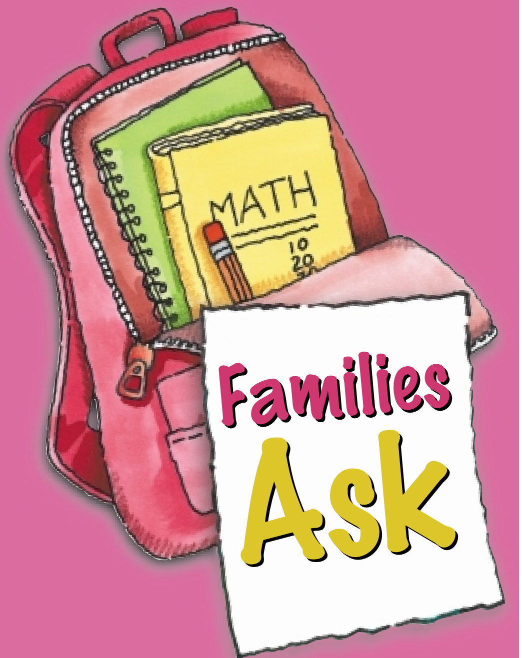

DANIEL J. BRAHIER

THE PURPOSE OF THE "FAMILIES Ask" department is to help classroom teachers respond to questions commonly asked by caregivers of their students. Each month, a commonly asked question will be posed; a rationale for the response will be presented for teachers; and a reproducible page will be offered for duplication and distribution to parents, other caregivers, administrators, or community members—anyone involved in the mathematical education of middle school children.

Here is this month's question:

Why aren't students learning to add, subtract, multiply, and divide like we did?

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Understanding Mathematics and Basic Skills

Since the publication of *Curriculum and Evaluation Standards for School Mathematics* (NCTM 1989) and *Principles and Standards for School Mathematics* (NCTM 2000), many school districts and teachers have implemented new curriculum materials to achieve the vision of the Standards. In addition, many educators have adopted a constructivist viewpoint in their teaching practices, resulting in hands-on lessons for children and the use of real-life problems, visual and hands-on approaches, and invented strategies for solving problems. In the context of reform, however, parents and community members are prone to question whether their children will actually "learn the basics" when engaged in hands-on, real-life investigations.

One of the interesting aspects of the debate on reform in mathematics education is that parents of schoolchildren assume that "everyone" could do mathematics when they were in school, and they question whether today's students will achieve the same skill level by using reform curricula and student-centered teaching strategies. However, the data from past tests of achievement may surprise parents of our children. For example, if the parent of a current sixth grader was twenty-five when the child was born, then the parent was in middle school in the mid-1970s. The relevant question is, How did middle school children perform on tests of achievement in the 1970s? And the answer is, Probably not as well as most parents remember. For example, on the 1972–1973 National Assessment of Educational Progress (NAEP), eighth graders were asked how many votes a candidate would receive if the individual got 70 percent of 4200 votes cast. Only 10 percent of the thirteen-year-olds tested determined the correct answer for this item (Carpenter et al. 1975). When asked to estimate the answer to the question 12/13 + 7/8, only 24 percent of eighth graders and 37 percent of high school seniors chose the correct answer of 2 in a multiple-choice format on the 1977–1978 NAEP (Carpenter et al. 1980).

Much of the resistance to using hands-on, student-centered approaches comes from parents who assume that the curriculum was better when they were in school and who appear to believe the myth that "everyone understood it" as teenagers. To respond to these concerns, educators need to show parents the shortcomings of teaching mathematics by lecture and demonstration, and help them realize the power of analyzing a problem in a conceptual manner. The reproducible sheet for caregivers is designed with this goal in mind. The page can be duplicated as is and distributed to families and community members to help address the question.

References

Carpenter, Thomas P., Terrence G. Coburn, Robert E. Reys, and James W. Wilson. "Results and Implications of the NAEP Mathematics Assessment: Elementary School." *Arithmetic Teacher* 22 (February 1975): 438–50.

