It's more important to demonstrate the logic of math than to memorize rules.

ALICE P. WAKEFIELD

etting clear standards for what children should know is important, but teaching directly to standards without consideration for how learning occurs can be dangerous. As pressure mounts on teachers to ensure that their students do well on mandated achievement tests, there is often a strong temptation to give students the right answers—or tell them how to get them. This type of teaching eliminates the need for reflection, and it is reflection that underlies lasting learning.

Most teachers and principals would agree that focusing on learning is better than simply telling students how to get the right answers, and this is the approach used by constructivist teachers. Guided by principles espoused by such prominent education theorists as John Dewey and Jean Piaget, they choose to develop teaching strategies that support their students' thinking—
1. **Encourage Children to Think**

The first principle is to encourage children to actively think about their answers. Although that principle doesn’t sound the least bit unreasonable, many teachers ignore it when they engage children in rote math activities. When children simply must remember a rule to lead them to the correct answer, there is no underlying logic to give them a sense of whether their answer is correct (see box). Instead of developing their own number sense, everyone is expected to do the problem the same way, depending on the teacher to tell them if the answer makes sense.

Math rules are learning tricks that require only memory—the lowest rung of Bloom’s taxonomy. While children who are already motivated to do well in school will use the rules to churn out the right answers, those children who aren’t motivated to memorize the rules may fall through the cracks and lose confidence in their ability to do math. Even worse, they often learn to dislike math. Compare them to children who are not taught the rules but are taught to think about and describe their math solutions. By asking if everyone in the class agrees with the answer, or if anyone did the problem in a different way, the teacher can lead a lively debate in which students challenge one another’s thinking.

Wait a minute, you say. Don’t most math educators agree that it is helpful to use memorized “math facts” to solve the basic addition and multiplication problems that prepare students for more difficult problems? And isn’t drill and practice more appropriate than discussion when students are learning math facts? Constructivist teachers would answer “yes” to the first question and “no” to the second. They believe there are practical alternatives to drill and practice that combine the teaching of math facts with meaningful mental engagement.

Consider group game play (Kamii and DeVries 1980; Wakefield 1998), which involves thinking about numbers. For example, children have to think about adding and comparing a series of playing cards in a game called “double war.” By playing it again and again, they get valuable practice in determining number relationships. The same can be achieved by having children roll and add dice to determine their positions in a board game.

2. **Encourage Children to Think about Thinking**

A second principle that constructivist teachers use to support learning in young children is to encourage them to think about their thinking, to conceptualize how they got an answer to a math problem. But haven’t we been told that most children aren’t capable of that kind of thinking until they are in their teens? What we know now is that children who have never been asked to think about their thinking won’t miraculously begin to do so at age 14 or, for that matter, even at 18 (Schwebel 1975). But young children who are challenged to think about their thinking will become skilled at doing it.
Teachers can use a variety of strategies to accomplish this. One of the best strategies is a word problem that requires the child to organize the information provided, frame the problem, and figure out a solution. For example, consider this problem: three children want to share nine goldfish equally. How many fish would each child get? While this would be an appropriate division problem for third graders, most kindergarten children can solve it without knowing division or receiving help from the teacher (Carpenter et al. 1993). Typically, they “deal out” the fish to the three children, one at a time. Or they might create three equal piles by trial and error. The point is that they thought about the problem and found a solution that made sense to them. If they worked in teams, they might compare methods and re-think their solutions. If different children came up with different answers, they would have to figure out which is correct and defend their logic.

3. Encourage Representations of Thinking

A third principle that constructivist teachers use is to encourage young children to represent their thinking with words, pictures, or symbols. I know a second-grade teacher who begins the day by writing a word problem in math on the chalkboard. As the children come into the room, they get out their...
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Remember how you were taught to add 17 + 15? First, add the 5 and the 7 to make 12; then put down the 2 and carry the 1. Add 1 + 1 + 1 to get 3 and there’s your answer: 32. But when constructivist teachers ask children to “make sense” of the problem without giving them specific instruction, they can respond in different ways. One might say, “I know that 10 and 10 are 20, and that 5 and 5 are 10, and that 2 more makes 12. So 20 and 12 make 32.” Another might put it this way: “I know that 10 and 10 are 20, and 5 and 7 are 12, which makes another 10 for 30, and 2 more for 32.” When children work out their answers in this way, they learn that math makes sense. Knowing that they “get it” gives them confidence, which in turn may lead to them actually liking math.

math journals and start figuring out the problem and solutions that make sense to them. The children can then compare notes and debate their solutions in small groups before the teacher gathers them to discuss their answers and how they got them.

This teacher also has the children record data from classroom experiments, like weighing apples on the window sill each day to determine their moisture loss. After the data are collected, she allows the children to organize and present them in whatever way makes sense to them. If their classmates don’t understand the organization, they ask questions and offer alternative ideas for how the data could be shared. Other ways in which young children can use representation in their math thinking might include surveying classmates to find out how many and what kinds of pets they have at home, how many can ride two-wheeler bikes, and what breakfast cereals they prefer. The list is endless.

When teachers encourage children to reflect on thinking and use representation of thinking in their classrooms, it inevitably leads to more thinking, and more thinking about thinking. It also leads to a lively, mentally engaging classroom climate, which supports more complex and sophisticated mental activity.

Implications for Early Childhood Teachers

We are left with one big unanswered question. If these principles are so good, why aren’t more teachers using them to teach math to young children? The only answer that makes sense to me is that this approach is more challenging than a textbook approach and harder to conceptualize. It’s also a harder approach for education schools to teach to their students. When teacher education programs give future teachers methods for teaching math without exploring math logic, teachers can be expected to use only those methods. And just as children who follow rules to get right answers don’t grow in their understanding of math logic, teachers who follow “recipes” to meet math objectives don’t grow in their understanding of teaching and learning.

Before teachers can prepare classroom environments that encourage students to think, they must first learn to be thinkers themselves. It takes a lot of thinking and a lot of thinking about thinking for both teachers and students to grow and develop.

References


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