

## **HOW ELEMENTARY SCHOOL PRINCIPALS WITH DIFFERENT LEADERSHIP CONTENT KNOWLEDGE PROFILES SUPPORT TEACHERS' MATHEMATICS INSTRUCTION**

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I have known the difficult part of instructional supervision from a teacher's perspective for twenty-five years ... Perhaps there may come a day when the annual "dog and pony show" does not occur, when my stage fright doesn't need to put in an appearance, and when my supervisor truly does help me to understand what I do and why I am doing it. More poignantly, when he or she cares as much as I do about what I am doing and why I am doing it.

(sixth grade teacher, interview)

Classroom observation and teacher supervision is an important part of the life of schools. From the teacher's point of view it can be an opportunity for one's principal to get to know one's work and provide opportunities for continued learning; or it can be an ordeal. From the principal's point of view it can be an opportunity to understand what is going on in mathematics classrooms in his school and to offer help to teachers; or it can be a perfunctory process of filling out a checklist.

In recent years a number of theories about classroom observation and teacher supervision have informed how principals do this work. Such theories include: looking for teacher behaviors that are statistically correlated with high student outcomes (Acheson & Gall, 1980; Hunter, 1984; Joyce & Showers, 1988); encouraging teachers to set goals for themselves and be reflective about their teaching (Garman, 1986; Zeichner & Liston, 1987); attending to the lesson content and known "best practices" for teaching that content (Nelson & Sassi, 2000; West & Staub, 2000). The latter is becoming increasingly important and is affected by principals' actual

knowledge of the subject matter and beliefs about how it is learned, and how it is best taught.

In a 2003 article in the journal *Education Evaluation and Educational Policy*, Stein and Nelson showed that principals' "leadership content knowledge" (LCK) – their knowledge of subject matter and their beliefs about how it is learned (and therefore how it should be taught) – affects how principals conduct many aspects of their work. Stein and Nelson argued that principals' LCK affects not only the ways they conduct classroom observation and teacher supervision, but also their decisions about hiring teachers, their implementation of district curricular policies, the nature of their communications with stakeholders about instruction, and more.

Because classroom observation is such an important part of school life, we recently conducted a study to determine the role principals' LCK plays in their observations of mathematics classrooms and conferences with teachers. We were particularly interested in how different LCK *profiles* – particular combinations of principals' mathematics knowledge for teaching and their beliefs about mathematics learning and teaching – affected principals' goals for mathematics instruction and their approaches to the supervision of teachers.

### **The Study**

In our study, *Thinking about Mathematics Instruction*, we administered an LCK survey to 485 elementary and middle school principals in eight different states. Forty-four percent of the principals worked in or near large cities, forty percent in or near mid-sized cities, and the remainder in small towns or rural areas. (Note that the names of all principals, teachers, and students used in this article are pseudonyms.)

The survey measured two major components of LCK: mathematics knowledge for teaching and beliefs about mathematics learning and teaching. We assessed principals' mathematics knowledge for teaching by analyzing their reasoning about a set of math problems appropriate to the elementary and middle school grades. By "mathematics knowledge for teaching" we mean the specialized mathematical knowledge that teachers need, for example, to interpret unusual

student answers, anticipate students' difficulties with the mathematics, and choose mathematical tasks and representations that will promote students' learning (Ball, Hill & Bass, 2002; Hill, Schilling & Ball, 2003; Hill, Ball & Schilling, 2004). Our measure of mathematics knowledge for teaching included items about number, operation, and functions developed by Ball and her colleagues as well as six "naked number" computations. We measured principals' beliefs about high quality mathematics instruction by asking them to indicate the degree to which they agreed with statements about mathematics instruction and by asking them to interpret several teaching "moves" that were described in a vignette about a mathematics discussion in a fourth grade class (Schifter, Bastable & Russell, 1998).

We analyzed principals' knowledge and beliefs on two dimensions: 1) level of mathematics knowledge for teaching; and 2) beliefs about how students learn mathematics. We determined principals' level of mathematics knowledge for teaching relative to the sample as a whole (low, medium, and high). We categorized principals' beliefs about mathematics learning and teaching in terms of a continuum ranging from a focus on teachers' demonstrating for students how to perform procedures to a focus on teachers helping students make conceptual sense of mathematical ideas. Every principal in our study was given both a mathematics and a beliefs score; the pair of scores constituted their *LCK profile*.

In a second phase of the study, we conducted case studies of a subsample of 13 of these principals. We strategically selected this group on the basis of their LCK profiles to investigate the relationship between their LCK as measured by the survey and how they made judgments about the quality of math instruction in their daily work. We made three multi-day visits to each principal in the case study group, focusing our visits on the principal's practice of classroom observation and teacher supervision. In order to standardize data collection as much as possible, the same interview and observation protocols were used at all sites. All interviews and conferences were audio-recorded and ethnographic field notes were made of classroom observations.

