

# The Use of Calculators

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**D**o we really need algebraic order of operations on all the calculators?" asked the middle school principal. "I'd rather get more calculators with the money."

"No," I responded, "I would much prefer that *not* all middle school calculators be programmed with algebraic order of operations."

The principal was referring to the recommendation in the NCTM Curriculum Standards for students in grades 5-8.

Why do I disagree with an otherwise admirable document on this issue?

The NCTM recommendation evidently is aimed at using calculators to convince adolescents that the algebraic order of operations is the right one.

What a terrible thing to do to children! What a terrible thing to do to mathematics!

The question  $3 + 2 \times 6 = ?$  is ambiguous because either addition or multiplication could be performed first (there are perfectly good physical examples for either). Most high school algebra teachers believe the answer must be 15 (multiplication should be performed before addition). Most other people survive quite nicely believing the answer is 30 (they read from left to right). Neither group is wrong, but they may have a hard time communicating with each other.

To solve the communication problem, we need a convention. Possible conventions include using parentheses, always working from left to right, always doing addition first, or always doing multiplication first. Understanding the need for a convention is important. Being trained to use the "right" convention before understanding the need for a convention is

undesirable — it discourages the very kind of discovery thinking encouraged throughout the rest of the Standards.

Children should learn that technology is created by people to do what people want it to do. Nothing done in school should encourage the notion that technological paraphernalia take precedence over people — the reverse is true and must be emphasized. A machine may have been programmed to do something different from what a user might assume. Too many dishonest business people are using technology to "prove" false propositions to gullible customers. Schools should teach so that people understand the possible misuse of technology.

What do I advocate?

Show children different contextual problems that could lead to different meanings of  $3 + 2 \times 6$ . Help them see the need for a convention to remove the ambiguity. Parentheses are fine but become cumbersome in complex expressions. Other conventions are possible. If children want to work from left to right (as many will), you might mention that in high school algebra, a different convention is followed (but in college abstract courses, still different conventions may be adopted for new systems).

Examine calculators that give different answers to the same problem. Let children try to figure out what each calculator is doing and why. Discuss with

them the fact that people program calculators, and that calculators give different answers because people fixed them that way. Encourage students to always check any technology they are using to see how it solves various problems.

Children should learn mathematics (and other subjects) in a way that encourages them to believe they can figure things out. Even if they can't guess what convention certain adults have agreed upon, they should be able to see the need for conventions. The attitudes and methods of thinking that children acquire are far more important than that they be trained to do certain things in certain ways.

Morals for teachers: (1) Don't try to impose your prejudices on your students. Try, instead, to encourage them to figure out what makes sense. (2) Never use technology as the ultimate authority. Remind your students regularly that calculators and computers are products of the human mind and useful tools, nothing more. (3) Teach so that your students will believe that mathematics is natural and fun, and something they can figure out for themselves — not a bunch of rules handed down from calculators to people. □

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