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## PROBLEMS WITH NO BOUNDS IN TEACHING MATHEMATICS AT PRIMARY SCHOOL

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**Abstract:** The curriculum of mathematics for the initial stage of the basic educational level is relatively constant for the past 35 years. The only visible trend in educational reforms of 2000 and 2015 is to simplify the material, dropping out the traditional Bulgarian elementary school substantive topics in mathematics and minimal redistribution of content for individual classes. In the process of implementation of the ongoing reform, an opportunity was missed for global understanding of trends in mathematics educational content for primary classes in Europe, USA and other developed countries. The change realized in approved and enacted new curricula for the first and second grade is symbolic. The topic of forming concepts of numbers 30, 40, 50 ... 100 and the operations addition and subtraction with them was transferred from second grade at the end of first grade. That is all. In theoretical terms we are talking about the formation of key competencies through training in mathematics. How an old educational content will form new key and transversal competences, important to the child throughout his future life, remains unclear. In 2015 for the first time Bulgaria was included in an international research of achievements in mathematics and natural sciences TIMSS. The results in mathematics for students completing fourth grade were encouraging, but again they clearly highlighted the large gap between the curriculum in Bulgaria and other countries around the world, causing Bulgarian students not being able to deal with one part of the test problems in international studies. The only reason is that this educational content or these types of mathematical problems do not occur in Bulgarian textbooks in mathematics. To overcome this vacuum in 2015, my colleague from the University of Plovdiv Zlatina Sharkova and I, we created the textbook “Problems with no Bounds” in order teachers to be able to prepare their fourth-graders for the upcoming international study TIMSS, and other similar international format math competitions. This article will present the areas of educational content, which are developed in this textbook in addition to the classical educational content in mathematics for elementary schools in Bulgaria. Each topic is presented through sample problems, and the guide for teachers making an integral part of the textbook “Problems with no Bounds” gives guidance for a methodology to work with the types of problems.

**Keywords:** mathematics, problems, education, primary school.

### 1. INTRODUCTION

Nowadays acute issue is the mismatch of the curriculum in mathematics for elementary schools in Bulgaria and other European countries. The differences are, on one hand, essential. Such an example is the lack of knowledge of fractions, decimals and percentages and operations with fractions or decimals. On the other hand there are differences that relate only to the types of problems that are not present in the curriculum in existing textbooks in mathematics for elementary schools in Bulgaria. If overcoming the first kind of differences is a matter of serious reform in the curriculum, overcoming the second kind of differences is a matter of goodwill in awareness of the authors of the new study sets in mathematics about the lack of certain types of mathematical problems. The lack of relevant skills to solve these types of problems hinders the good performance of Bulgarian students in international tests such as TIMSS. To answer this problem my colleague from Plovdiv University – assistant professor Dr. Zlatina Sharkova and I, we created a textbook of mathematics “Problems with no Bounds” [1].

### 2. PROBLEMS RELATED TO NATURAL NUMBERS AND OPERATIONS WITH THEM

Classic element of the content of mathematics education for primary classes in all countries is to have knowledge of natural numbers and the four basic arithmetic operations with them. In this educational content it is possible and necessary to use more not traditional problems and creative exercises. These are exercises in compiling and recording specified multitude of numbers with certain digits. An interesting kind of exercise is the arrangement of dates on the time line with years marked on it. Problems with Roman numerals are of extremely small number in current textbooks in mathematics for fourth grade in Bulgaria. This lack is compensated by a corresponding number of problems in the textbook “Problems with no Bounds”. Modern Bulgarian pupils of primary school age are facing in their daily lives with decimals – prices of goods in the shops where students are shopping. In our textbook, addition of decimals is explained in a simple and practical way. Formation of key skills related to mathematics became the basis of solving the problem tasks for selecting the cheapest or most efficient way of solution. The

Bulgarian educational content is focusing on studying the operations addition and subtraction on acquiring and consolidating algorithm for written addition and subtraction. In real life, in their daily lives, a person more often carries out such calculations in mind than in writing. Oral (mental) calculus is far more necessary and crucial skill for every child. An example of this type of problem:

"Quote at least 5 different ways to sum the numbers 48 and 29."

Solution:

$$\begin{array}{r} 1) \quad 48 \\ + 29 \\ \hline 77 \end{array}$$

Bulgarian student will run out of solution options with variant 1).

- 2)  $(40 + 20) + (8 + 9) = 60 + 17 = 77$
- 3)  $(48 + 20) + 9 = 68 + 9 = 77$
- 4)  $(29 + 40) + 8 = 69 + 8 = 77$
- 5)  $(48 + 2 + 29) - 2 = (50 + 29) - 2 = 79 - 2 = 77$
- 6)  $(29 + 1 + 48) - 1 = (30 + 48) - 1 = 78 - 1 = 77$
- 7)  $(48 + 2 + 29 + 1) - (2 + 1) = (50 + 30) - 3 = 80 - 3 = 77$

The last way is the most popular in the calculus in mind when shopping in everyday life.

