, she said she was very pleased to see that the teacher had asked open-ended questions such as, "What does that mean?", which gave students the opportunity to say more about their mathematical thinking. She was also pleased that he didn't appear to be fishing for the "right" answer, but accepted many answers and responses.

When she observed the classroom she appeared to be using a list of desirable teacher behaviors – a sort of up-dated list of things to look for in a math class. Making an updated list of things to look for is a very natural step for principals to take, as they "re-learn" how to observe mathematics classes. Courses in supervision have often suggested lists of things to look for, e.g., an introduction, demonstration of how to do the new problems, individual student seat work practice, whole group discussion, assignment of homework; or smooth transitions from one section of the lesson to another; or specific assessment practices. Substituting new instructional practices and strategies for older ones would seem a sensible thing to do.

However, it is well-known (Ball, 1992) that implementation of these instructional strategies, alone, will not guarantee that math class is providing students with the opportunity to think carefully and rigorously about the central mathematical ideas of the lesson. Small group work can miss the mathematical mark, work with manipulatives can fail to bring students into contact with the mathematical ideas that these instructional tools are intended to illuminate, and enumeration of student problem-solving strategies without comment about the accuracy or effectiveness of the strategies can deprive students of having serious mathematical discussions. Our research shows how some

principals have gone beyond substituting new strategies for old and are able to evaluate instruction for rigorous mathematical thinking.

### **Focusing on Mathematical Thinking**

What is considerably harder to do during classroom observations, and harder to learn, is to attend to the mathematical content of students' thinking; use one's own mathematical knowledge to make an assessment of what the students are understanding correctly (and what they do not yet understand); and analyze how the teacher's instructional moves – assignment of follow-up tasks, discussion questions, brief dialogues with particular students, and so on – respond to the students' mathematical ideas and give them the opportunity to inspect the validity of those ideas and modify them if necessary.

Some principals have had the opportunity to develop this skill through professional development or from working closely with the skilled teachers in their schools. These principals did not necessarily have a strong mathematics background themselves, but, over time, they have developed an ear for listening to students' mathematical thinking.

Ms. Diggins had come to believe that when doing a classroom observation she must attend closely to both the students' mathematical thinking, to see what sense they were making of the material, and to the teacher's work, to see what sense *he* was making of the students' thinking. When she observed a first grade class she watched two children working on a counting game and saw one learn from the other:

[The boy] was actually counting on, and the other one [a girl] had to count from the beginning to the end. By the end of that session, the little girl had begun to count on because there were certain numbers that she started recognizing as a group. ... The little boy consistently counted on from the beginning to the end, and I saw her, she did it with the number 5 and she did it with the number 3. You could sort of see a little light bulb go on as she watched him. He said, "That's a 5," and then counted on. And then the next time, she did the same thing and started counting on. And she hadn't been doing that at the beginning ... I knew that there were levels of understanding, and I could see the different levels in that classroom.

In her conversation with the teacher afterward Ms. Diggins probed to see the degree to which he had been attending to his students' thinking at this level of detail. She wanted to see "how much information he takes away around their understanding."

Focusing on students' mathematical understanding, and on teachers' ability to understand that thinking and interact with it, was a different focus for classroom observation than she had had in earlier years, and this principal acknowledged that it was hard to learn to do:

I'm not at a place where I can [do this] expertly without questioning myself. So it's a work in progress all around and we all need to be kind to ourselves about that.

## Learning to Listen to Students' Mathematical Thinking

To understand what is happening in today's math class and make informed judgments about the adequacy of the instruction, principals need to listen to students' mathematical thinking and assess the teacher's capacity also to listen and to make instructional moves that help students' mathematical thinking progress. The first step in learning to do this is for principals to take every opportunity they can to learn to listen to students' mathematical thinking, themselves. There are a number of ways to do this:

- Observe a good math teacher or two in your school, from a stance of curiosity and interest in learning, rather than being critical, and then talk to them afterwards about what the students were thinking about and why the teacher responded the way she did. Teachers are likely to be quite happy to have you visit their classes in this way.
- Sit in on professional development for teachers – especially sessions that use artifacts from classrooms – videotapes, student work, etc.—to help teachers, themselves, learn to understand students' mathematical thinking.

Of course, there is much to learn about how and under what conditions new instructional methods work, how to support teachers as they develop new instructional skills, and how to integrate the commitment to high quality mathematics instruction with the demands of high-stakes tests. But the foundation for all of these is listening carefully and knowledgeably to students' mathematical thinking.

### References

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