Teaching and Learning Creatively: Using Children's Narratives

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The Children's Math Worlds project seeks to integrate students' social, emotional, and cultural experiences into classroom mathematics. For seven years, we have been developing in classrooms a conceptually challenging research-based mathematics curriculum called Children's Math Worlds (CMW) for kindergarten through grade 3. We build on the individual experiences, interests, and practical mathematics knowledge that diverse children bring to our classrooms. Our collaborative research project has been, and is being, carried out in urban schools of underrepresented minorities, mostly Latino English-speaking and Latino Spanish-speaking children, and in English-speaking upper-middle-class schools to ensure that our work crosses socio-economic boundaries. The CMW family component was described in De La Cruz (1999). See that article for data concerning the excellent comparative performance of CMW children.

In this article, we focus on two central, related activities of CMW: (1) linking mathematical activities in the classroom to children's mathematical experiences outside of school and (2) creating a rich and sustained environment for learning to write, solve, and explain ways of solving word problems. Solving word problems has traditionally been difficult for many children, especially those for whom English is a second language. Word problems are often neglected and not assigned to these children. We have found that centering our classes on such problems, using problems of increasing difficulty, and supporting language use by children enable them to solve word problems readily. For more details, see Fuson et al. (1997). In our following description, we weave in voices of some of our classroom teachers to comment on various aspects of teaching using children's lives.

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Theoretical Underpinnings of the Curriculum

Our project uses a Vygotskian model for unfolding, formulating, and solving mathematics problems from children's experience. This model describes one way in which teachers build on children's prior knowledge about various situations to facilitate students' construction of understandings of formal mathematical concepts, symbolism, and problems

(see Fuson et al. [1997] for more details). The unfolding multiple narratives of different children's experiences provide a framework that is co-constructed by the teacher and children and within which teachers relate new mathematical ideas to children's lives.

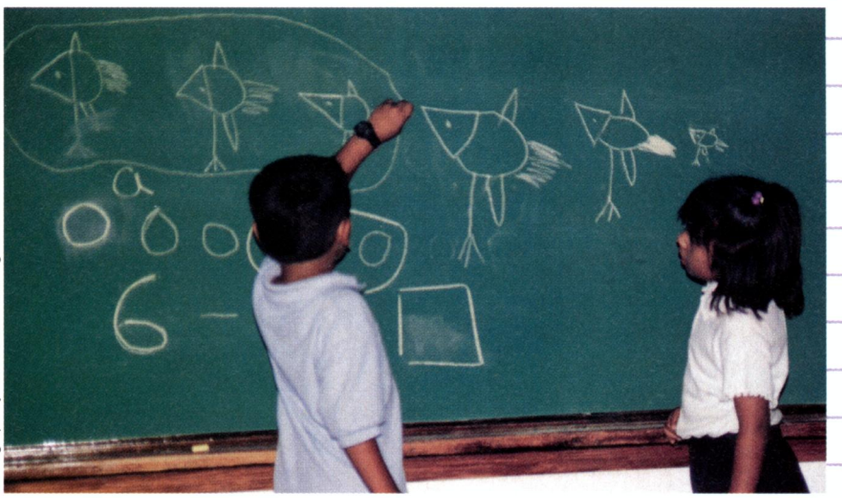
This building on children's knowledge is balanced by the other vital Vygotskian aspect of our approach: teaching within the "zone of proximal development" (ZPD). The ZPD, or learning zone, is what children can accomplish with assistance. The teacher leads children from a starting point to more advanced mathematical knowledge. This knowledge includes being better at listening, explaining and helping one another understand; learning more advanced, efficient, and accurate solution methods; and learning mathematical symbolism, language, and new ideas. The teacher, and eventually other children, help students progress in all these ways. The teacher is guided by an ambitious vision of the growth in children's knowledge by the end of the year and is supported by the CMW curriculum.

Getting Started: Eliciting and Using Children's Stories

Some children are eager and ready to share their stories. Others are initially too shy to relate their stories to the class, so they draw or write their stories. Eventually all children participate. Asking children to bring photographs from home either about a trip or any other subject can produce intriguing stories and can give teachers insights into the children's lives. Children enjoy listening to one another's stories. Since each story gives some insight into that child's life, children believe that they are a part of a dynamic class. Stories can be told at other times of the day and told again during mathematics class, perhaps by another child, to emphasize listening and remembering. Each child's story can be repeated during the year to foster ongoing coherence and inclusion. Mathematical aspects can be expanded, and nonmathematical points can be discussed in other subject areas. Children enjoy hearing their story mentioned again in class. Using children's stories in these ways involves teaching and learning processes that develop thinking and creativity and facilitate children's emerging mental, oral, and written competence with language *and* mathematics.