## Results

In this article, we discuss only data from the second part of the study (i.e., the case studies). (Interested readers can find a discussion of the quantitative findings in Jordan, Goldsmith, & Miller, in preparation.) Data from our case studies of elementary principals at work in their schools show that principals with different LCK profiles use very different criteria when evaluating mathematics classes (see Nelson, Weinberg, & Heuer, in preparation). Their LCK for mathematics affects what they notice and value when observing math classes, what they talk about with teachers during post-observation conferences; and how they interact with teachers during those post-observation discussions. Principals with different LCK profiles also provide very different kinds of support for teachers. Two contrasting examples are presented below.

### Harriet Mussel

Ms. Umsel's LCK scores on the paper and pencil survey placed her in the top third of our sample for her mathematics knowledge for teaching. Her "beliefs" score indicated she viewed mathematics learning as a sense-making enterprise and thought it was important that mathematics instruction emphasize conceptual development and the construction of students' own understanding. As we might expect of a principal with this LCK profile, Ms. Umsel believed that children are continually developing their mathematical ideas and thought that a primary task of teachers was to learn about the mathematical thinking of the students in their classes and plan for mathematical questions or tasks that would push their thinking forward. Armed with these beliefs about the nature of mathematics learning and teaching, and her relatively high mathematics knowledge for teaching, when she observed mathematics classes, Ms. Umsel paid close attention to the students' mathematical thinking and how the *teacher* paid attention to that thinking and intervened to pose questions or tasks that would encourage further conceptual development.

One of the math lessons we observed with her was a 4<sup>th</sup> grade lesson on comparing decimals in which students, working in pre-assigned pairs, compared several pairs of decimal numbers and

analyzed which of each pair was the larger. The teacher invited them to use any of a number of strategies for this work – for example, visualizing the two numbers, using a 10 x 10 or 100 x 100 number grid, or using a number line. While observing this class Ms. Umsel noticed that two students had come upon the idea of equivalent decimals and that the teacher, in observing their work, noticed that they had and gave them additional questions to focus their attention on that idea. As Ms. Umsel told us later,

Susan and her partner, Jennifer, were really understanding what they were doing. ... Susan had said to me, “You know, I think we have some equivalent decimals here.” And I said, “Well how could that be, how could that be?” She said, “Well, like you could have .3 and that you could have .30 and it’s really the same thing.” [The teacher] stopped by and wrote a question for them and the question was: “Are  $\frac{5}{10}$ , .5, .05,  $\frac{5}{100}$ s, and  $\frac{50}{100}$ s the same?”

(interview, third visit)

Particularly striking about Ms. Umsel’s observation was its mathematical specificity. She was able to tell us exactly what the students had said about equivalent decimals and what the teacher posed as the new task.

In the post observation conference Ms. Umsel asked the teacher what mathematical ideas had been central to the lesson. The teacher liked having been asked this question, saying,

[That’s] a really interesting thing to think about. ... The math book talks about ... math focus points, and you can have learning goals and you can have objectives, but thinking about the central ideas is ... really the most important thing, and it can sometimes, I think, get covered up. ... Instead of just thinking, “What do I want?” “What are the benchmarks for this lesson?” “What do I hope that all kids would be able to do?” ... Thinking about where we are headed mathematically. What do we want them to be able to understand?

(interview, third visit)

The teacher went on to comment on the fact that decimal numbers represent parts of a whole and are “always based on tens, unlike fractions, and that they could be broken apart into tenths and hundredths.” The teacher and Ms. Umsel also

discussed Susan and Jennifer's discovery of equivalent decimals in their set of decimal numbers, their solid understanding of what equivalency meant, and what this indicated about their mathematical understanding.

*What* Ms. Umsel chose to talk about with this teacher (and the other teachers we observed with her) was the mathematical ideas of the lesson and the mathematical thinking of the students in the class, focusing on the details of student thought and working with the teacher to tease out what students understood, and didn't understand, about the mathematics. *How* she engaged in these discussions with teachers indicated that Ms. Umsel appeared to view teacher knowledge as constructed, by the teachers themselves, in response to what they observed in their classes and the discussions they had with the principal about those classes. By engaging teachers in open-ended discussions about the students' mathematics, as she did in all of the post-observation conferences we observed, Ms. Umsel provided them the opportunity to continue to develop their own understanding of students' mathematics and of mathematics instruction. Both the content of these discussions and their collaborative nature would likely have helped teachers improve their own abilities to attend to and analyze students' mathematical thinking, and also to move toward using these analyses as a basis for the planning of future lessons.

### Edward Lewis

Mr. Lewis's LCK scores on our pencil and paper survey indicated that his mathematics knowledge for teaching was in the lower third of the sample. They also indicated that he believed that students learn mathematics through teachers' clear and accurate demonstration of mathematical ideas and procedures, together with opportunities to practice. Mr. Lewis also believed that students should have the opportunity to be active and engaged in math class. In his discussions with our project staff about mathematics learning and teaching, he emphasized the importance of teachers' engaging students through lively pacing, hands-on activities, and highlighting of connections to real world applications. However, Mr. Lewis did not appear to see such activities as related to specific

mathematics content. Rather, his interest in student activity and discussion was prompted by a concern that students be motivated to participate in class and feel successful.

