Working Toward Mathematical Literacy

Anne MacQuarrie

As a former math illiterate, I knew there had to be a way to present math so that everybody, even people like me, could understand it. I was determined to find a way to teach *all* children to love math and appreciate it as a real and living thing.

I came to my love of math rather late in life—in my 30s, if I remember correctly. Before that, math seemed a giant ogre in the classroom, lying in wait for me with its convoluted operations that occurred for no discernable reason and its numerals that were supposed to be numbers (I thought the word *two* referred only to two items, not to the numeral *2*). I thought I was being punished for not being very smart. It turned out I was being tricked.

When it finally occurred to me that math is all about patterns, I became a zealot. I started seeing math everywhere, and it was beautiful and exciting. I needed to pass the message on, and my classroom was where I began trying to convert mathophobes to mathophiles. Some children will get math and love it no matter how it is presented. I was more concerned about those children whose math flowers were still shaded buds in the gardens of their minds. Those buds needed sunshine in order to open.

For several years, MCATA has been working on developing mathematical literacy—promoting understanding of big ideas and recognizing that arithmetic is the grammar and spelling of mathematical thinking. I try hard to develop math literacy in the children I teach. Here, I share a story about my Grades 2/3 class.

A *Calgary Herald* story about the results of the Grade 9 provincial achievement test in mathematics included a sample question that went like this:

> A farmer and his son left the barn to do a fence check on their property. They walked in opposite directions—the farmer at 4 km/h and his son at 3.5 km/h. How long did it take until they were 2.5 km apart?

The possible answers were 1/5 hour, 1/3 hour, 3 hours and 5 hours. Could it be any more fun? I decided to do the question with my Grades 2/3 class—not using algebra (we don't usually get that tricky in the lower grades) but, instead, considering the question, What is a *reasonable* answer?

First, we converted 3.5 and 2.5 into fractions (3½ and 2½). I emphasized that a decimal is just another way of writing a fraction and demonstrated that 5/10 is the same as 1/2.

We then considered the clock. I drew a clock on the board and broke it into quarters, and the children counted off the minutes for each quarter. We considered how fast the farmer and his son were walking. By labelling each section of the clock with "1 km," I helped the children easily recognize that 4 km/h (the farmer's pace) means 1 km in 15 minutes. I asked the children if the son, who was walking slower than his father, could have gone 1 km in 15 minutes, as his father had. As a test, I had two students walk away from each other in the classroom. The longer the students walked, the farther they got from each other, and the faster person got farther from the start point in the same time period. The children agreed that the son wouldn't have walked as far as his father in 15 minutes. On the board, I drew a diagram showing two stick figures walking in opposite directions. Knowing that in 15 minutes the farmer had walked 1 km and his son had walked less than 1 km, the children concluded that after 15 minutes the farmer and his son were less than 2 km from each other.

Referring to the clock again, I drew five circles on the board to represent each hour in the answer choices. I asked the children how I could show that the farmer was going 4 km/h and was instructed to put "4 km" in each circle. Some children multiplied and some added, but they all agreed that if the farmer travelled 4 km in 1 hour, he went 12 km in 3 hours and 20 km in 5 hours. The children told me that 3 hours and 5 hours were much too long because the farmer and his son only had to be 2½ km, not 12 or 20 km, from each other. I erased the choices of 3 hours and 5 hours from the board and, in so doing, demonstrated to the children a test-taking strategy that they can use in the future.

We were left with the answer choices of 1/5 hour and 1/3 hour and, therefore, had to undertake the job of comparing the size of fractions. We talked about what the denominator means, and the children chanted our fraction mantra: "The number on the bottom is the number of equal-sized pieces the whole thing is broken into." We reviewed what happens to the size of the pieces when the denominator gets bigger. We talked about what the fraction is called when you break something into five equal pieces. We looked at the clock again to see what it could tell us about the relationship between 60 (the number of minutes in an hour) and 5 (the number of pieces we had to break the hour into to get fifths). We could see that, counting by fives starting at the top of the clock, 12 sets of 5 are 60. Because I always have the children give me four math sentences for every fact, we also determined that 5 sets of 12 are 60, 60 broken into sets of 12 is 5, and 60 broken into sets of 5 is 12. I wrote the sentences on the board in standard algorithmic form, explaining again that this is how the words look in the language of mathematics. We determined that each fifth was worth 12 minutes because that was the size of each piece when you broke 60 into 5 equal parts. We looked at the quarters on the first clock and found the difference between the 15-minute quarters and the 12-minute fifths. The fifth was three minutes less than the quarter—not enough time for the farmer to go 1 km. If 12 minutes wasn't enough time for the farmer to travel 1 km, it certainly wasn't enough time for the son, and together they would have travelled less than 2 km. Thus, we had to reject 1/5 hour as a possible answer. That left us with 1/3 hour as the only possible answer.

Obviously, the procedure did not go that smoothly or quickly, so, please, all you elementary generalists out there who say, "I could never do that," believe me when I say, "Yes, you can!" I did not give the children the answers. I got excited. I jumped up and down. I got the children moving around, and they got excited, too. I asked and probed and made them construct meaning, drawing on their own experiences and actions. I talked about patterns—the basis of all mathematics—and urged the children to find the patterns in the problem. By drawing on their knowledge, I was able to stimulate the children to put things together. Not all of them got all parts of the problem, but they all got some of it. In this Grade 9 test question, I was able to find something for even the least developed math mind in Grades 2/3 while addressing the needs of the other students, including the most capable.

The children were thrilled that they had solved a Grade 9 test question and that most of them had understood it. They all understood that the answer had to be reasonable and that 3 hours and 5 hours were not reasonable answers. Comparing the fractions was a far more rigorous task, but most of the children were able to make some meaning out of it.

Math should be something that excites, not terrifies, children. The more broadly based a problem is, the more willing children are to try it. I always stress to them that, although they may not be able to do everything, there will always be something in a problem that they can grasp. It is important for children to see that math is not the ogre in the corner or the demon in the red notebook who is out to get them. They also need to see math as numbers and shapes and forms, not just numerals arranged in algorithms. They need lots of practice estimating so that they can learn to discern a reasonable solution.

Math is everywhere, and it is beautiful!

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