Mathematically Incorrect?

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Schoolteachers may make good parents, but they're often not the best teachers for their own offspring. As my two daughters frequently complain, Mom has her own ways of doing things that often don't coincide with their teachers' expectations. Mom also has her own views on education, and when these contradict the curriculum or the textbook—watch out!

The conflict between Mom's views and the school's came to a head last year, when I discovered that—despite her As in math—my 12-year-old daughter could not multiply or divide one decimal by another, add or subtract fractions with unlike denominators, or operate with percentages to calculate sale prices. So the summer was spent with a Grade 6 math text, catching my daughter up to where I—though not the New Brunswick Department of Education—believed she should be.

I suspect more parents are about to discover deficits in their children's math skills, thanks to a sea change in math instruction. Dismayed by poor results on international measures, the influential National Council of Teachers of Mathematics (NCTM) in the U.S. has radically rethought mathematics instruction. The result is the NCTM's *Curriculum and Evaluation Standards for School Mathematics* (1989), now adopted by many states and provinces.

Rooted in child-centred educational theory, the NCTM approach favors active learning: using "manipulatives" such as counters or base-10 blocks and working in small groups ("cooperative learning" in today's jargon). It stresses problem-solving (a weak area on international comparisons) over arithmetical operations. Calculators are permitted, teaching students to divide by two-digit divisors is discouraged, and estimating, which enhances the ability to judge whether calculator results make sense, is emphasized. Math problems are realistic, embedding the math classroom in the "real world."

The New New Math

NCTM math is the object of considerable controversy in the United States, where it is variously tagged the New New Math, visual math, fuzzy math or—to highlight parallels with the highly controversial whole language approach—whole math. Critics point to a decline on standardized test scores in Oregon and Idaho following NCTM implementation. A powerful California lobby of highly educated parents, including a molecular biologist, geophysicist and statistician, has set up a Web site called "Mathematically Correct" (http://ourworld.compuserve.com/homepages/mathman) to counter NCTM claims.

In Atlantic Canada, NCTM math is on the ascendant. The NCTM Standards provide the philosophical underpinning for the new Foundation for the Atlantic Canada Mathematics Curriculum document. Two new math textbook series—Prentice Hall–Ginn's *Interactions* and Addison-Wesley's *Quest 2000*—have been developed to align with the NCTM guidelines. My daughter's school used *Interactions* for the first time this year, with the results I noted.

Without an extensive grasp of the research, it is hard for a parent or a teacher to determine whether the NCTM is on the right track. Does repeated practice in rudimentary arithmetic operations enhance a feel for numbers or do children arrive at arithmetical understanding better by playing with geoboards and centicubes? Do students learn to estimate more skillfully by doing accurate pen-and-pencil calculations, or does this skill develop by estimating answers to real-life problems? Have calculators made dividing by two-digit numbers obsolete, or is there inherent value in learning to do difficult division operations? The NCTM's lofty ideals—"To solve a problem is to find a way where no way is known offhand, to find a way out of a difficulty, to find a way around an obstacle" (G. Polya quoted by Krulik and Reys in the NCTM Standards)—certainly have a ring to them, but so did the elevated principles of whole language, with dismal results.

What is clear is that the execution of these ideals in *Interactions* and *Quest 2000* is ineffective. Lavishly printed in large format with brilliant graphics and full-color photographs of cheerful young

mathematicians, the texts are poorly organized and frequently confusing. In traditional math texts, chapters are organized according the mathematical principles—measurement, fractions, ratio-rate-percent. To make math relevant, the organizing principle behind some chapters in *Interactions* is thematic. The Investigating Transportation unit, for example, lurches from volume and mass problems to time-rate-distance problems to money problems, time problems and map reading. There are no model problems for students to imitate; each is one-of-a-kind, requiring a great deal of teacher assistance. When I helped my daughter with a problem on population densities, for example, I had to explain rounding, ratio and equivalent fractions—all in one night! When concepts are dropped as quickly as they are introduced, nothing is practised, assessed and mastered.

To ensure understanding, both texts encourage students to invent their own arithmetic algorithms (operations) or to choose the ones they're most comfortable with. The Professional Handbook (Intermediate) to *Quest 2000* encourages students to "chunk" numbers into smaller parts for operations, so 35×4 may be computed as $30 \times 4 = 120$, $5 \times 4 = 20$, $120 + 20 = 140$ or as $(30 + 30 + 30 + 30) + (5 + 5 + 5 + 5)$. Such steps are useful in the initial stages of teaching operations—you'll find them in traditional texts as well—but is it really necessary to understand what you're doing every time you add, subtract, multiply or divide? Weren't algorithms invented to avoid cumbersome calculations? And why confuse children, as *Interactions* does, with five options for multiplying 24×25?

Interestingly, consumer pressure has forced both publishers to rethink the value of practice and drill. In its first edition, *Quest 2000* had very few practice exercises; the revised edition has short Practise Your Skills boxes—though the practice is often limited to a mere handful of exercises and a booklet of "Extra Practice and Testing Masters" that provide exercises hardly distinguishable from the practice pages in a traditional math text. *Interactions* now offers blackline masters for practice. Like the textbook, though, these sometimes assumed more knowledge than my daughter had (she didn't automatically know that $4 \times 16 = 64$, which was required to convert 25×64 to 100×16 in her head).

Problems With Groups

In compliance with the NCTM emphasis on collaborative problem-solving, *Interactions* tags certain problems for Work in a Group, and the promotional video for *Quest 2000* shows students working in twos and fours on problems or math games. In small doses, cooperative learning can be an effective teaching technique, but it is rarely well used. Activities must be carefully designed to avoid group reliance on the quickest and brightest worker. Monitoring what goes on—especially for a teacher with a class of 30 or more—is exceedingly difficult, and the noise level can be punishing. (Interestingly, the *Quest 2000* video never stays with any group long enough to track individual contributions to a solution.) In some classes, children simply don't work well together; they socialize or quarrel.

When I taught elementary math, I was often stymied by the enormous range in my class. At the bottom were children who didn't know their number facts and could barely read word problems. At the top were kids who got every mechanical operation right and were wasting their time on multiplication and division drills. With their challenging word problems, *Interactions* and *Quest 2000* might have been just what these top students needed—but only to supplement a solid, sequential core math program.

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