BACK

CALCULATOR MODULATED ARITHMETIC IN ELEMENTARY SCHOOL

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Abstract
The paper investigates the problem of understanding of arithmetic and suggests that calculator can be used in an exploratory and investigatory way, and how it can help children in constructing their own understanding of arithmetic. All three methods of computation: written computation, mental computation (also estimation), and calculator should relate to conceptualisation and problem solving. We see calculator modulated arithmetic as a possible solution for redefining school arithmetic in terms of enhancing understanding and problem solving.

1. Introduction

The idea of using calculators in the mathematics classroom is one of the main areas of concern and argument particularly in elementary school in Slovenia. The main questions of concern we believe, among others, are: Will understanding of arithmetic be lost with the advent of a calculator?, and Will our children become dependent on calculators?.

We agree with Coburn (1989) who says that a child who multiplies 300 by 122 using the traditional paper-and-pencil algorithm is dependent on written computation.

The study of children's understanding of written computations which has been done at the end of the school year 1999-2000 in a group of 27 Year 4 children in Slovenia showed that 5 children used written algorithm for 25×2, 6 children used written algorithm for 115×10, 5 for 200×5, 15 for 101×8, 7 for 2000×4, 7 children calculated 300×60 as shown in figure 1 and 12 children used the same method for calculating 980×80. We could agree that these children are dependent on written multiplication.

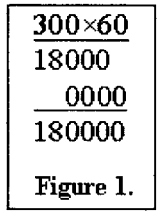

Figure 1.

2. Main reasons for resisting calculators

We see the following reasons as the main reasons for resisting calculators in elementary school in Slovenia:

- Teachers' subjective theories about teaching and learning which define their interpretations of the curriculum demands, their teaching methods, their ways of assessing mathematical knowledge, etc.
- Definition of school arithmetic. Arithmetic in Slovenia is mainly about computations. Although it is important for children to practice mathematical algorithms and to become skilful in arithmetic, we must be aware that skills are sufficient and useful if they are built upon understanding about how algorithms work.
- Lack of knowledge about the ways of using calculators in the process of learning arithmetic.

3. Evidence and Opinion from Around the World

Only a few research findings which support using calculators in elementary school will be listed here.

Calculators have the potential to transform school mathematics from a procedurally dominated subject to the exciting study of patterns and relationships, may expand the curriculum in a problem-solving direction, can help children in constructing their own understanding of arithmetic, and play an important role in motivating children for learning mathematics (Wheatley & Shumway (1992), Finley (1992), Herden (1985), Hembree & Dessart (1986), Shuard, H., Walsh, A., Goodwin, J. & Worcester, V. (1991)).

Can evidence and opinion from around the world change teachers' subjective theories about teaching and learning arithmetic? What can change these theories?

4. Children's calculations with calculators: a study of Year 4 group of children in Slovenia

This section reports some results of a study aimed to assess children's understanding of arithmetic algorithms, pattern recognising, and ability to estimate when children may use calculators. In this study, 27 children of Year 4 participated. The test consisted of 7 items, four relating to computations, and three to patterns. The main study hypothesis was that calculators are of no use for children if they do not understand how algorithms work. Each child has his or her own calculator. The study took place at the end of school year 1999-2000.

1. Use your calculator to find the missing numbers in each of these problems.

a. 673×45 = 26920 + ____ ← ←

b. $9\square \times 28$ = ____ + 784

c. $4\square \times \square 8$ = ____ + 8 = 319_

d. 3872 + ← + 7687 = 20295

e. 7683 : 98 = , rem 39

Figure 2: The first item on the test

Some results and short discussion

Children's solutions of the first item can be grouped into four categories as shown below in Table 1.

Item 1 / Categories	a	b	c	d	e
1. does not apply standard algorithm/incorrect answer	4	11	4	8	3
2. partly applies standard algorithm/incorrect answer	5	4	4	3	0
3. gets correct answer	17	3	2	8	24
4. does not tackle a task	1	9	17	8	0
	27	27	27	27	27

Table 1

Children's solutions of the first task show poor understanding of written algorithm of multiplication. We observed also that children helped

themselves with paper and pencil computations whenever possible in the test and did not even try trial and error method for getting the results.

Some children made an interesting comment that it was easier to do written calculations than computations with calculators.

5. Concluding remarks

A research in Slovenia on using calculators in elementary school should address the following issues:

- children's understanding of standard algorithms,
- teaching standard algorithms,
- integrating a calculator in the learning and teaching of algorithms,
- assessing children's understanding of standard algorithms with calculators.

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