SMTS Position Paper: Calculators (1980)

The Saskatchewan Mathematics Teachers' Society has drafted a position statement on calculators. The following is their position paper, reprinted in its entirety from SMTS Newsletter, *Vol. 7, No. 5, November 1980.*

SMTS promotes activities which will help calculators to become an accepted, effective tool in the classroom:

1. Administrators should provide leadership, guidance, and encouragement to promote an atmosphere of acceptance for the use of calculators in mathematics classes.
2. Teachers should be trained to use calculators effectively.
3. Materials that integrate calculators into the regular mathematics curriculum should be developed and disseminated.
4. The entire school community should become familiar with the potential of the calculator for instruction. This should include knowledge of research and reports from schools that have used calculators.

A. Rationale

Calculators are in and they are never going to be out. They may change form, but they will not go away. They are not a fad that will disappear after a certain number of years due to boredom on the part of the consumer. The decrease in price of calculators is making them accessible to an ever-increasing number of students. The worst response that we, as educators, can make to the use of calculators is to ignore them.

Almost 100 studies on the effects of calculator use have been conducted during the past four or five years. This is more investigations than on almost any other topic or technique for mathematics instruction during this century. The general consensus continues to be that there are no measurable detrimental effects associated with the use of calculators for teaching mathematics.

The SMTS strongly endorses the NCTM position statement on "Calculators in the Classroom" which states:

> The National Council of Teachers of Mathematics encourages the use of calculators in the classroom as instructional aids and computational tools. Calculators give mathematics educators new opportunities to help their students learn mathematics and solve contemporary problems. The use of calculators, however, will not replace the necessity for learning computational skills.
>
> As instructional aids, calculators can support the development and discovery of mathematical concepts. As computational tools, they reduce the time needed to solve problems, thereby allowing the consideration of a wider variety of applications. Furthermore, the use of calculators requires students to focus on the analysis of problems and the selection of appropriate operations. The effective use of calculators can improve student attitudes toward, and increase interest in, mathematics.

Other electronic devices, programmed to generate questions and activities, that provide immediate feedback to students, are not to be confused with calculators or computers. These devices can be used to reinforce computational skills through drill.

B. History

Simple Calculators

The electronic pocket calculator has a relatively short history. In 1965, the first electronic calculator was produced. It had about the same size and price as the desk model electromechanical calculator it was designed to replace. Approximately $170 worth of transistors and other electronic components were hand-assembled to make this $1 500 machine. It was faster and quieter than electromechanical calculators.

Progress in electronics led to the integrated circuit and later to the large-scale integrated circuit. A single one-quarter-inch square "chip" could contain at first a few dozen, then hundreds, and then thousands of transistors and related components. The cost per transistor dropped by many factors of 10, and assembly time was also greatly reduced. Eventually, the $170 worth of components in the original electronic calculator were replaced by a few dollars worth of components. Assembly became almost completely automated, so labor costs were greatly reduced.

The pocket calculator became commercially available in the early 1970s. By the mid-'70s, the price of a simple 4-function calculator was about the same as a college-level textbook. These inexpensive calculators quickly became as commonplace as the TV set. Elementary schools began to purchase classroom sets. Their use began to be required in certain high school and college courses. For example, in 1975, Ohio State University began to require their use in introductory mathematics courses. Since then, other colleges have begun to follow suit.

The simple 4-function calculator is a marvelous device. It is designed to perform the operations (functions) of addition, subtraction, multiplication, and division on whole numbers and decimal numbers. To compute the product of 87.5 and 6.93, one depresses the key sequence 8 7 . 5 x 6 . 9 3 = and the answer 606.375 appears immediately in the output display. What could be simpler? Moreover, it is very easy to learn how to use a calculator. A few seconds of training suffices for most adults. This is partially dependent upon their having prior knowledge of the arithmetic operations. But a primary-school-aged child can also easily master these calculator skills.

C. Characteristics

NOT ALL CALCULATORS ARE THE SAME. You must become familiar with your calculator and the ones the children might have.

Kinds of calculators include:

algebraic logic calculators -
process all operations in the order in which they are entered.

algebraic operating system calculators -
are programmed to process information according to the order of operations.

reverse polish notation -
emphasize ordered pairs and functions. These require that both numbers be entered before the operation is specified. There is a key marked *ent* for enter. Thus, 2X3 is entered as 2 ent 3 X. No = key is necessary.

Calculators are as functional as the person using them. The operator must know what one calculator will or will not do and to do this he must be aware that there are differences in calculators.

