"SORRY, YOU CAN'T USE THE CALCULATOR IN THE CLASSROOM."

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Pocket-size electronic calculators are sprouting everywhere, even in the pockets of school children, and some teachers are undecided what to do about them.

I have heard from concerned elementary and secondary mathematics teachers who feel many of their students have not yet mastered the basic operations with whole numbers, and some critics of calculators argue that their use will create a generation of computational illiterates.

There is little question as to the usefulness of a calculator in upper school or university, but the issue becomes more clouded at the elementary level.

John Del Grande in his booklet 'Pocket Mini-Calculator Revolution' states, "In educational circles, the calculator can provoke as much controversy as the Spadina Expressway, the price of Canadian oil or M.P.'s salaries." He reminds us that we may be on the verge of repeating the ridiculous flap that was staged over the use of ballpoint pens in our classrooms around 1950. Many of us recall the pressures exerted to try and keep these pens out of the classes because the kids wouldn't learn how to write properly.

CALCULATORS ARE HERE TO STAY

Drill in basic arithmetic and computational skills will still have to be learned and understood. A calculator cannot tell a student when to multiply or divide and in what order the operations should be performed. Pressing the wrong key or obtaining an incorrect answer because of a run-down battery are common problems, and if the student doesn't know what he's doing or what to expect, he's got problems.

The calculator cannot replace the understanding of numbers.

Practical Teaching Ideas at the Junior/Intermediate Levels

Following are simply a few of the ways that I used a set of calculators with different groups of children ranging from Grade 4 to Grade 8.

1. Pattern Work (done with a Grade 4 class).

Children are provided with a calculator and a dittoed worksheet similar to the one below while I used an overhead sheet which was the same as their dittoed copy.

Numeral	Multiplied By	Product
426	10	-------
426	100	-------
426	1000	-------
82	100	-------
926	1000	-------
.	.	.
.	.	.
.	.	.

After being instructed on how to use the calculator, they were asked to use the instrument to find the products for questions 1 and 2. I entered their products on the overhead and they were encouraged to look for a pattern and to fill in the next product(s) by themselves using the calculator to check. Many discovered the pattern quickly and enjoyed checking their assumptions. Some children took longer to discover the pattern, but at the end of the lesson, my own intuitive feeling was that this enhanced more pupil involvement and learning than the traditional method.

Another day a similar exercise was initiated dividing whole numbers ending in zeros by 10's, 100's, and 1000's (care was taken not to introduce quotients with decimals at this stage).

2. Fractional - Decimal Equivalence

With a Grade 6 class, I continued the dividing process until I arrived at:

Numeral	Divided By	Quotient
.	.	.
.	.	.
.	.	.
100	10	10
10	10	1
1	10	0.1

I was able to use the children's knowledge of fractions that 1÷10 was the same as 1/10, and at this point they used the calculator to find 1/10=0.1 (printout on calculator conforms with SI notation as shown in the Ministry's Metric Styleguide). The pattern was developed estimating first then using the calculator to check into hundredths and thousandths.

With a "slower" group of intermediate students, it was encouraging to see students taking 5/8 and dividing 5 by 8 on the calculator to obtain the decimal equivalent instead of doing it the other way around.

3. Addition, Subtraction, Multiplication, Division Using Decimals (used at the Grade 6 level)

a) Addition

$$\begin{array}{r}30\\+40\\\hline 70\end{array} \rightarrow \begin{array}{r}3\\+4\\\hline 7\end{array} \rightarrow \begin{array}{r}0.3\\+0.4\\\hline ?\end{array}$$

They were encouraged to use a pattern, estimate their answer, then use the calculator to verify their results. The above example was the easiest pattern used but it did lead into the more difficult additions. Obviously, subtraction was handled in much the same way.

b) Multiplication and Division by 10's, 100's, 1000's

Number	Standard Numeral
5.2 ÷ 10	-------
0.7 ÷ 10	-------
0.035 x 100	-------
4.03 x 10	-------
2.403 x 1000	-------
0.025 x 100	-------
.	.
.	.
.	.

Question	Product	Number of Figures to the Rt. of the Decimal in the First Factor	Second Factor	Product
5 x 25	125	0	0	0
0.5 x 25	12.5	1	0	1
0.5 x 2.5	1.25	1	1	2
0.5 x 0.25	----	1	-	-
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

The children were able to see the pattern develop for determining the number of decimal places in the product, come up with this pattern, and check it out using the calculator with further examples.

Dividend	Divisor	Fraction	Quotient
156	13	$\frac{156}{13}$	12
15.6	13	$\frac{15.6}{13}$	1.2
15.6	1.3	$\frac{15.6}{1.3}$	12
.	.	.	.
.	.	.	.
.	.	.	.

Which led to questions such as:

"What do you notice about the quotients for $\frac{156}{13}$ and $\frac{15.6}{1.3}$?"

"Why is $\frac{15.6}{1.3}$ equivalent to $\frac{156}{13}$?"

Which in turn, I believe, led to a better understanding of questions similar to:

$$3.708 \div 2.06 = \frac{3.708}{2.06} = \frac{3.708}{2.06} \times \frac{100}{100} = \frac{370.8}{206} = 1.8$$

After each of the above type exercises, I asked students to answer many questions using the traditional pencil and paper technique using the calculator to check. I really believe that the calculator helped many children see the patterns involved in decimal operations.

Further Uses

1. At the Grade 6 and 7 levels, I found the calculator as a useful aid in teaching rounding off (the calculators had a floating decimal and decimal shift key).

e.g.

First Factor	Second Factor	Product	Product Rounded Off to 1 Decimal Place
3.9	4.3	16.77	16.8
.			
.			
.			

Once again the children were encouraged to look for a pattern. i.e. "When the product is 16.77 and you push D.S. 1 on the machine, why does it become 16.8? (whereas with 16.43, why does it become 16.4?)"

2. In a Grade 8 class, I found it useful when teaching Newton's Method for finding square roots correct to one decimal place (or more). It eliminated a lot of the tedious calculations.

i.e. $9 < \sqrt{83} < 10$

Since it is closer to 9, the possibilities become 9.1, 9.2, 9.3, 9.4, or 9.5.

We were able to learn more mathematics by using the calculator at this stage to check these out.

i.e. 9.1 x 9.1 = 82.81
9.2 x 9.2 = 84.64
9.3 x 9.3 =
9.4 x 9.4 =
.
.
.

and find that $\sqrt{83} \doteq 9.1$

The list goes on. Calculators can be effectively used for:

- checking work (even fractions by using decimal equivalents and a knowledge of rounding off)
- grocery list
- per cents
- powers

Will our students become "mathematical dummies" if allowed to use them? As W. Judd pointed out in his article "A New Case for the Calculator", if a student uses a machine to find 603 x 404, then he needs to know something about estimating and rounding off.

i.e. 603 x 404
⟶ 600 x 400

which means he still has to know 6 x 4

Place value understanding is essential:

i.e. 200 ÷ 0.03 "Is the answer very big or very small?"

200 x 0.03 "Is the answer very big or very small?"

Many children now have mini-calculators and many more will have them as the ten dollar calculator becomes a reality. Children see their mothers using them when they go grocery shopping and their fathers when they do the family budget. Can we simply tell children "Sorry, you can't use the calculator in the classroom"? ■