One classroom teacher made these comments:

> In different years, different themes have emerged from the class and from other nonmath activities we are doing. One year, we began with a story of a child whose grandmother made and sold candy in Mexico. We worked on lots of stories about packaging candy to buy and sell, made candy using the grandmother's recipe, and had a bake sale for another grade. The whole math curriculum for that year was developed around these and other stories about buying and selling. In another year in first grade, we began with a child whose dog was back in Mexico. The grandfather gives the dog five bones a day. We made many stories about how many bones Paco has had and about feeding and taking care of other animals. To enrich these stories, we may bring people from the business community, as well as family members, to talk to the students about math in their lives or their jobs.



Understanding, Listening, and Describing

The teacher first develops the whole-class understanding of the child's story by asking other children to tell the story in their own words and to ask and answer questions about the story. This phase facilitates listening, memory, and participation as well as understanding. The teacher has the children ask questions about mathematical aspects of the story. Children become very good at asking questions about a situation. Posing the question is usually the most difficult part of writing a word problem for children, so whole-class modeling and practice in asking questions are very helpful. Less-advanced children can participate well in this phase.

One teacher describe her experience in this way:

> It has not been easy for me to move from the old paper-and-pencil math to developing a language of inquiry to support math understanding. Encouraging students to draw their problems and answers, to act out situations, to work sometimes in pairs, and to have students explain their math thinking can be a struggle. But if we want children to feel free to take risks, we have to take them, too. Frustration many times precedes insight, for children and for teachers. This task of understanding math becomes easier when we bring children's experiences into the classroom. Meaning emerges from context and connectedness.

Putting a Story in Mathematical Terms

After hearing the story, the teacher focuses on its potential mathematical aspects by posing a story that contains complex real-world attributes but that omits many nonmathematical elements. Some children retell this story in their own words and ask and answer questions about it so that the class understands this new version. This information is then further restricted to a particular situation that occurs within the context of the story. Children pose questions about different kinds of problem situations, one of which will be chosen to represent a typical word problem. After this process has been completed, the teacher can use only parts of this process on some days.

One teacher related this scenario:

> In my second-grade class, children told many stories about going to the store with their family. The children then generated several possible questions about the situation and made word problems about the situation.

Problem Solving, Reflecting, and Explaining

The class then moves into the problem-solving phase, in which children solve problems individually using their own mathematics drawings. The core of problem solving is understanding the situation. Drawing the situation engages children in this analysis. Early in first grade, children learn to make labeled drawings that show the mathematical aspects of the situation with circles or other shapes, line segments, and spacing. Labeling with letters or words ties the parts of the drawing to the situation. These drawn models help children understand the situation, reflect on their own problem-solving method, and explain their solution steps (see **fig. 1**). These explanations give teachers insight into children's mathematical thinking and help students learn from one another. These coherent, extended, and meaningful interactions engage the students and help them make connections between the mathematics concepts and language embedded in their everyday cultural practices and their emerging mathematical concepts, vocabulary, and notations.

One teacher explains the insight gained:

> While students are working, I watch the students working at the board, and I walk around listening and looking at work at children's seats. I note who has different solutions to explain and who is in trouble. Sometimes students work and discuss with a partner so that they learn from each other's thinking. Listening to their dialogues gives me an insight into their thinking and how I can expand their comprehension. When a pair of students explain their work, I ask the less-advanced student to start first. In this way, even if only at the level of description, the student feels that she or he has contributed. Other children ask about a method if they do not understand it. This is a crucial aspect that moves the math talk from being focused just on me and creates direct student-to-student interaction. After a method is described, I usually ask how many did it that way. This [tactic] increases interest, involvement, and analysis of methods—"Is mine the same or different?" We frequently discuss strengths and weaknesses of different methods. After some correct methods, I pick one or two major wrong answers to discuss so that the confusions behind them can be cleared up. Using the children's math drawings enables all children to be active listeners in the conversation.

The Co-Constructing Process

The classroom conversation is co-constructed by all those involved. The active participants in a conversation each direct the conversation in certain ways. Each contribution stimulates thinking. Throughout the conversation, personal meanings are continually being constructed and reconstructed in ways that are influenced by the classroom process. The emerging group history and climate support the sense of all participants that the conversation is a common group product created and shared by all members. All students in the class build and contribute to an environment in which everyone helps everyone else learn—sometimes actively and sometimes through emotional support—while patiently waiting for another to give input. Thus, the growing mathematical learning of each student is the result of the thinking, stories, and explanations of every student.

