NATIONAL COUNCIL OF SUPERVISORS OF MATHEMATICS

NCSM JOURNAL

of Mathematics Education Leadership

VOLUME 10, NUMBER 1 SPRING 2007

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The Interpersonal Side of Professional Development in Math

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What makes a successful professional development experience for elementary school math teachers? For over ten years, TERC's Investigations Workshops leaders have facilitated week-long professional development workshops across the country to support K-5 teachers implementing the *Investigations in Number, Data and Space* mathematics curriculum (Russell, Tierney, Mokros, & Economopoulos, 2006). *Investigations* emphasizes depth in mathematical thinking and reasoning, helping students develop flexibility in their approach to problem-solving, fluency in using mathematical skills and accuracy in evaluating solutions to problems. Engaging teachers in mathematics is a complex task. Many elementary school teachers learned math within a traditional curriculum — one that emphasized memorization and procedure over understanding (National Research Council, 2001). Consequently, elementary school teachers implementing *Investigations* and other programs that emphasize deep mathematical thinking are often uncomfortable with math or have gaps in their knowledge (Ball, Hill, & Bass, 2005). Moreover, some teachers mistrust the math content and pedagogy, doubting that changes will endure.

Consider the three-digit by one-digit multiplication problem 486 x 5. A traditional teacher might approach the problem by writing it this way:

$$\begin{array}{r} 486 \\ \times\ 5 \\ \hline \end{array}$$

The teacher may start out showing students to multiply the 5 by the 6, write the 0 and 'carry the 3' and then proceed to multiply 5 by 8 and by 4. We would like teachers to think of the problem in a variety of ways. For example, as 'half of 486 x 10' (or use estimation, noting that 4,860 is close to 5,000 so the answer should be just under half of 5,000; under 2,500) and solve it quickly, mentally, using both estimation and number sense. Or taking into account the value of 486, and multiplying as follows, 5 x 400 (2,000), 5 x 80 (400) and 5 x 6 (30), rather than breaking 486 up into three disconnected digits (4,8, and 6). To approach problems in these ways teachers need opportunities to solve them on their own, hear others' strategies, and develop a deeper understanding of the mathematics and an understanding of children's math thinking. This will enable them to question perspectives and strategies and facilitate children's learning as they guide them towards efficiency, accuracy and fluency.

Because the approaches that *Investigations* takes are often different from what's familiar to teachers, they may be apprehensive about attending professional development for *Investigations*. In addition to comfort with the math, teachers' attitudes and enthusiasm for attending professional development often depend on their involvement in the decision to select a curriculum for their district. As a result, some teachers arrive at workshops on guard, reluctant to attempt challenging math problems or eager to defend the math content and pedagogy that they find familiar and comfortable. So while Investigations Workshops focus on math content and pedagogy, leaders must tackle much more. To engage teachers, leaders must address all the dynamics that affect participation. Navigating this interpersonal dimension of professional development is among the most daunting and unpredictable aspects of facilitating sessions. To explore this issue we first review the literature on math professional development and then share three vignettes illustrating

interpersonal challenges that arose at Investigations Workshops and how leaders addressed them. Each vignette raises ideas and questions with implications for professional development.

Recent research sheds light on what elementary math teachers need to know in order to convey math concepts to a diverse range of learners and how professional development can help build this knowledge. Mathematical knowledge for teaching goes beyond math content and computational accuracy. It also includes the "ability to unpack mathematical ideas, explain procedures, choose and use representations, or appraise unfamiliar mathematical claims and solutions" (Hill & Ball, 2004, p. 335). In addition to subject matter knowledge, this specialized teacher knowledge predicts student math achievement (Hill, Rowan, & Ball, 2005). These findings underscore the need for professional development intended to improve mathematical knowledge for teaching. For instance, in the multiplication example above, deep understanding of place value, estimation, and mental math is vital for understanding and supporting children's thinking. A growing body of literature highlights characteristics of effective professional development, such as an emphasis on math as embedded in the curriculum, strategies for teaching that math, and children's mathematical thinking (Loucks-Horsley, Hewson, Love, & Stiles, 1998; Cohen & Hill, 2001; National Research Council, 2001; Hill & Ball, 2004). Additionally, teachers in effective programs actively challenge their own and each other's thinking. Opportunities for teachers to reason, analyze, and communicate about math have been linked to gains in mathematical knowledge for teaching (Hill & Ball, 2004).

