WESTERN CONNECTICUT STATE COLLEGE

CALCULATORS IN THE FOURTH-GRADE CLASSROOM: AN EXPERIMENTAL STUDY

THESIS SUBMITTED TO
THE FACULTY OF THE MATHEMATICS DEPARTMENT
IN CANDIDACY FOR THE DEGREE OF
MASTER OF SCIENCE

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MARCH 1977

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May 12, 1977
[illegible]

CHAPTER I

Introduction

The advent of the small electronic calculator will probably change numeracy in the same way that the advent of television changed literacy. It is likely that the number of people remembering the complicated algorithm for long division, for example, will drop drastically, in the same way that the number of people with the inclination to read a long novel has dropped drastically. So a certain type of mental skill will become less practiced, almost obsolete for many people. On the other hand, the ability to deal with more complex mathematical problems, which would previously have been too time-consuming to consider, should increase. Similarly, television has made available a larger world view and great quantities of information to people whose outlook formerly had been confined by the boundaries of the small community in which they lived.

There seems little doubt that, like most labor-saving inventions, the calculator is here to stay. Fifty million calculators were sold worldwide in 1975 and an estimated one in every ten Americans now owns one. (Harrington 1976). Only five years ago when calculators first became available, the price of such a gadget was over $200; in an article by Stulz (1975) published as recently as 1975, the author stated: "At present, there are several types of calculators ranging in price from $50 to $4000." At that time the argument was that students should not be permitted to use calculators in high schools and colleges, because of the advantage which such use gave to those rich enough to afford a package of electronics to do the work for them. Already this argument is invalid, because it is now possible to purchase a simple calculator with the four basic arithmetic functions +, −, X and ÷ for less than $10.

The question then becomes, not whether to use calculators in school, but how best to use them. Some of the important issues which arise are:

Should the school district purchase calculators for students' use?

Should calculators be used merely to assist in computation, or should they be used in a more fundamental way to foster understanding of mathematical concepts?

At what age should calculators be introduced?

If they are used in the classroom, are calculators helpful for all students or should they be used mainly with high-ability or with low-ability students?

Does using calculators result in over-dependence on the calculator with the ultimate consequence that comprehension of mathematics will fall rather than rise?

Obviously all of these questions cannot be answered in a limited experimental study. The most significant issue appears to be whether calculators assist children to gain an understanding of mathematical concepts; other issues are dependent upon or subsidiary to this. The question of whether school districts should supply calculators is partly dependent upon how effective calculators are for instructional purposes. One could also argue that children should learn about calculators because they are becoming a tool of modern society, but this is a separate issue, to be decided by philosophical considerations rather than by research findings. Investigation of the use of calculators with students of differing abilities would require a pool of subjects with a wide range of abilities, which was not available in the small homogenous school district in which this research took place. The possibility that children permitted to use a calculator may become over-dependent upon it is a valid cause for concern, but it seems to require a long-term rather than a short-term study.

The purpose of this experimental study, therefore, was to investigate whether the calculator is an effective instructional tool. In other words, do children who use a calculator acquire a better understanding of mathematical concepts than those who use pencil and paper, as shown by their performance on an achievement test?

The children who were the subjects of this study were fourth-graders attending one elementary school in a district where most families belonged to the upper-middle class. The subjects were randomly assigned to small groups of four, in equal numbers of boys and girls. The subjects were given small group instruction, one half-hour lesson daily for four days, then a test was administered on the fifth day. In half the groups each child used a calculator under the direction of the teacher; in the other half of the groups each child used paper and pencil only. Calculators were not available to any of the subjects during test-taking. The subjects were required to answer questions which tested their understanding of the following ideas:

(i) A decimal number is an alternative way of writing an integer and a fraction.
e.g. 7.5 is another way of writing $7\frac{1}{2}$.

(ii) In a decimal number the first decimal place after the point represents tenths, the second decimal place represents hundredths and the third decimal place represents thousandths. e.g. 9.876 means 9 ones, 8 tenths, 7 hundredths, 6 thousandths.

By applying their understanding of decimals, the subjects acquired certain skills, which were tested at the same time. These skills were:

(i) Being able to decide the order ranking of two decimal numbers i.e. which is larger, which is smaller.

(ii) Being able to arrange two 3 digit (or fewer) decimal numbers correctly for addition or subtraction, to add or subtract the numbers and to write the answer correctly, with decimal point.

The term "decimal concepts and skills" as used in this study will refer to those concepts and skills enumerated above. The only computational skills required were being able to add or subtract 3 digit (or fewer) numbers. Since the subjects involved in this experiment all had scores of 3.5 grade-level equivalent or above on the computation section of the California Achievement Test, it was assumed that their computational skills were fairly well established before the experiment began. It was found in fact that computation errors on the test were few and appeared to be randomly distributed.

The hypotheses and alternatives for the study were:

A0: Students given small-group instruction using calculators will not score higher on a decimal concepts and skills test than students given small-group instruction using paper and pencil only.

A1: Students given small-group instruction using calculators will score higher on a decimal concepts and skills test than students given small-group instruction using paper and pencil.

B0: Any difference in scores on the decimal concepts and skills test is not related to the sex of the student.

B1: A difference in scores on the decimal concepts and skills test is related to the sex of the student.

C0: There is no interaction between method and sex of the student.

C1: There exists an interaction between teaching method and sex of the student.

References

1. Ty Harrington, Those hand-held calculators could be a blinking useful tool for schools, American School Board Journal (April 1976): 44.

2. Lowell Stulz, Electronic calculators in the classroom, Arithmetic Teacher 22 (February 1975): 135.