IMPLEMENTING CALCULATORS: ISSUES AND IMPLICATIONS

Lynn Columba
Lehigh University
Bethlehem, PA 18015

The *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989) recommends the integration of the calculator into the school mathematics program at all grade levels in class work, homework, and evaluation. In other words, hand-held calculators should be made readily available to all children, K through 12. Large amounts of time spent on computation could be freed up and used to develop an understanding of mathematics through reasoning and problem solving. Problem solving, the principal reason for studying mathematics, is the process of applying previously acquired knowledge to unfamiliar situations. It is also a method of inquiry and application, interwoven throughout the *Standards* to provide a consistent context for learning and applying mathematics (NCTM, 1989). The calculator is a tool that reduces calculation difficulty in problem solving.

At one time price was a barrier to using calculators in the classroom, but no longer. Discount stores have calculators for less than $5.00. Data from the Second Mathematics Assessment of the National Assessment of Educational Progress (reported in Reys, 1980) support the fact that many children have access to calculators outside the classroom: 75% of 9 yr. olds, 80% of 13 yr. olds, and 85% of 17 yr. olds either own their own calculators or have one available to use. As George Immerzeel, a mathematics educator, noted: "Almost any teacher who asks children to bring calculators find that they do."

Another consideration reported by Suydam (1978) is that the tendency to use calculators may be associated with the teacher's level of mathematical background: the greater the teacher's knowledge and confidence about mathematics, the more comfortable or secure he or she may feel with a tool that can process numbers so quickly.

Schools are "burying their heads in the sand" if hand-held calculators are not recognized and used as the calculational tool that they are (Shumway, 1976). Of course elementary students still will be required to learn their facts; the human mind is much quicker than keying in the basic facts on a calculator. Estimating and judging reasonableness of answers will be even more important. The intangible benefits of using calculators are exciting; children are eager to do mathematics when calculators are available (Shumway, 1976). In a technological society our children need to master the one electronic device that is the most common, affordable, and practical: the calculator.

Some say that learning basic facts will not occur if hand-held calculators are made available in the schools and that school must ban the use of calculators to ensure facility with the basic skills of arithmetic (Shumway, 1976). The "back-to-the-basics" bandwagon or the more "traditional" arithmetic program has undoubtedly played a part in the use of calculators in schools, especially at the elementary level, but research projects find that, "Students who use calculators for instruction achieve scores at least as high as students not using calculators even though the calculator is *not* used on the test... The decrease in time spent on paper-and-pencil practice did not appear to harm the achievement of students who used calculators.", (Suydam, 1982). Also, studies show that children who use calculators find mathematics more interesting, spend more time checking their work, and become more involved in learning (Hembree and Dessart, 1986).

A calculator does not solve problems; the problem solver has to press appropriate keys. The emphasis in problem solving is in selecting and using appropriate strategies, not in computing. The most valuable benefit for the students is to reason logically through a problem. Even when calculators are used in the problem solving process, students must do the thinking.

This kind of mathematical thinking is not reserved for the academic elite, but with the appropriate use of the calculator all students can have the time and instructional support to learn to think through problems, knowing that lengthy computations will not be a barrier to success (California, 1985).

In summary, the overall goal is not to produce a calculator-driven school mathematics program, but rather a mathematics program that integrates the calculator in meaningful and useful ways. The impact of technology and its implications for mathematics education can no longer be ignored (California, 1985). The time is now for enriching and strengthening the mathematics education our children receive. Instead of requiring students to spend years studying arithmetic as a series of rules and rote procedures, it is time to provide the opportunity for all students to experience the richness and beauty of the study of mathematics as a whole.

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Some of our older readers, referees, and editors remember when similar arguments were made for slide rules, adding machines, and hand-cranked and motor-driven desk calculators. Napier's Bones, logarithms, and the abacus must have had good press in their time, also. Our Journal could use a few articles on what kids should think about with all their free time!

Solutions to Alaskan Cryptarithms:

82	568	7033	42	859
82	132	1526	579	2561
164	700	8559	621	3420