Modeling the constructivist pedagogy of the *Investigations* curriculum, our workshop leaders ask participants to solve problems and explain their reasoning in nontraditional ways, using manipulatives, representations, and mental strategies. In effect, leaders often ask teachers to confront their discomfort and challenge their reasoning. This can be scary, especially when participants find themselves in an unfamiliar setting, surrounded by new faces, as is often the case. Some participants must also adjust to a workshop that differs from their expectations. Many teachers arrive secure in their ability to solve and teach problems involving the four basic operations. They come anticipating an opportunity to add a few new ideas to their existing approach. Instead, by introducing unfamiliar constructivist pedagogies, we ask them to reconsider their whole foundation, a daunting task. Shulman (2000) notes, "When you begin to wrestle with people's deeply held, private intuitive theories, you are engaging them in a process that is as deeply emotional as it is cognitive. This is why conceptual change is so difficult to negotiate. When there is no pain, I suspect there has not been much conceptual change. The emotional aspect is something we have to learn to deal with" (p. 131).

Professional development leaders must understand the goals they and their participating teachers are working towards, and must recognize conditions that enable change. These are important steps. Yet many leaders still grapple with the delicate balance between forging ahead with the mathematics and pedagogy and attending to the emotional and interpersonal challenges that arise in professional development contexts (Miller, Moon, & Elko, 2000; Schifter & Lester, 2005). How can leaders promote norms of trust, respect, and active learning? How can they address resistance constructively? Teacher leaders know that the success of professional development sometimes hinges on these relationship variables.

During the past ten years, Investigations Workshops leaders have faced many interpersonal challenges and successes. Through debriefing sessions and conversations at annual leaders' retreats, leaders have identified and explored patterns in their experiences. Collectively, they have amassed a toolkit of strategies for addressing common challenges.

ALINA'S VIGNETTE:
Engaging a Reluctant Participant

Alina's vignette highlights the importance and the challenge of accommodating individual differences in adult learners' participation styles.

It is the second day of a week-long workshop, and I am reading the "exit cards" that my participants completed as they left. One of the questions I posed was: What have you discovered about yourself as a learner? The card before me reads:

> *Did you notice that I sat in the back of the room with my arms crossed the first morning? Did you notice that I didn't talk at all in the large group until this afternoon? I was uncomfortable with the mathematics. And now we have completed our second day, and I found myself talking excitedly in my small group and I even shared my idea with the large group. Boy, that felt scary. Almost like*

jumping off the side of the pool into cold water. But now that I'm in, I have so much to say.

And I am thinking, *Yes, I did notice…*

In my role as a professional development facilitator, I need to consider both the goals of the professional experiences I offer and the needs of individual participants. A question that is always at the forefront is: How can I create an environment that supports the disequilibrium experienced during the construction of new understandings? This question demands consideration of how my facilitation supports and values the contributions of all teachers, even those who are reluctant to participate.

On day one, I greeted Shelly, who sat in the back. I gave her time and space to settle in. On the second day I grouped Shelly with people with whom I had seen her interacting and put the group at a middle table. When I shared some comments from the previous day's exit cards, I included one of hers. As I circulated during small group time the second day, I heard her share an idea with her group. I asked them to consider sharing that idea during the whole group discussion. Although Shelly didn't offer to speak, a member of her group began the sharing by saying, *"Shelly said…"*. In this way, Shelly's idea was made public. As the week progressed, Shelly became more animated and engaged. She stayed after our session on the fourth day to discuss a mathematical idea with which she was struggling.

Each new workshop brings a group of learners with a range of experiences in mathematics content and pedagogy. It is crucial that my first interactions with participants allow multiple entry points for connecting with our work. I must also establish an inclusive rapport and express genuine interest in their needs and ideas. Realizing that this type of learning environment must be carefully orchestrated, I:

- greet each participant before we begin each session
- begin sessions with time to reflect on prior learning and personal goals
- learn names and use them throughout the sessions
- ask participants to share concerns and questions on exit cards each day
- acknowledge and address those concerns as soon as possible
- model equity and respect
- maintain a brisk pace that also allows for adequate wait time and reflection
- discuss group norms and post them prominently
- listen carefully to participants' ideas in both small and whole group discussions
- honor the group's valuable time by focusing on their learning
- avoid external affirmation and foster intrinsic motivation through interesting and challenging tasks
- share my enthusiasm for learning as well as my interest in their ideas