1. Order of Operation

To become aware of differences, try these:

2 + 3 x 4 =	3 + 2 x 5 - 1 + 3 x 4 =
2 + 4 - 2 + 3 =	3 + 2 x 5 + 1 - 7 =
1 - 3 =	8 + 2 - 7 x 4 =

Where the order of operations is not simply from left to right, answers may differ - depending on the type of calculator.

2. Overloading the Display

Another situation will arise when an answer has more digits than the calculator will display. This *overloads* the machine, and this will be indicated by:

- a flashing display
- an E appearing on the left-hand or right-hand side

Try these: key in - 99 999 999 x 1 =

111 111 x 111 111 =

162 x 50 505 050 =

33 333 333 + 77 777 777 =

(NB - SR-50, T1-59, etc., do not overload with these questions as they can hold more than 8 digits.)

3. Division by 0

Enter: any number divided by 0; for example 12 ÷ 0 = .

This is an illegal operation and each calculator has its way of indicating this.

Some features to look for in a calculator:

4. Floating Decimal Point

Decimal remains at the right of the number until it is entered.

5. Shutoff

Some calculators have an automatic shutoff if left unused for a few minutes. Others display a travelling decimal point and then shut off. A great many will remain on and drain the power supply.

6. CE Key

Clears erroneous number entries without affecting previous entries. It will not cancel operational entries just pressed. *C key* clears calculator and sets display at 0. *CE/C key* - a combination key which clears the last number entered with one push and clears the entire calculator with two pushes.

7. Different Power Sources

Long life silver oxide replaceable batteries are the most costly and time-efficient. Automatic power-down displays and delayed power-off features maximize life of batteries.

8. Negative Numbers

Some calculators allow entry of negative numbers by pressing +1- key or CS key.

9. Other Keys

Constant, parentheses, square root, per cent, squaring, etc., may appear on the calculator.

10. Memory

2 key - stores (STO) the displayed number for later recall (RCL).

4 key - allows functions, usually addition (M+) and subtraction (M-) to be performed on the content of the memory register with retention for later recall (MR). Includes memory clear (MC).

11. Displays - two different types:

LED (light emitting diode)

- in use longer
- less expensive
- durable (depending on the particular calculator)
- "flashing" or symbols can be read in dark
- use 9-volt battery: relatively short life
- red numerals or blue/green numerals: higher battery drain for blue/green than for red numerals

LED

- red numerals not readable from wide angle; blue/green generally readable from wider angle

LCD (liquid crystal display)

- more recently on market
- more expensive
- less stable, reportedly (for example, dropping may cause display to shift or lose part of symbol)
- "immediate" display of symbols
- uses silver oxide battery; hundreds of hours of life
- black numerals on gray, yellow: low battery drain

LCD

- readable from wide angle

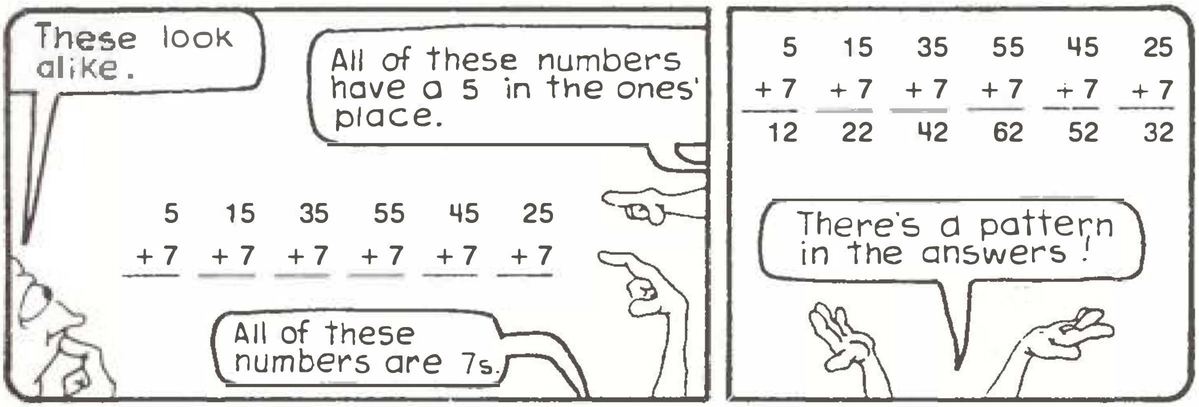
12. Per Cent Key

This key changes a number to its equivalent percentage. This is generally viewed as a negative feature, as this is the kind of process a student should do in his head.

