A POCKET CALCULATOR EXPERIMENT WITH FIFTH- AND SIXTH-GRADERS

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INTRODUCTION

The effectiveness of pocket calculators as a teaching tool is in question. Hard data is needed to determine to what degree these devices are useful. Opinions are strong on each side of the question with subjective appraisals ranging from "the panacea" to "the ruination of science." To help clarify the situation, an experiment was undertaken to determine the effectiveness of calculators with below average arithmetic achievers in the fifth and sixth grades. With a small experiment it was determined that the pocket calculator used in a specific manner can be effective.

THE EXPERIMENT

Twelve students from Lincoln Middle School of Pullman, Washington, were selected for treatment with pocket calculators, and another 12 were matched with the treatment group to be used as control. The selection was made on the basis of scores on the Iowa Test of Basic Skills administered during October, 1974. Each subject was judged at least a year behind grade level, with one exception each in the experimental group and in the control group. Twenty 40-minute classes were devoted to the instruction of the experimental group. Each student in the experimental group was supplied with a Minuteman 3-M calculator. Since funds were not available to employ the recognized master teacher, the authors conducted the 20 periods of instruction for the experimental group. The control group received their regular classroom instruction.

The types of activities in which the pocket calculators were utilized were:

1. Calisthenics - drill on the basic multiplication, division and subtraction facts using the calculator for immediate correction and/or reinforcement.

2. Repairing misconcepts on algorithms - borrowing across zeros, estimating divisors, and placement of partial products.

3. Equivalent fractions - fractions were defined to be equivalent if numerator divided by denominator agreed to the eight places on the calculator.

4. Multiplication and addition concepts - calculate the number of tiles on the floor of the school building; calculate the number of holes in the acoustical tiles on the ceiling of the room, and the number of mailboxes in the array.

5. Consumer usage - a visit to a grocery store where the students calculated the price of all the potato chips, cans of peaches, and bags of flour.

6. Area and perimeter - find the perimeter and area of the playfield. Find the number of square metres of glass in this building; find the number of metres of aluminum trim necessary to trim the windows.

7. Self-correction of work - does the calculator agree with your answer? If it doesn't, you have likely made a mistake. Check your work and find your mistake. (This alleviates the problem when students give random answers just to finish an assignment.)

8. Averages - what is the average height and weight of the people in this class?

9. Reading blueprints - some measurements have been left out of the design. Fill in the missing numbers. How far is it from point A to point C?

In February the 24 students were administered the Iowa Test of Basic Skills as a post-test. During October, 1975 they took the regularly scheduled Iowa Test of Basic Skills with their class as an additional time-lag post-test. The data from these tests was analyzed. No additional in-school treatment was given the students by the authors. Two students in the experimental group failed to return to school in September, 1975 so data concerning their status in October, 1975 is not available.

Table 1: Raw Scores and Means

	Experimental			Control		
	Oct. 1974	Feb. 1975	Oct. 1975	Oct. 1974	Feb. 1975	Oct. 1975
			5th Grade			
1	3.6	4.7	-	3.6	5.9	6.2
2	3.9	5.4	-	3.8	4.4	4.8
3	4.0	4.8	5.4	4.1	4.8	5.6
4	4.1	6.6	6.4	3.9	6.1	6.0
5	4.2	5.4	5.7	4.2	4.2	5.2
6	4.4	6.4	7.6	4.4	6.4	6.2
			6th Grade			
1	3.8	5.2	4.2	4.0	5.4	4.7
2	3.9	4.8	6.0	4.0	5.2	6.0
3	4.4	6.0	6.9	4.5	4.9	6.3
4	4.6	5.6	6.8	4.6	4.9	5.8
5	4.8	6.8	7.5	4.8	7.2	7.4
6	5.0	6.0	5.6	5.0	6.7	6.4

				N			
$\bar{X}_1$	4.22	5.64	-	12	4.24	5.51	5.88
$\bar{X}_2$	4.31	5.76	6.21	10	4.35	5.58	5.96

Table 2: Grade Level Gain

	Experimental				Control		
	0-74 F-75	F-75 0-75	0-74 0-75		0-74 F-75	F-75 0-75	0-74 F-75
				5th Grade			
1	1.1	-	-		2.3	0.3	2.6
2	1.5	-	-		0.6	0.4	1.0
3	0.8	0.6	1.4		0.7	0.8	1.5
4	2.5	-0.2	2.3		2.2	-0.1	2.1
5	1.2	0.3	1.5		0.0	1.0	1.0
6	2.0	1.2	3.2		2.0	-0.2	1.8
				6th Grade			
1	1.4	-1.0	.4		1.4	-0.7	.7
2	0.9	1.2	2.1		1.2	0.8	2.0
3	1.6	0.9	2.5		0.4	1.4	1.8
4	1.0	1.2	2.2		0.3	0.9	1.2
5	2.0	0.7	2.7		2.4	0.2	2.6
6	1.0	-0.4	.6		1.7	-0.3	1.4
				N			
$\bar{X}_1$	1.42	-	-	12	1.27	.38	1.64
$\bar{X}_2$	1.44	.45	1.89	10	1.23	.38	1.61

Using the paired observation technique to analyze data for the interval from October, 1974 to February, 1975 the grade level gain yields a t value of 0.678 for the 12 students and 0.971 for the 10 students. The first t score is significant at the 0.275 level and the second t score is significant at the 0.20 level.

From February, 1975 to October, 1975 the grade level gain yields a t value of 0.398 significant at the 0.36 level. In the combined grade level gain from October, 1974 to October, 1975 the paired observations yield a t value of 1.2522 significant at the 0.13 level. The complete data from the October, 1974, and October, 1975 ITBS shows that fifth grade students at this school averaged 0.9 years of gain and the sixth-graders averaged 1.5 years of gain. Since data is available on only four fifth-graders and six sixth-graders, the weighted mean of 1.26 years of growth was used between the two test periods. The corresponding t score is 2.2141 which is significant at the 0.03 level.

Each pairing was sex-consistent. In the October to February test interval, the four girls were exactly even with their control on grade level gain so the margin of gain was entirely attributable to the eight boys. The paired observation on the eight boys gave a t value of 1.043, significant at the 0.20 level. The girls in the control group outperformed the girls in the experimental group from February, 1975 to October, 1975, and the boys accounted for more than the slight edge held by the experimental group. In the combined total the boys produced most of the advantage and had a t value of 1.2026 which is significant at the 0.15 level. Compared to the class average grade level gain the seven boys produced a t value of 2.41815 which is significant at the 0.03 level.

COMMENTS

Although the results are quite impressive, several points of caution should be noted:

1. The sample size was small and consisted of students from one school in one small community.

2. The control group scored considerably higher than class average on growth (significant at the 0.05 level). This may have had something to do with removal of half of the slower students from a class giving the teacher more time to concentrate on the others who were having some difficulties.

3. Other programs for slow learners were in progress and may have been having some effect on the observations.

4. The instruction was conducted by two persons with more mathematical training than the usual fifth grade teacher, but with less experience at this grade level.

CONCLUSIONS

It appears that using pocket calculators in the manner of this experiment doesn't seriously erode the basic mathematical skills of the children. The calculators may be more effective with boys than with girls. Possibly the boys derive more excitement out of this mechanical toy than do girls. Fifth-graders outperformed sixth-graders. There was less regression between February and October than expected. It seems as though once started, the students continued to grow without further treatment.