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TECHNOLOGY FOR TEACHING FIRST GRADERS WORD PROBLEMS CONTAINING THE WORD COMBINATIONS "MORE THAN" AND "LESS THAN"

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Abstract: The use of various activities in the educational process contributes to the mastery of both mathematical content and key competences on the part of the pupils. Regarding the mastery of mathematical competencies, in particular, the greatest emphasis is placed on the following: solving word problems, describing real and picture-based practical situations by means of mathematical models, connecting arithmetic actions with practical solutions and formulation of answers.
The publication introduces the content and technology for teaching word problems with one computation (addition or subtraction), which contain the word combination "*more than*" and "*less than*". The established system and technology includes word problems:

- of finding a number that is a number of units greater or less than a given number;
- of comparing two numbers by their difference.

The presented ideas can be used, elaborated and pored over according to the learners' abilities – during the lesson or during extracurricular forms of education.
Keywords: primary education in mathematics, word problems, didactic technology

1. INTRODUCTION

An important unit in the system of the general education of first grade pupils is the new curriculum in mathematics [4] and the textbooks elaborated thereon. The program emphasizes that the use of a variety of activities in the learning process determines the mastery of the mathematical content and contributes to the mastering of key competences and personal development of the pupils. In particular, the emphasis for the mastery of mathematical competencies is placed on the solving of word problems with one computation, the describing of real and picture-based practical situations with mathematical models, the connecting of arithmetic actions with practical solutions and the formulation of answers.

2. METHOD

In [1] we present a system and technology for studying the group of word problems in mathematics in the first grade, which clarify and assist the learning of the meaning of arithmetic addition and subtraction. These problems are of the following type: set-set-set word problems with an additive structure.
The studying of the global topic *Addition and subtraction of numbers up to 20 by passing to* [4] defines the following competence as an expected learning outcome: the solving of word problems with included word groups "*more than*" and "*less than*". According to the set-theoretical interpretation of the situation, these problems are of the set-relation-set type [5].
The purpose of this article is to present a system and technology for the mastering of word problems in mathematics of the set-relation-set with an additive structure type in the first grade.
The established system and technology is subject to the requirements of the new curriculum in mathematics for the first grade [4]. It includes the following word problems:

- to find a number, that is a number of units greater than or equal to a given number;
- to compare two numbers by their difference.

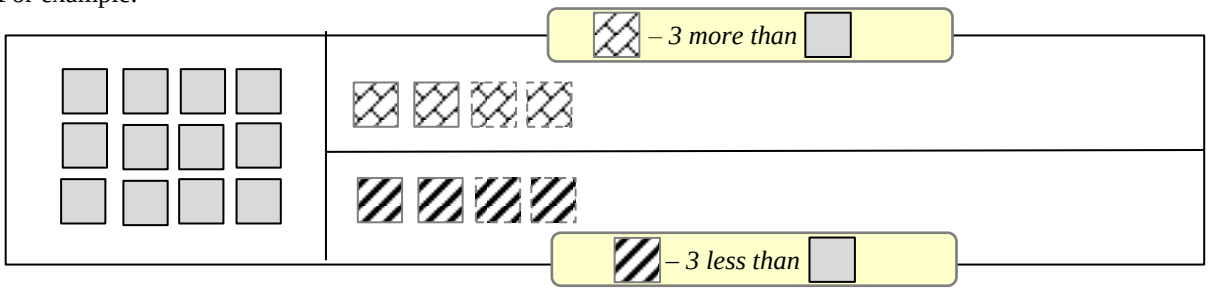
The basis for understanding and solving word problems of these types is the clarification and the realization of the meaning of the word groups *"more than"* and *"less than"*.

2.1. System and technology for studying word problems, the terms of which include the word groups "*more than*" and "*less than*"

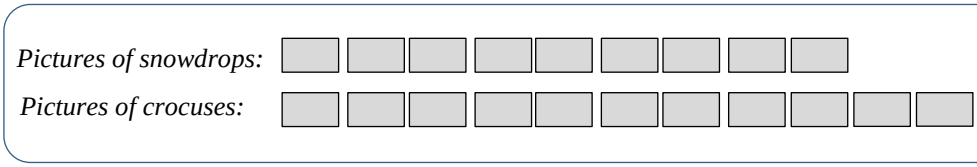
The preparation for the clarification of the concept of relations "*more than*" and "*less than*" consists in updating the knowledge and skills for the relations "*equal*", "*greater*" and "*less*" in the sets of natural numbers.
During the formation of new knowledge it is necessary to observe the stages of abstraction.
Appropriate means for object visualization are various shapes, sticks and the like.
Several figures are placed in a row on the magnetic board or the desk in front of the pupils. In another row the same number and one more figure are placed. Thus, in the second row (respectively the first one) there is one figure more (respectively less) than in the first row (respectively the second one). Similarly should be proceeded, if there are a

