Chapter 2: Creating an Environment for Learning Mathematics: Social Interaction Perspective

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Chapter 2

CREATING AN ENVIRONMENT FOR LEARNING MATHEMATICS: SOCIAL INTERACTION PERSPECTIVE

Terry Wood
(An overview of work by Cobb, Yackel, and Wood)

It was with the theoretical ideas about constructivists’ view of learning discussed in the preceding chapter that we began our collaboration with the classroom teacher. We met weekly in the spring before the teaching experiment year to discuss our theoretical perspective and to view selected videotapes of interviews with her students in the fall (cf. Cobb, Yackel, & Wood, 1991; Cobb, Wood, & Yackel, 1990). Although we communicated our intentions in discussions about the importance of problem solving for learning and the necessity of social interaction and class discussion, it was still the teacher’s obligation to enact these in the classroom. Admittedly we were well aware that children actively discussing challenging problems in primary grades was different from the way mathematics had been taught in the past, but we had not yet realized the extent to which these ideas would influence the practice of elementary school mathematics. These aspects—challenging problems, collaborative group work, and class discussion about students’ solutions—were, for the teacher, against tradition. It was accepted practice for her to initiate grouped settings and discussions in social studies, science, and reading, but she did not do this in mathematics. It was against this background that the classroom teaching experiment began.

AN EXAMPLE OF A MATHEMATICS LESSON

Typically a class session began with the teacher leading a brief introduction intended to insure that the children understood what they would be working on for the day. Once the teacher was satisfied that the children understood the intent of the activities, she then passed out the activity sheets and small-group work began. Children worked in pairs on activities, which were on sheets of paper that provided room for students to write. Each pair received one sheet to share in completing the activity. Generally three to four sheets, each containing four to six problems, were available for the students to work on. Some children completed all the activity sheets, whereas others only finished one. The problem solving as pairs generally lasted 20 to 25 minutes and was followed by a class
discussion of 15 to 20 minutes, after which the papers were collected by the teacher. During the small-group time the teacher initially moved about observing students as they worked. Once assured that all were working, she selected individual pairs to observe and listen to and intervened if necessary.

When it was time for class discussion, the teacher told the children to get ready because they would begin in one minute. The teacher began the discussion by writing a problem from one of the activity sheets on the overhead projector and then asked for volunteers to explain their solution to the problem. Pairs of children offered their explanations while the others listened. Following a pair’s explanation, other children could ask questions for clarification or justification. Because the emphasis of the discussion was on students’ solutions, on many occasions only a few problems were discussed.

On some days, the session might begin with a whole-class activity that would last 5 to 10 minutes. In this situation, the teacher would pose problems in activities such as “What’s My Rule?” These sessions would be followed by the session as described above. And on a few occasions, the lesson would consist of a whole-class activity such as Spatial Imaging (cf. Yackel & Wheatley, 1990) that was led by the teacher.

THE DEVELOPMENT OF SOCIAL NORMS

The expectations for children’s actions in the mathematics class were quite different from their previous experiences in school and in this classroom in other subjects (Wood, Cobb, & Yackel, 1990). In those situations, the students were expected to learn what the teacher wanted them to know rather than express their own thoughts (Edwards & Mercer, 1987; Weber, 1986). However, in this mathematics class it was necessary for children to express their thinking in order to create opportunities for learning and so that their existing constructions could be investigated by both the teacher and researchers.

Additionally, a cognitive constructivist perspective on learning necessarily implies ways of teaching in which children are acknowledged as active constructors of knowledge. These implications for teaching are as follows:

- Teachers should provide students with instructional activities that will give rise to problematic situations.
- Children’s actions, which are logical to them but may be irrational from an adult perspective, should be viewed as rational by the teacher.
- Teachers should recognize that what seem like errors and confusions, are children’s expressions of their current understandings.
- Teachers should realize that substantive learning occurs in periods of conflict, confusion, surprise, over long periods of time, and during social interaction.