On that first day, I could have interpreted Shelly's demeanor as disrespectful and her disengagement as confrontational. But to ensure that all participants engage with workshop goals, I must find a way to connect their needs, identify where they are, and offer them a way to enter our work. This is my responsibility as their facilitator. Once I offer them a safe place to try out ideas, opportunities to push their thinking, and authentic interest in their ideas, I begin to see the development of a learning community that values rigorous thinking and is willing and ready to pursue some common goals.

ALINA'S VIGNETTE: Discussion

Contemporary educators recognize the value of personalizing schools to ensure that every child feels safe, welcome, and heard. Alina's experience with Shelly underscores the need to also personalize adult learning environments. Effective leaders "know that principals and teachers will only be mobilized by caring and respect, by talented people working together, and by developing shared expertise" (Fullan, 2001, p. 63). Nurturing the dynamics that enable strong learning communities to emerge and thrive is, for many, one of the most difficult leadership challenges. Since every group is different, there are no easy recipes for building community and fostering active learning. We can't always pluck the strategies used in one setting and apply them in another. Often, however, the experiences we have in one setting provoke questions relevant to other contexts. Alina's experience raises recurring leadership questions, such as:

- How can leaders accommodate diverse participation styles?
- How can we identify and respond to individual participants' concerns?
- How can we help each participant to feel recognized and valued?

There are times when even the most seasoned leaders walk away from a leadership experience feeling that they didn't build an effective learning community. The group didn't gel. Some participants seemed disengaged. The leader wonders if she inadvertently offended someone, undermining the supportive rapport she was working so hard to maintain. We often dwell on these disappointments, grappling with the tough questions they raise. This is important work, but revisiting positive experiences is worthwhile too as it enables us to wrestle with important leadership questions unencumbered by the emotional baggage of a disappointing experience. Positive experiences also give us hope, motivating our work and our efforts to improve. Alina's experience drawing initially reluctant participants into a learning community illustrates the assertion that professional development "can also be a vehicle for strengthening culture" (Loucks-Horsley et al., 1998, p. 185).

SAMANTHA'S VIGNETTE: Encouraging Open Minds

Samantha's vignette illustrates one way to address resistance to change, by acknowledging participants' stances first and then facilitating activities that challenge their thinking. In discussing factors that influence people's willingness to learn and change, Stone, Patton, and Heen (1999) write, "[People] are more likely to change if they think we understand them and if they feel heard and respected. They are more likely to change if they feel free not to" (p. 138).

We were at a workshop the summer after the participating teachers had struggled for one year to implement a curriculum that they did not fully accept or understand. This was their first professional development opportunity in support of the implementation. Many teachers were upset; the most outspoken earned a reputation in the district and at the workshop as the "vocal" group. I worked with the fifth grade teachers, who I had been warned were very angry. I know from working with other groups that participants really need to understand that I am there to support their progress.

I started the first session by addressing their feelings. As a former fifth grade teacher, I agreed that they had a tough job; teaching fifth grade math involves working through challenging mathematics concepts. I also acknowledged that their students had the least exposure to the math program, having had no opportunity to build the foundation established in the earlier grades. In short, these teachers experienced a trying year and I empathized with their frustration. I assured them that I would do my best to clarify the curriculum's content and pedagogy, but that I needed them to remain open to the ideas at least until day three. After that I would address all their concerns.

In essence I asked them to have faith in me for three days. If they didn't see a reason to give the workshop ideas a chance we could talk again on day three. As I spoke, I watched some heads nod and some participants' arms unfold and relax — small, but meaningful, signs that they were with me, and our work could begin.

The three-day agreement was a gamble because it often takes a fourth day for the workshop ideas to come together. In this case, day three came and went without incident. Teachers explored challenging math content, asked thoughtful questions, and worked together to build their understanding. By the end of the week, the fifth grade teachers, initially closed and angry, were willing to try *Investigations*. In their exit cards, the "vocal group" even expressed plans to listen to students' mathematical thinking and ask probing questions. They no longer dreaded the curriculum.