D. Sample Lessons

1. Division One

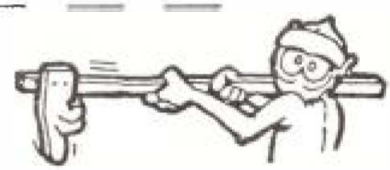
PATTERN SEARCH*



Use your 🖩 to solve the following problems. If you see a pattern, try to guess the remaining answers in that row. Then check your guesses on your 🖩 .

1. Enter [+][2][=], then [8][=], [1][8][=], and so on.

8	18	28	38	48	58	68	78	88	98
+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2



2. Enter [+][9][=]

8	18	28	38	48	58	68	78	98	108
+ 9	+ 9	+ 9	+ 9	+ 9	+ 9	+ 9	+ 9	+ 9	+ 9

3. Enter [+][4][=]

7	17	47	67	27	37	57	97	87	107
+ 4	+ 4	+ 4	+ 4	+ 4	+ 4	+ 4	+ 4	+ 4	+ 4

4. Enter [+][6][=]

11	31	81	101	91	51	21	41	61	71
+ 6	+ 6	+ 6	+ 6	+ 6	+ 6	+ 6	+ 6	+ 6	+ 6

*Refer to Reys, Bestgen et al., *Keystrokes, Calculator Activities For Young Students, Addition and Subtraction* (see bibliography).

2. Division Two

DOT CONNECTION*

Use your to find each answer below. Write the letter of each problem above its answer in the code. Then connect the dots in order according to the code.