These implications were not provided for the teacher as dictates of what she should do but were the logical outcome of earlier discussions about children’s learning (Cobb, Wood, & Yackel, 1990).
Using these premises of children’s learning as her guideline, the teacher initiated the mutual construction of a different set of norms for mathematics lessons as she acted to help the students reconceptualize their role during mathematics instruction. Her intention was for the children to figure things out for themselves and to express their ideas in the public arena of whole-class discussions. Additionally, during small-group work she expected them to cooperate and work together to solve problems and to agree on an answer. Her expectation that the children would express their thoughts placed the students under the obligation of having to recall their solutions and explain them to others during the whole-class discussion.

In small groups, the children were obligated to exchange ideas and solution methods and ultimately to agree on an answer (Yackel, Cobb, & Wood, 1991).

Conversely, if the teacher had expectations for the students, then she had to reciprocate and accept certain obligations for her actions as well. From the children’s point of view a certain amount of risk was involved in fulfilling the teacher’s expectations. A child thinking about how to solve a problem privately is one thing, but it is quite another matter to express those thoughts in a public setting. A child’s thinking in this situation can be publicly scrutinized and evaluated not only by the teacher but also by his or her peers.

**Norms for Class Discussion**

The nature of the teacher and student interaction that occurred within the whole-class discussion was crucial to establishing the social norms that were necessary for developing a setting in which the children would feel psychologically safe to express their mathematical thinking.1 The teacher’s intention as she led class discussion was to encourage children to verbalize their solution attempts. Situations like this give rise to possibilities for learning as students attempt to reconstruct their solutions (Levina, 1981) and resolve conflicting points of view (Perret-Clermont, 1980). The manner in which the mutual construction of the different norms for class discussion evolved is reflected in the early classroom interaction patterns, in which two levels of discourse occurred. At one level, they talked about doing mathematics, whereas at the other, they talked about talking about mathematics. On the occasions when they talked about how they were to talk about and do math, the teacher typically initiated and attempted to control the conversation. When they talked about mathematics, she acted to orchestrate and guide the discourse. The framework of the social norms created a setting for students in which their thinking was respected and they could say what they really thought. The following episode, which occurred

1. We have previously written fairly extensively about the development of the social norms and their importance in establishing an environment for children to learn mathematics meaningfully. Rather than repeat this work in this text, if the reader is interested in further details, the following articles may be of interest: Cobb, Wood, and Yackel (1990); Cobb, Wood, and Yackel (1991a); Cobb, Yackel, and Wood (1989); Cobb, Yackel, Wood, Wheatley, & Merkel (1988); Wood (1989); Wood & Yackel (1990); Wood, Cobb, and Yackel (1991); Yackel (1989); Yackel, Cobb, & Wood (1991); Yackel, Cobb, Wood, Wheatley, & Merkel (1990).
during the first week of school, illustrates how they mutually constructed the social context in which students could express their mathematical thinking.

The students were discussing a word problem that was shown on the overhead projector.

*Teacher:* Take a look at this problem, The clown is first in line. Which animal is fourth? *Peter.*

*Peter:* The tiger.

*Teacher:* How did you decide the tiger? ... Would you show us how you got the fourth?

*Peter:* (Goes to the front of the room and points to the screen). I saw the clown and then ... (He counts the animals to himself). Oh, the dog [is fourth]. (He hesitates.) Well, I couldn’t see from my seat. (He looks down at the floor.)

*Teacher:* Okay. What did you come up with?

*Peter:* I didn’t see it. (He goes back to his seat).

At this point, the teacher realized that although her intention was for him to give his solution, she had put him in the position of having to admit his answer was wrong in front of the entire class. Then the teacher initiated explicit comments.

*Teacher:* That’s okay, Peter. It’s all right. Boys and girls, even if your answer is not correct, I am most interested in having you think. That’s the important part. We are not always going to get answers right, but we want to try.

