Using Machine Technology to Enhance Problem Solving in the Middle School Mathematics Classroom

by

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Six of the ten basic skill areas listed by the National Council of Supervisors of Mathematics (1977) related to problem-solving skills and the use of machine technology. The listed skills are: (1) problem solving, (2) applying mathematics to everyday situations, (3) alertness to the reasonableness of results, (4) estimation and approximation, (5) reading, interpreting, and constructing tables, charts, and graphs, and (6) using mathematics to predict. Such an emphasis on problem solving and related skills along with the applicability of calculators and computer technology requires strategies for use by the teachers of middle school mathematics. It is the purpose of this article to discuss such strategies.

Bell (1978) lists five reasons that calculators and computers can enhance motivation to learn mathematics in the schools: (1) promoting internal satisfactions; (2) providing external reward; (3) enlivening the learning experience; (4) opening avenues of creativity; and (5) responding to a need for control in one's environment. All of these factors are generally evident as students plan and execute their own computer programs or address interesting situations -- often problems -- using hand-held calculators.

Some additional aspects of computers and calculators make them attractive:

(1) They provide a means for doing tedious calculations quickly.
(2) They provide immediate feedback.
(3) They may be facilitators in problem solving as they help to give partial solutions to more difficult problems.
(4) They seem to have applications with both weak and strong students.
(5) Computers and calculators are a spreading phenomenon in today's society.

Decreasing prices defy inflation, and affordability puts hand-held calculators into American pockets and micro-computers within reach of many families and businesses. Here are some examples of calculator and computer usage which may help these devices realize their potential.

Calculators

(1) Relegating tedious calculations to secondary status to enable students to make a judgement.

Consider two cars. One went 317.9 kilometres on 36.48 litres of gas; the other went 512.4 kilometres on 58.68 litres of gas. How do the cars compare in kilometres per litre?

(2) Using the calculator to find errors in computations.

Below is part of the record from a checking account. There is a $1.90 discrepancy with the bank statement. Find any errors, and correct them. How did they occur? What should the balance be?

Check #	Date	Amount	Previous Balance: $1245.18	
#1431	29 May	12.50	Bret's Hardward	1232.68
#1432	2 Jun	25.43	J.C. Peanuts, Inc.	1208.25
#1433	2 Jun	128.94	Post-Pine Furniture	1079.31
#1434	5 Jun	38.11	Mina Bird's Pets	1041.10
#1435	6 Jun	2.56	U.S.P.S.	1038.64
#1436	10 Jun	19.25	Henry's Hickory Hut	1019.39
#1437	11 Jun	29.87	Wonder Grocery	990.42

(3) Providing selected instantaneous information.

a. How useful is the calculator in finding these products?

250 x 10 =
267.5 x 10 =
2750 x 10 =
27.89 x 10 =

b. Find a decimal representation for 8/15.

(4) Regulating tedious calculations to secondary status to enable students to investigate patterns. The calculator is useful as a tool for generating, gathering, and organizing data.

a. Use the calculator to find the pattern for finding such products as those that follow.

15 x 15 = 225
25 x 25 = 625
35 x 35 = 1225
45 x 45 = 2025
55 x 55 = 3025

What is 95 x 95? (9025)
Do you see a means to find those products quickly?

Find the answer and patterns:

15 x 25 =
25 x 35 =
35 x 45 =
45 x 55 =

What is 75 x 85?
Do you see a means to find these products quickly?
How does it compare to the one you found in the first part of this question?

b. Use a calculator to find a pattern for the units digits in the sequence 7^0, 7^1, 7^2, 7^3, 7^4 . . .?
Try this activity with other base numbers.

c. Two sequences of numbers appear below. Investigate what happens when you add the same number of consecutive members of each sequence, starting at the beginning.
Sequence A: 1, 1/2, 1/4, 1/8, 1/16, ...
Sequence B: 1, 1/2, 1/3, 1/4, 1/5, 1/6, ...

d. A square has dimensions 16 cm on a side. If each side is halved, what effect is there on the area? Continue the process. What results emerge? Suppose you start with a square of 24 cm on a side. Apply the above procedure, and make similar observations. By what percentage does the area change?

e. Generate the Fibbonaci sequence (1, 1, 2, 3, 5, 8, 13, ...). Did you use the exchange key? If not, try to figure out a way to do that. It will be a procedure somewhat like doing "step programming" manually (Maor, 1980).

Computers

(1) Routine programs - for example, the student might receive drill on a previously learned skill.

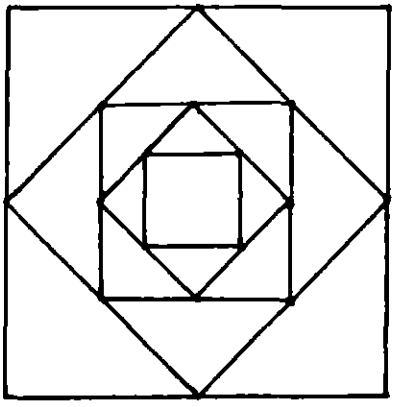
Use a programmable calculator to compute the mean, median, mode, variance, and standard deviation of a set of test scores.

(2) Debugging programs - making a program "work" may be problem solving at its best.

Debug the attached program for finding a Pythagorean Triple where all three digits are larger than 100. Do not use multiples of triples with smaller numbers.

(3) Writing programs - writing programs gives children a chance to exercise their creative abilities.

Create a program which simulates continuously inscribing squares for a sequence of iterations.



Some items appear so simple that the calculator may not simplify them (e.g., 2526 x 100). Nevertheless, children at the level of learning to "annex the zeroes" or "move the decimal point" can encounter numerous multiplication instances from which they can often discover the procedure by observing, writing, and studying the results their calculators show them. In each of these examples the calculator or the computer considerably simplifies each situation. People are using calculators and computers daily to resolve such practical concerns.

References

Bell, F.H. "Can computers really improve mathematics?" Mathematics Teacher, 1978, 71, 428-433.

Maor E. "Some uses of the exchange key on a calculator." Mathematics Teacher, 73, 1980, 213-217.

National Council of Supervisors of Mathematics. Position paper on basic mathematical skills. January, 1977.