SAMANTHA'S VIGNETTE: Discussion

Ideally, professional development can prepare and energize teachers for change. But what happens when professional development comes in the wake of an unpopular change—one in which teachers had no say and no professional development support? Such conditions are often a recipe for anger. After all, teachers should have a voice in administrative decisions. They *should* have the support they need to implement new curriculum. In acknowledging teachers' frustrations, while preserving workshop goals and structure, Samantha displayed "tough empathy" (Fullan, 2001, p. 63). She also pulled off a difficult balancing act. She had to consider how to acknowledge participants' frustration, without allowing an angry mood to cloud her sessions and interfere with learning.

Additionally, by promising to revisit teachers' concerns if, by day three, they still did not find value in the curriculum, Samantha restored a critical component of the group's security — participants' sense of control. As leaders, we cannot change participants; it's our job to set the stage, facilitate learning, and help participants take control of the process.

While, in this case, Samantha's frank discussion sparked the group's willingness to learn, it is important to consider the risks and challenges of her approach. At what point does a discussion of frustrations become counterproductive? After acknowledging angry feelings, how can leaders help a group transition into constructive activities? If a leader requests that participants keep open minds for a few days, is the leader prepared to address a potential onslaught of concerns on the designated day? There are multiple ways to recognize feelings and invite feedback. The challenge is to do so without abandoning learning goals.

Exit cards, distributed in between sessions, provide one alternative strategy for soliciting feedback. Participants sometimes write comments on exit cards, such as "I like it much better when I show students how to solve a problem. This way I don't have to know all the ways in which a problem can be solved." or "This may work with the students in (the video), but my students…." These exit card comments illustrate participants' misgivings about making change and they provide leaders with an opportunity to address concerns that teachers might not raise in discussions. In addition to verbally acknowledging exit card comments, leaders can set up activities that allow teachers to explore the very issues that they are most concerned about. For example, teachers who initially believed that there is one 'best' way to solve a problem may begin to shift when they hear their peers solve 486 x 5 in a variety of efficient ways, as described earlier. Likewise, examining a diverse array of real elementary students' work and identifying learning goals to build each student's understanding, helps teachers begin to understand how they can meet the needs of the range of learners in their classrooms.

JASMINE'S VIGNETTE: Respectful Language

Jasmine's vignette emphasizes the importance of addressing equity issues in a session.

As a professional development leader, and as an African American female, I am aware that equity and respect issues emerge in professional development settings and need to be handled thoughtfully. These situations are difficult. The leader must keep emotions in check and avoid judgmental or defensive responses.

While facilitating the final session of a week-long workshop I found myself in a difficult situation. From day one we had established an open and safe environment. Participants felt free to express concerns, and I did my best to acknowledge and address their concerns. I was ending the final session when a participant commented on rubrics and scores. She referred to students who scored 1s as "the lows and the slows." Her tone suggested it was a routine phrase or possibly a joke among some teachers. I was appalled to hear students referred to so derisively and I assumed others in the room shared my discomfort. (She was an African American teacher and I had a strong feeling that she works with predominantly African American students.)

I had to think about how to respond without making it seem like I was attacking her. Finally I said, "I am concerned about the comment referring to students as the lows and the slows. We need to be careful about what we say about children, even to each other. You would be surprised at how many times the students hear what we say and that our remarks can have a long lasting effect on them." My comment seemed to be received okay — people seemed to listen and nod in agreement — and I hoped that using a "we" statement and not "you" deflected some of the judgment in my response.

I ended the session feeling that the last few minutes had gone in a direction that I did not anticipate. It could easily have turned into a nightmare. It was the end of the week. We were all tired. I could have let the comment slide, or worse, I could have botched the response with a harsh remark expressing my disgust. Throughout the week, in each session, we stressed that all children can learn math and talked about how to meet the needs of the range of learners in our classrooms. We used student work to assess each child's mathematical understanding and discussed our next steps as teachers. How then could a participant use assessment to label students in such a derogatory manner? I was astounded.

Having participated in discussions with fellow leaders about handling difficult issues, I was able to think on my feet and respond to the comment in a way that respected the speaker, the group, and the children who we were all there for.