Carpenter, Thomas P., Mary Kay Corbitt, Henry S. Kepner Jr., Mary Montgomery Linquist, and Robert Reys. "Results of the Second NAEP Mathematics Assessment: Secondary School." *Mathematics Teacher* 73 (May 1980): 329–38.

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"Families Ask" responds to questions commonly asked about the current issues in mathematics education. It includes a "Families Ask Take Home Page" to share with parents, caregivers, and other interested members of the community. Readers interested in submitting manuscripts to this department should send them to "Families Ask," MTMS, *NCTM, 1906 Association Drive, Reston, VA 20191-9988.*

Families Ask

Take-Home Page

Families often ask a question like this:

> *Why aren't students learning to add, subtract, multiply, and divide like we did?*

Consider the following reply:

In today's middle schools, much more emphasis is placed on the *meaning* of number operations, geometry, statistics, and so forth, than it once was. Students are still being taught to add fractions and to find the percent of a number, but they are not necessarily being taught these skills in the same way as their parents and grandparents were. Today, *understanding* mathematics is as much a classroom focus as finding the correct answer is.

Consider the following recent incident:

In a restaurant, a cashier attempted to add two bills, one for \$4.50 and one for \$5.50, by carefully lining up the decimals and "carrying," like this:

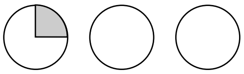
$$\begin{array}{r} {}^{1}5.50 \\ \underline{+\ 4.50} \\ 10.00 \end{array}$$

Although the procedure used was correct, the customer wondered why the cashier did not just add 4 + 5, see that 50 cents + 50 cents is another dollar, and know that the total was \$10. Certainly people should be able to perform this type of computation mentally, without a calculator or even a piece of paper. Many people cannot do so, however, partly because they lack number sense. The cashier learned the procedure in school but may not have learned enough about the nature of numbers to add them mentally.

A look back at history shows that difficulty with fractions and decimals has been with us for decades. For example, when eighth graders were asked in 1977 to estimate the sum of 12/13 + 7/8, only 10 percent of them selected the correct answer on a multiple-choice national examination. When those same students were asked to "add the fractions" 7/15 and 4/9, about 40 percent of them were able to find the common denominator and add the fractions. In other words, four out of ten students could *do* the computation, but only one out of ten could *think* about the fractions 12/13 and 7/8, realize that both were close to 1, and estimate their sum to be 2. The authors of a report on the performance of students on this national exam in 1977 wrote that "only about 40 percent of the 17-year-olds appear to have mastered basic fraction computation" (Carpenter et al. 1980). Such reports set the tone for changes in the way that mathematics should be taught. This year, the National Research Council released a report highlighting research trends that show that students in the United States can often perform computation but have difficulty applying basic skills to simple problems (NRC 2001).

Think, for example, about how you learned to divide fractions in school. To do a problem such as 3 ÷ 1/4, you were probably taught to invert and multiply, like this: 3/1 × 4/1 = 12/1 = 12. Although this answer is correct, did you understand why you were inverting or what the answer meant? Moreover, could you have created a word problem that would require using this division problem to solve it?

In the contemporary classroom, we might look at the division problem in the following manner: Think of each of the circles below as representing 1. The shaded slice in the first circle represents 1/4. The question is, How many one-fourths are in 3? We can see that twelve of the one-fourth pieces, four "slices" per circle, are needed to fill all three of the circles.



We might apply this situation in the real world, as in the following problem: Jason has 3 pounds of hamburger and wants to make patties that each weigh 1/4 of a pound. How many patties can he make? The answer is 12 patties. We could also think of the problem as asking how many quarters are needed to make \$3. Through such thinking, we not only know what the answer is but also have a picture of it in our minds and real-life applications that go with it. These connections allow us to move on to more difficult problems, then to create strategies for dealing with fractions. Eventually, students will be able to perform basic operations on fractions, and through using hands-on materials, visual aids, and real-life problems, they are more apt to understand why the operations work the way they do. Today's students will not struggle with fraction, decimal, and percent concepts; unlike the cashier, they will be very comfortable performing mental-math operations in these areas.

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National Research Council (NRC). *Adding It Up: Helping Children Learn Mathematics.* Washington, D.C.: Center for Education, 2001.

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