Her comments were focused on talking about how in this class they were going to talk about mathematics. In this example she told the students that thinking was valued even more than right answers. These mutual obligations and expectations were negotiated and renegotiated by the teacher and students as they established an interaction pattern that would form the basis for their activity. These mutually constituted patterns of interaction were taken for granted and made possible the smooth functioning of their collective activity.

In addition to expecting students to express their thinking, they were expected to explain and justify their solutions and listen to others’ explanations. Because the class discussion followed pair collaboration, the children were obligated to be prepared to give their solutions to the problems when called on. Being unprepared meant the rest of the class would wait while they redid the problem. Often this resulted in students losing interest in the discussion. As an example, in the following episode Barbara and Steve have come to the front to explain their solution to a problem involving adding the two-digit numbers 29 + 19 given in the context of a word problem. The teacher had asked Barbara to explain how she got her answer of 48. The pair began by writing on the board but providing no explanation. After a pause the teacher intervened:

*Teacher:* You two work on it. ... You whisper and figure it out for yourselves. Obviously, you don’t have it all quite worked out well enough to explain it to us. You got one answer but you’re not sure how you did it.

She turned to address the class as she made the last statement and called on another pair. In this way, she has made it very clear that when students explain
their answer, they must have agreed on the answer and solution in their small group before attempting to explain it to the whole class.

**Norms for Pair Collaboration**

The obligations and expectations mutually constructed during whole-class discussion also provided a framework for their activity as they worked in small groups. In this situation they worked to solve problems, to agree on an answer, and to respect each others’ ideas. In addition, there were norms for individual activity, including that the children figure out solutions that were meaningful to them, that they explain their solution methods to their partners, and that they try to make sense of their solving attempts. The teacher used the setting of the class discussion to explicitly discuss the nature of the students’ obligations. The following example illustrates the directive manner in which she conducted these discussions. She began the lesson by asking, “What are you going to be doing as you are working together?”

**Lisa:** Solve the answers.

**Teacher:** Find the solution. What else is your responsibility to you and your partner ... to each other?

**Ron:** Share.

**Teacher:** Share. What else, Adam?

**Dan:** Cooperate.

**Teacher:** Well, what if ... another responsibility?

**Children:** To agree.

**Teacher:** Not necessarily agree, but what else?

**Katie:** Well, if Ron and Charles are working together, if Charles got the answer, he’s supposed to tell Ron how he got that answer.

The mutual construction of classroom norms that has been described was crucial to establishing the setting for learning. Furthermore, in this classroom, because the children’s intention was to engage in meaningful mathematical activity with one another as they completed instructional activities (Yackel, Cobb, Wood, Wheatley, & Merkel, 1990), there was no need for an external reward system to motivate the children’s activity. In the terms of Nicholls (1983), they were task-oriented as opposed to ego-oriented and have developed what Kamii (1985) calls autonomy. Thus, children in the classroom developed both social autonomy, taking responsibility for their conduct, and intellectual autonomy, taking responsibility for their own learning (cf. Cobb, Yackel, & Wood, 1989).

**SUMMARY**

It became evident that a psychological perspective alone could not account for the complexity of the events occurring in the classroom. Establishing social norms that provided the setting in which children engaged in meaningful activity was an aspect of social interaction not considered prior to the classroom teach-
ing experiment. As these norms became accepted, the students participated in a type of discourse in which they were expected to explain and justify their solutions and listen to others. The teacher acted to initiate and guide students’ learning by posing questions and highlighting children’s expectations. As students engaged in this discourse, their personal meanings were negotiated until an agreement was reached. The establishment of taken-as-shared meanings between the participants enabled mathematical ideas to be established by members of the class.
References


Brown, G. (April, 1974). *Address to the International Conference on Confluent Education,* Santa Barbara, CA.


References


Erickson, F. (1986). Qualitative methods in research on teaching. In M.C. Wittrock (Ed.), Handbook of research on teaching (3rd ed.) (pp. 119–161). New York: Macmillan.


References


References


References


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