Creating a Problem-Solving Atmosphere

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Our ongoing project involves twenty-three second-grade teachers who are teaching all their mathematics, including computation, through small-group problem solving and whole-class discussion. Typically the children first work on problem-centered mathematical activities in pairs or occasionally in groups of three. During this phase of the lesson, the teacher moves from group to group, observing and interacting with the children while they do mathematics. After fifteen or twenty minutes, the teacher asks the children to stop working and begins a whole-class discussion of their solutions to the problems.

These teachers are generally successful in creating what we call a “problem-solving atmosphere” in their classrooms. As a result, the children persist in attempting to solve the problems and do not worry if they are still on the first mathematical activity while other groups have completed three or four. They view mathematical problems as personal challenges and become upset if someone tells them the answer. They believe that mathematics should make sense, and they achieve personal satisfaction when they figure something out for themselves. Furthermore, they feel free to discuss their mathematical understandings both in their small groups and in the whole-class discussions, and they accept that their solutions should be explainable and justifiable (Cobb, Wood, and Yackel 1991; Cobb, Yackel, and Wood 1989).

To understand the teachers’ success, we shall focus here on the ways in which they communicate their expectations to the children and thus attempt to place the children under certain obligations for their conduct in the classroom (Voigt 1985). For example, one teacher expectation is that the children should explain how they understand and attempt to solve the mathematical activities. The following incident occurred on the first day of school in one classroom and illustrates how the teacher exploited a potentially damaging incident to communicate her expectations. The discussion centers on the following word problem:

How many runners are there all together? There are six runners on each team. There are two teams in the race.

**Teacher:** Peter. What answer did you come up with?

**Peter:** Fourteen.

**Teacher:** Fourteen. How did you get that answer?

**Peter:** Because six plus six is twelve. Six runners on two teams . . . (Peter stops talking, puts his hands to the side of his face, and looks down at the floor.)

**Teacher:** Would you say that again. I didn’t quite get the whole thing. You had . . . . Say it again, please.

**Peter:** (Softly, still facing the front of the room with his back to the teacher.) It’s six runners on each team.

**Teacher:** Right.

**Peter:** (Turns to look at the teacher.) I made a mistake. It’s wrong. It should be twelve.

Peter’s acute embarrassment at having made a mistake in front of his classmates confounded the teacher’s goal of having the children talk about their mathematics. She made an on-the-spot decision to use this incident to talk about her expectations.

**Teacher:** (Softly.) Oh, okay. Is it okay to make a mistake?

**Andrew:** Yes.

**Teacher:** Is it okay to make a mistake, Peter?

**Peter:** (Still facing the front of the class.) Yes.

**Teacher:** You bet it is. As long as you’re in my class it is okay to make a mistake. Because I make them all the time, and we learn a lot.

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from our mistakes. Peter already figured out, "Oops. I didn’t have the right answer the first time" [Peter turns and looks at the teacher and smiles], but he kept working at it and he got it right.

Here, in context, the teacher emphasized that Peter’s attempt to solve the problem was appropriate in every way. She demonstrated to the children that she was genuinely interested in their mathematical thinking and that they can learn from errors.

The teacher, also capitalized on situations in which the children acted in accordance with her expectations. For example, during one small-group problem-solving session a number of children had completed several problems, but one pair volunteered that they had spent twenty minutes working on a single problem.

**Kara and Julia:** Because at first we didn’t understand it.

**Teacher:** How did you feel when you finally got your solution?

**Kara and Julia (almost jumping up and down):** Good!

By calling this incident to the attention of the entire class and asking the two girls further questions about what had happened, the teacher demonstrated that she expected the children to persist and figure problems out for themselves. She tried to show them that they should take pride in their own accomplishments. In contrast, the teacher never drew attention to a group that had completed a relatively large number of mathematical activities.

In both these examples, the teacher acted as a practical reasoner who continually had to find ways to deal with the unexpected. She displayed her skill and expertise by using problematic classroom situations, such as Peter’s response, to further her goals for mathematics instruction. The manner in which the teacher negotiated her expectations with the children illustrates a crucial aspect of what it means to be an effective mathematics teacher.

The teacher’s expectations for the children during whole-class discussions included that each child be able to do the following:

- Explain how he or she understood and attempted to solve a mathematical activity that the group has completed
- Listen to, and try to make sense of, explanations given by other children
- Indicate his or her agreement or disagreement with solutions given by other children
- In the event of conflicting solutions, attempt to justify a solution and question alternatives and thus work toward the achievement of a consensus

In the small-group problem solving, the teacher expected that the children would do the following:

- Cooperate to complete the activities
- Agree on an answer and, ideally, on a solution method
- Explain their solutions to one another and listen to one another’s explanations
- Persist to figure out problems for themselves

During small-group problem solving in particular, the teacher had to draw on her expertise to help the children find ways to fulfill their obligations. For example, the children’s initial attempts to think things through for themselves and to explain their solution methods to their partners sometimes led to conflicts. If one child was trying to figure something out while her partner was simultaneously explaining his solution method, the first child typically complained to the teacher. The teacher then initiated a discussion to help the children take each other’s viewpoint into account. She might first ask each child what the difficulty was and then ask how they might resolve it. By giving the children the primary responsibility for their learning and conduct in the classroom, the teacher was generally successful in helping them develop productive working relationships.

Thus far, we have focused on the expectations that the teacher had for the children. The teacher also had to accept obligations for herself if she was to realize her expectations in the classroom. For example, the teacher had to accept the children’s explanations and justifications in a nonevaluative way if she wanted them to say what they really thought. The discussions came to a abrupt halt on the very rare occasions in which the teacher attempted to steer the children to a solution that she had in mind. The children failed to
volunteer solutions and, when called on, typically made excuses to avoid having to present a solution (e.g., "We didn't do that one" or "We forgot how we did it"). An open, accepting attitude in which the teacher assumes that the children's solutions make sense to them is a prerequisite for the creation of a problem-solving atmosphere during mathematics instruction. This crucial attitude is captured by asking, "What is this child trying to say and how is he or she thinking?" (Labinowicz 1987). We cannot overemphasize the importance of viewing children's solution attempts as expressions of their mathematical thinking that should be treated with respect rather than as examples of faulty thinking that need to be corrected.

In conclusion, we note that our view of teachers as practical reasoners implies that experiences of interacting with children in the classroom are vital to the development of the wisdom and judgment that characterize the expertise of successful teachers. The teachers we are working with are developing this expertise further as they make sense of classroom occurrences that arise as they implement a problem-solving approach. We are not translating theory into practice in the sense of telling teachers what they ought to do. In certain domains, the teachers are far more knowledgeable than we are for the simple reason that they have far richer experiences of interacting with children within the institutionalized constraints of the school. However, we have greater expertise in other domains. Thus, it is not a matter of transporting readymade theories into the classroom, but one of researchers and teachers learning from each other. In this way, theory and practice grow together, with each informing the other.

References