Y	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

(A) 136 ÷ 17 = ___ (B) 110 ÷ 5 = ___ (C) 121 ÷ 11 = ___ (D) 45 ÷ 3 = ___

(E) 80 ÷ 4 = ___ (F) 432 ÷ 18 = ___ (G) 39 ÷ 3 = ___ (H) 330 ÷ 11 = ___

(I) 72 ÷ 12 = ___ (J) 306 ÷ 18 = ___ (K) 200 ÷ 40 = ___ (L) 108 ÷ 4 = ___

(M) 91 ÷ 13 = ___

(N) 261 ÷ 9 = ___

(O) 98 ÷ 49 = ___

(P) 184 ÷ 8 = ___

(Q) 504 ÷ 42 = ___

(R) 112 ÷ 7 = ___

(S) 390 ÷ 15 = ___

(T) 92 ÷ 23 = ___

(U) 125 ÷ 5 = ___

(V) 126 ÷ 9 = ___

(W) 50 ÷ 5 = ___

(X) 196 ÷ 7 = ___

(Y) 1 ÷ 1 = ___

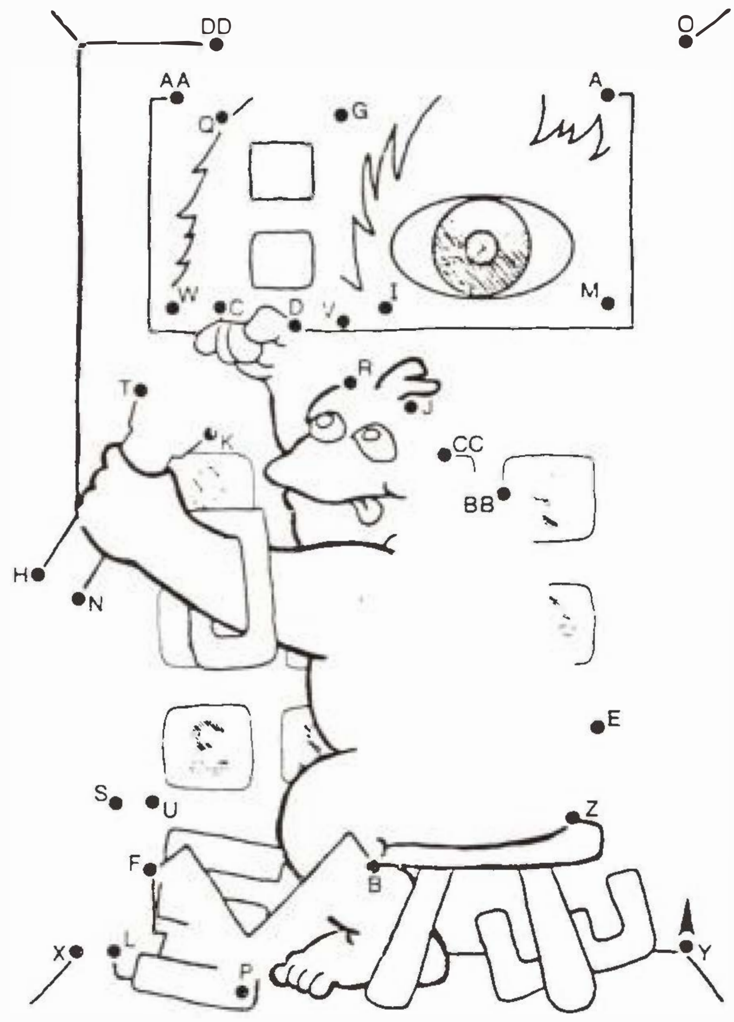
(Z) 126 ÷ 6 = ___

(AA) 261 ÷ 29 = ___

(BB) 646 ÷ 34 = ___

(CC) 108 ÷ 6 = ___

(DD) 42 ÷ 14 = ___



*Refer to Reys, Bestgen et al., *Keystrokes, Calculator Activities For Young Students, Multiplication and Division* (see bibliography).

3. Division Three

Lesson: PATTERN SEARCH*

Objectives:

1. To develop a positive attitude toward working with and developing patterns using the calculator.
2. To give the children practice in finding formulas.

Directions:

1. Do the first couple of problems in each set of patterns with the calculator. After doing the first few problems, look at the answers and see if you can predict what the answers for the remaining problems will be.
2. If after doing the first three or four problems you are unable to figure out the pattern, do the next couple using the calculator. Then, do the rest without the use of the calculator, figuring out your answers by just looking at the patterns from the previous answers.

Problems:

1. Find a pattern:

8 x 88 =
8 x 888 =
8 x 8888 =
8 x 88888 =
8 x 888888 =
8 x 8888888 =
8 x 88888888 =
8 x 888888888 =
8 x 8888888888 =

2. Complete the pattern:

0! = 1
1! = 1x1 = 1
2! = 1x2 = 2
3! = 1x2x3 = 6
4! = 1x2x3x4 = 24
5! = 1x2x3x4x5 = 120
6! = 1x2x3x4x5x__ = __
7! = 1x2x3x4x5x__x__ = __
8! =
9! =
10! =

3.

1 x 9 =
2 x 9 =
3 x 9 =
4 x 9 =
5 x 9 =
6 x 9 =
7 x 9 =
8 x 9 =
9 x 9 =

4.

1 x 99 =
2 x 99 =
3 x 99 =
4 x 99 =
5 x 99 =
6 x 99 =
7 x 99 =
8 x 99 =
9 x 99 =

5.

1 x 999 =
2 x 999 =
3 x 999 =
4 x 999 =
5 x 999 =
6 x 999 =
7 x 999 =
8 x 999 =
9 x 999 =

6.

1 x 9999 =
2 x 9999 =
3 x 9999 =
4 x 9999 =
5 x 9999 =
6 x 9999 =
7 x 9999 =
8 x 9999 =
9 x 9999 =

7.

0 x 9 + 1 =
1 x 9 + 2 =
12 x 9 + 3 =
123 x 9 + 4 =
1,234 x 9 + 5 =
12,345 x 9 + 6 =
123,456 x 9 + 7 =
1,234,567 x 9 + 8 =
12,345,678 x 9 + 9 =
123,456,789 x 9 + 10 =

8.

(1 x 8) + 1 =
(12 x 8) + 2 =
(123 x 8) + 3 =
(1,234 x 8) + 4 =
(12,345 x 8) + 5 =
(123,456 x 8) + 6 =
(1,234,567 x 8) + 7 =
(12,345,678 x 8) + 8 =
(123,456,789 x 8) + 9 =

9. Use the products of 37 and these multiples of 3 to find the pattern.

3 x 37 =
6 x 37 =
9 x 37 =
12 x 37 =
15 x 37 =
18 x 37 =
21 x 37 =
24 x 37 =
27 x 37 =

10.

1^2 =
11^2 =
111^2 =
$1,111^2$ =
$11,111^2$ =
$111,111^2$ =
$1,111,111^2$ =
$11,111,111^2$ =
$111,111,111^2$ =

11.

9 x 6 =
99 x 66 =
999 x 666 =
9,999 x 6,666 =
99,999 x 66,666 =
999,999 x 666,666 =

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*Refer to Mauland and Prigge (see bibliography).

E. Conclusion

It is important that calculators be used for more than checking answers and playing games. Every child should develop skill in estimating and should have algorithms that he/she can use in the absence of a calculator. Students should be allowed to use calculators for classroom tests which assess mathematical ideas rather than computational accuracy. Above all, teachers should realize that the calculator is not a panacea: it cannot resolve all the difficulties in mathematics instruction; teachers must accept the responsibility for teaching children how and when to use calculators, and thus, to be aware of their limitations.

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