Another type of tasks that are included in the textbook "Problems with no Bounds" but are not present in Bulgarian textbooks in mathematics for primary grades, these are the tasks of finding average value, average number, as well as tasks for determining divisibility of numbers. Such tasks often present in international studies in mathematics. Bulgarian students from fourth grade cannot cope with these tasks, not because they lack the necessary basic knowledge or mental capacity, but only because they have never encountered this kind of tasks.

### **3. PROBLEMS FOR CALCULUS WITH APPROXIMATION, NUMERIC ROWS AND PROBLEMS FOR DETERMINING THE HALF, THIRD**

Problems for calculus with approximation are of very great practical importance [2]. In everyday life every person is often calculating values with approximation. Problems for rounding up to the nearest ten, hundred, thousand, etc. are not present in current textbooks in mathematics for elementary schools in Bulgaria. The textbook "Problems with no Bounds", presented here, have featured a significant number of problems for calculus with approximation and the approach to rounding is shown. I think that these are fully accessible and interesting even for students from second grade problems that can be included in the teaching of mathematics in our country. The problems related to numeric sequences are directly related to logical thinking. The development of logical thinking in students of primary school age is one of the leading tasks of teaching mathematics today. In the textbook there is a separate theme of the numerical rows. Problems of this kind are also often present at tests in international studies as well as in international math competitions. Concepts half, third, quarter, etc. are taught in third grade math. The new curriculum [3] even foresees, finally, also Bulgarian students from primary school to start recording fractions. Finding a half, third, etc. of something is a skill of a big practical importance to the child yet from preschool. The textbook "Problems with no Bounds" includes a system of tasks, illustrated with paintings and models to determine a part of the whole. Such tasks we believe are fully accessible and understandable for Bulgarian students from third grade. They need to be aware of this type of exercise in order not to fall into difficulty when they occur in international studies or contests.

### **4. GEOMETRY, DRAWING IN A SQUARE GRID, SYMMETRY, COORDINATE SYSTEM**

The differences in the geometric educational content for elementary schools in Bulgaria and countries in Europe and the US are two types – essential and type-related problems. The problems of symmetry are extremely accessible and fun for young students from the first grade. They can find much wider place in the new educational kits in mathematics, created on the basis of new curricula in mathematics for the first [4] and second grade [5]. On geometric educational content, the essential difference is in studying, in European countries and the United States, three-dimensional shapes: cube, cuboid, cone, cylinder, and pyramid. Such educational content is missing so far in Bulgarian textbooks. Under the new math curriculum for fourth grade, which is still a draft version [6], it is provided for students to distinguish between geometric objects – cube, cuboid, cylinder, pyramid, cone, sphere and indicate the elements of geometric bodies cube and cuboid – wall, tip, edge. Drawing in a square grid is not sufficiently

practiced in educational math kits in Bulgaria. Exercises related to the coordinate system in entertaining, game-like form are provided in the textbook “Problems with no Bounds”.

#### **5. DATA TABLES, PICTOGRAMS, RECTANGULAR, CIRCULAR AND LINEAR CHARTS, VENN AND CAROL DIAGRAMS, ORIENTATION WITH A MAP, WORKING WITH SCHEDULES, COMPLETION OF TASKS UPON INTERNET DATA**

Working with numeric data graphically represented in different types of charts is a new element of the curriculum in mathematics for elementary schools in Bulgaria. Our textbook covers various kinds of tasks with such diagrams. The methodology of work on solving problems with diagrams is represented by me in previous publications [7] [8] [10]. Orientation on map is a key skill of great importance in the daily lives of every person. Basic problems of this kind are presented in the textbook “Problems with no Bounds” and methods of dealing with such problems are developed in my previous publication [11]. A different, from the Bulgarian educational content, topic in mathematics in primary school is working with schedules and timetables. What tasks and how to present them to students from fourth grade is the topic I presented in a scientific journal publication [9].

#### **6. CONCLUSION**

The textbook “Problems with no Bounds”, presented in this article, is an example of how the shortcomings of the new curricula and relevant teaching sets can be compensated. The problems in this textbook are available and well presented to students from fourth grade and from an earlier age. The main topics in the textbook correspond to the types of mathematical and practical problems that are part of the educational content in mathematics for primary grades in countries in Europe and the US. With such additional educational resources it is possible to equalise the level of skills and competencies of Bulgarian students from primary school age to those of 7-11 year olds in the world.

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