number of figures in the first row, and in the second one there are as many as in the first one and two, three and ... more figures. It should be determined by how much the number of figures in the first row is greater (respectively smaller) than the number of figures in the other row.
The described activity is recommended and useful to be done by the pupils themselves.
Interactive resources from the electronic textbook [3] can be used.
It should be consecutively continued with the use of illustrations through drawings and schematic and mathematical models of problems.
Here is an illustration, through which it can be determined by how many the one type of objects/martenitsas is greater (less) than the other types:

It is found that the storks-martenitsas are 3 more than the snowdrops-martenitsas and that the snowdrops-martenitsas are 3 less than the storks-martenitsas.
The meaning of the word groups *"more than"* and *"less than"* is solidified on a practical basis. The pupils depict quantities that are more or less with a few units of a given quantity of elements.
For example:



The beginning of the establishment of the system of word problems of the given type is set by the following problem:
Ivan cut out nine pictures of snowdrops and two more pictures of crocuses. How many pictures of crocuses did Ivan cut?
A schematic pattern of rectangles (a figure closest to the format of the image) can be used for illustration:



The reasoning is as follows: Pictures with snowdrops (9) are displayed symbolically on one line. The pictures with crocuses are 2 more. This means that their number is the same as that of the pictures with snowdrops and 2 more. The second row displays the pictures with crocuses. It is established that in order to obtain the number of them, it is necessary to add 2 to 9, i.e. 9 + 2 = 11 (pictures with crocuses).
Through problems of this type, a skill is formed for modeling with numerical expressions of situations described with the relation *"more than"*.
A few more problems of this type are discussed by changing the plot, the data and the way they are set (numerically or in words), but their mathematical nature is preserved. The choice of arithmetic action is justified.
Such actions are also carried out with the problems, in which the word formation *"less than"* take part.

Suitable patterns for rationalizing relation are the use of strips (rectangles) of different lengths, but composed of the same squares (their number is determined by the data of the specific problems).

Let's examine the problem:

Twelve ducklings and 4 less swans are swimming in a lake. How many swans are there?

The reasoning is now the following: On the first line, the ducklings are symbolically displayed (a band consisting of 12 squares), and on the other one – the swans – as much as the ducklings, but four less. Therefore, to find out how many swans are there, we need to take out 4 of the 12, i.e. 12 – 4 = 8 (swans).

Through problems of this type, a skill is formed for modeling with numerical expressions of situations described with the relation *"less than"*.

A few more problems of this type are discussed and solved by changing the plot, the data and the way they are set (numerically or in words), but their mathematical nature is preserved. The choice of arithmetic action is justified.

On the basis of the described content and methodology, a conclusion is formulated about finding a number that is by several units greater or less than another number.

The system of word problems includes those, in which quantities are involved. In such cases, the relations are expressed with the word combinations: *... centimeters longer, ... centimeters shorter, ... kilograms heavier, ... kilograms lighter, ... leva more expensive, ... leva cheaper*. These problems are the basis for shaping the perceptions of the pupils of quantity and dependence between quantities.

Examples:

Martin drew a section with a length of 12 centimeters and Boris – a section with a length of 8 centimeters (8 cm shorter). How many centimeters is the section that Boris drew?

Elitsa weighs 15 kg and Emo is 2 kg heavier (lighter) than her. How many kilograms weighs Emo?

Annie bought a doll for 10 leva and a book – 5 leva more expensive (cheaper). How many leva does the book cost?

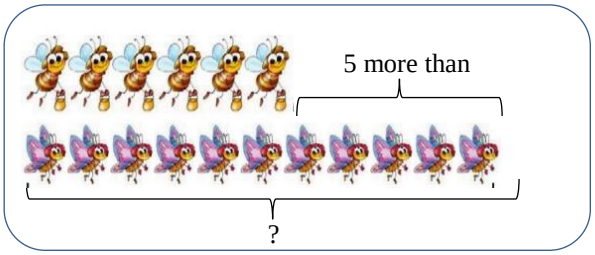
When working with word problems, it is necessary to highlight the difference between the problems that reveal the meaning of the action addition (or subtraction) and the problems of finding a number that is a number of units greater (or less) than a given number. Therefore, it is suggested to compare the following pair of problems:

There are 6 bees and 5 ladybugs on a meadow. How many insects are there on the meadow?

There are 6 bees and 5 more ladybugs on a meadow. How many ladybugs are there on the meadow?