When doing formal observations of classroom teaching, Mr. Lewis oriented toward the presence (or absence) of particular instructional strategies. These characteristics of lessons were generic; that is, they were relevant to the teaching of any subject, rather than being mathematics-specific, and did not require attending to the mathematics of the lesson or students' mathematical thinking. He described an observation form programmed onto a hand-held device that he used when doing walk-throughs of classes.

The initial screen is focused on basically these eight areas. ... We just look at are they teaching to the objective? Is it right on target for their grade level, based on the standard course of study? Which level of ... Bloom's [taxonomy] is it being taught to? And then are your texts and materials aligned to that objective? Then you look at what the teacher's doing, the strategies that the teacher uses to teach. And according to Robert Marzano, there are nine high yield teaching strategies ... that lead to student achievement ... So those nine things are in here. So those are things that you're looking for as you are in the room. Then ... we're looking at four levels of engagement. Where are the students? Where are the majority of the students? And then we look at the learning environment. Is the classroom conducive to teaching those areas?

(interview, first visit)

Mr. Lewis took it as his responsibility to be knowledgeable about these "best practices" and to ensure that the classrooms in his school were in alignment with these standards of practice.

When he conducted post observation conferences, Mr. Lewis asked teachers questions about how they thought the lesson went, what they felt worked well, what they wished they had done differently, and whether they thought they had accomplished their goals for the lesson. None of his questions asked the teacher about the mathematics itself, but, rather, focused on pedagogical processes in use in the classroom. He

was particularly interested in students having the opportunity for group work, which he saw as providing an opportunity for students to participate because they had the right answer, not as a context in which mathematical thinking could develop. He praised one teacher for her use of group work, as follows:

Something that you do well, and I noticed the other day ... is that you have really taken to those ... engagement strategies, and setting it up so that the kids have the chance to talk with their buddy prior to you calling on them. Or having a chance to work it out so that they all have a chance to get the right answer, versus only being one or two that always gets to go up [to the board]. ... That is helping some of those kids raise their hand and be willing to step out and be involved, where as they weren't always doing that last school year. (interview, first visit)

While informing teachers of his thoughts about the effectiveness, or ineffectiveness, of their instruction does provide them with information about his values for mathematics instruction and provide encouragement for them to engage in generic "best practices," Mr. Lewis did not help teachers further understand the mathematics they were teaching or what the students in their classes understood (or not did not understand) about that mathematics. Neither did he discuss the pedagogical rationale for the instructional strategies that he was hoping teachers would use, or the relationship between those strategies and student understanding. By not linking his views of effective instruction specifically to student learning and mathematics instruction, he lost the opportunity to help his teachers examine how their own practice contributed to their students' understanding (and, therefore, to consider ways to be more effective at promoting student learning).

### **Implications**

What principals know about mathematics and believe about how it is learned, and therefore how it should be taught, matters. Ms. Umsel and Mr. Lewis noticed very different things in the classrooms they observed, valued very different things, and were in the position to support teachers in very



different ways. Mr. Lewis was able to point out to teachers whether they were using “best” pedagogical practices, but because he did not discuss the mathematics with them he did not help them judge whether their use of those pedagogical practices was having the effect on students’ knowledge that they hoped for. Ms. Umsel’s ability to attend to students’ mathematical thinking put her in the position to encourage teachers to attend carefully to students’ mathematical thinking, analyze it, and use that analysis to plan the next teaching move.

Research by Ball, Hill, and their colleagues has shown that teachers’ mathematics knowledge for teaching has a significant impact on student achievement (Hill, Rowan, & Ball, 2005), positively predicting student gains in mathematics achievement. Principals who use the process of classroom observation and teacher supervision to support teachers in developing and using their mathematics knowledge for teaching, as Ms. Umsel did, may therefore indirectly enhance students’ mathematics achievement.

However, attending to the mathematical content of students’ thinking and how instruction intersects with that thinking is a focus that few principals have been trained to attend to in classroom observations. If they could develop this orientation, it would be helpful to teachers. Some activities the principals we studied have used to improve their own knowledge include: 1) attending professional development for teachers that focuses on students’ mathematical thinking in order to get some experience attending to this aspect of a mathematics class; 2) observing math classes taught by expert teachers for the purpose of learning about students’ mathematical thinking and instructional strategies in mathematics; and 3) working with math coaches on observing mathematics classrooms.

Many principals use the process of classroom observation and teacher supervision to monitor the overall status of math instruction in their schools as well as an opportunity to help particular teachers improve their instruction. Principals also can use classroom observations as an opportunity to learn, for themselves, about how students learn mathematics and how it can be best taught.

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