The teacher plays important roles in creating, maintaining, and using this sense of class mathematical history. This shared history rests on mutual respect and on explicit acknowledgment of the importance of the participation and contributions of each student. The collaborative interactions foster participants' understanding of language, drawings, notations, and mathematical conceptual structures that are common enough to permit meaningful conversations using the emerging "taken-as-shared meanings" (Cobb and Bauersfeld 1995). The teacher leads children in group and individual reflection on their personal meanings and facilitates critical thinking and decision making. These conversations flourish in classrooms that inspire learning, support children's self-regulation, build self-confidence, and provide regular feedback on learning progress.

One teacher made these notes:

> My approach to math teaching is one where students feel free to express themselves by playing an active role in the

teaching-learning process. I try to give learners enough time to assimilate and to contribute ideas. I work to create a "family" feeling of belonging to the class so that students pay attention to each other and help each other. It is important to encourage students to be autonomous, to seek meaning, to help them articulate questions, and to sense their needs. This creates a learning environment that is stimulating and tolerant, but filled with excitement to push forward.

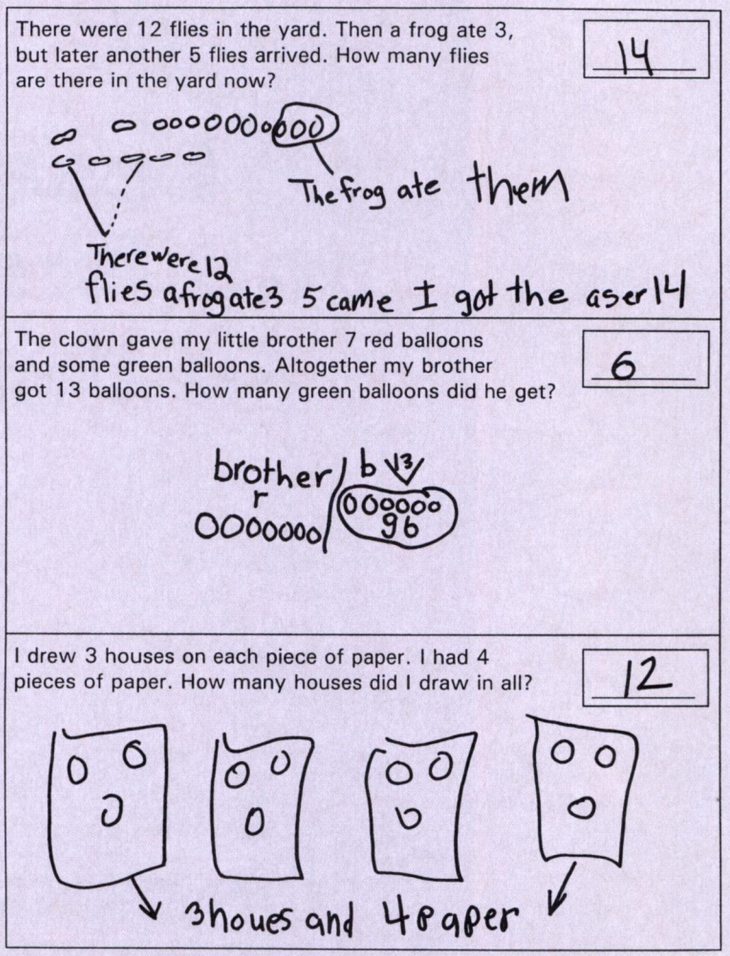
It is also important to help students learn how to help each other. There are many of them and only one of me. In a co-constructed classroom, the class will participate in helping a student who is struggling with some concept or solution. This in-depth clarification of concepts helps everyone. Students begin to see things from another point of view. With help from the teacher, students naturally become supportive of each other, and errors are seen as an opportunity for solving and posing new problems. Such an approach allows the teacher to evaluate how and what the class has learned and how to strengthen this understanding.

Conclusion

Listening to children, putting their stories in a mathematical context, using children's labeled mathematics drawings and number drawings, and eliciting explanations from children about how they solved problems are powerful approaches. But these approaches need constant leadership by the teacher so that children can progress in their knowledge of mathematical methods, vocabulary, and understanding. The CMW curriculum supports teachers in these efforts. The teaching and learning experiences are adapted to the participants and enable them to progress and become competent in mathematics.

FIGURE 1

Children's labeled mathematics drawings



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