JASMINE'S VIGNETTE: Discussion

Jasmine responded to a troubling comment without alienating the speaker or undermining the group's unity. She recognized her responsibility to model respect and she paused to carefully select an appropriate response. To a

leader, those silences can feel eternal, but in enabling reflection and careful word choice, a long pause can mean the difference between havoc and harmony.

Teachers know that when an unexpected or tense incident occurs in the classroom—a child teases a classmate, a visitor drops in, equipment crashes to the floor—all eyes turn to the teacher. Children gauge their teacher's reaction and her response informs their own. This phenomenon, social referencing, begins in infancy and endures throughout the lifespan (Schaffer, 1996). When a contentious comment is made at a workshop, participants are likely to glance at each other and, most of all, to study their leader. Just as teachers must maintain composure in their classrooms —perhaps fighting the urge to roll their eyes as yet another announcement airs over the loud speaker — professional development leaders must constantly model respect with adult learners. This responsibility raises questions for leaders. In addition to our language, are we aware of our facial expressions, body language, and tones of voice? What factors influence our ability to react — a group's diversity, time, experience, beliefs? How do our experiences, race and ethnicity, socioeconomic backgrounds, and values affect our reactions to what we interpret as insensitive remarks?

As leaders, we are always being observed and our actions — or inaction — may be mirrored by those around us. It is easier to let an insensitive comment slide, but addressing it is an imperative part of modeling respectful practice. We cannot expect teachers to focus on math when they are distracted by a remark that puts down children.

Jasmine's vignette also illustrates that building a respectful community is an ongoing process, not a finite task limited to first days or ice-breakers. As a group's time together draws to a close, particularly in cases where members have bonded, some people will experience anxiety or a sense of vulnerability (Tuckman & Jensen, 1977). In responding to any situation near the end of a workshop, leaders must be careful to respect the delicate emotions that participants may experience as they prepare to leave the group.

Conclusion

Standards-based mathematics is a hard sell because many teachers are skeptical, overworked, and reluctant to make changes in their mathematics practice. Further, some teachers are uncomfortable with the math. While these obstacles make professional development work difficult, they also underscore its importance. When we have an opportunity to impact the way teachers teach and think about math, it is vital that we do it right. As with all types of teaching, facilitating professional development is about content, but it's also about being in touch with the participants. To maximize the impact of professional development on mathematical knowledge for teaching, we must be ready to address dynamics that can distract from the mathematics. While the Investigations Workshops focus on mathematics content and pedagogy, our leaders know that they must also focus on the intra- and interpersonal factors that affect participation.

There are many ways to handle any situation. Each approach carries potential risks and benefits. The three vignettes illustrate situations that can impede or facilitate growth and learning, depending on how they are handled. Alina reached out to a reluctant participant by creating a learning environment that accommodated different participation styles. Samantha faced the challenge of empathizing with participants' frustrations without letting their anger interfere with learning. Jasmine modeled respect by responding to an insensitive comment, while maintaining a positive rapport with the group. Reviewing relevant literature, sharing experiences, and problem-solving together helps facilitators build a repertoire of leadership strategies, so that when situations arise, they are better prepared to select a constructive response. A successful professional development experience involves more than content. As the three vignettes show, to get to the math we must also attend to the needs, emotions, and comfort levels that affect teachers' enthusiasm for learning math content and pedagogy.

Those leading professional development workshops, like Alina, Samantha and Jasmine, benefit greatly from discussions around hard issues. Making time for those discussions to take place among leaders is critical. While each group is different and the issues that surface in any given session may vary, it is helpful to think in advance about how or whether to address potential challenges. Before a workshop, learn about the group you will be working with. Even if they are from your school or district, each group has its own idiosyncrasies and character. When starting a session, work to establish a culture of trust. Participants will be 'with you' if they realize you are trustworthy and that it's okay to take risks and make mistakes. During your sessions, connect with the individuals as you would with students in a classroom — find out what the 'quiet ones' are thinking and provide opportunities for them to talk in small groups or pairs. Encourage partici-

pants to share strategies even when they hesitate or say that their approaches may be 'wrong.' If an individual or group's strategy does in fact reflect a misconception, ask questions that enable participants to rethink their approaches and build a stronger understanding. Explicitly communicate session goals and follow through. Don't be afraid to tackle and raise difficult issues, particularly those related to equity — those conversations are not easy, but they are critical if we believe that all children (and adults) can learn math.

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