It is discussed with the pupils that with the first problem the action addition shall be used in order to find out how many insects are there on the meadow. In the second problem, the action addition shall be used, but in order to find out the number of ladybugs.

It should be noted, that the comparison of the problems is facilitated by using appropriate visuals to illustrate their content.



Similar problems are compared, but with the subtraction action.

The construction of the system of word problems continues with consideration, collation and comparison of a pair of problems, in which the condition of the one includes the combination of *"more than"* and of the other – *"less than"*. The choice of the arithmetic action is justified for each of the problems.

Examples:

Mila painted 13 red eggs and 4 more yellow eggs for Easter. How many yellow eggs did Mila paint?

Moni painted 13 red eggs and 4 less yellow eggs for Easter. How many yellow eggs did Moni paint?

Similar is the idea of presenting and viewing a pair of "unordered" problems.

Examples:

Ellie's mother baked croissants and cakes. The croissants are 14. How many cakes did Ellie's mother bake, if they are 6 more than the croissants?

Children made kites and carousels. The carousels are 14. How many are the kites, if they are 5 less than the carousels?

It is good to transform the arrangement of the elements of the external structure of each of these problems and to reformulate them in the form of ordered problems.

An appropriate technique for improving the skills for solving word problems of the considered type is completion of the problem upon a given condition, a partially given condition or a given question.

Examples:

- ✓ *Complete the condition and solve the problem.*
  Lina drew 8 roses and ☐ more tulips. How many tulips did Lina draw?
- ✓ *Complete the data and solve the problem.*
  They bought ☐ kg apples and ☐ kg more pears for a school canteen. How many kg of pears did they buy?
- ✓ *Fill in appropriate numbers and solve the problem.*
  They delivered ☐ kg of walnuts and ☐ kg less hazelnuts in a store. How many kg of hazelnuts did they deliver?

The system includes composing word problems by illustrations and by numerical form, according to the requirements of the educational documents.

Examples:

- ✓ *Compose a word problem on the illustration. (The illustration depicts a basket of pears weighing 17 kg and a basket of apples that is shown to weigh 9 kg less. The sign "?" is shown, which indicates that we should find out how much kilograms is the basket of apples).*
- ✓ *Compose word problems on the illustration and solve them. (The illustration depicts a ball, which costs 8 leva and badminton, which is 6 leva more expensive. The sign "?" is shown, which indicates that we should find out how much does the badminton cost).*

For each word problem, the five steps related to the process of its solving [1] must be implemented.

2.2. System and technology for learning word problems by comparing two numbers by their difference

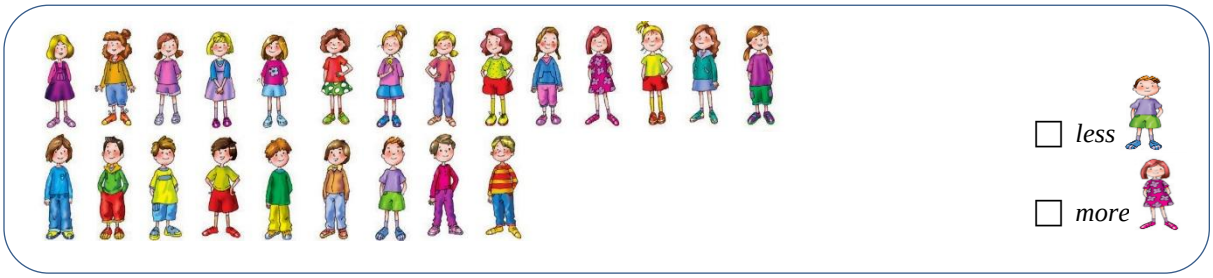
At first it is necessary to use object modeling.

For example, 10 red figures are placed on a magnetic board in one line, and in a second line – 15 blue figures. The pupils are required to find out how many figures are there in each of the two lines. In order for pupils to find out how many the blue figures are more than the red ones and how many the red figures are less than the blue ones, we should start removing one red and one blue figure simultaneously until only blue figures remain. It will be established that 10 red and 10 blue figures are removed and that five blue figures remained. Therefore, the blue figures are 5 more than the red ones, and the red ones are 5 less than the blue ones. This result is obtained by subtracting 10 from 15: 15 – 10 = 5.

We can also do the following: to remove several from the blue figures in order to match them with the red ones.

This shall be followed by visualizing the problems by using illustrations, schematic and mathematical models.

For example, 14 girls are drawn in the first line and on the second line – 9 boys. In this illustration, the following questions can be answered: *By how many are the girls more than the boys? And how much less are the boys?* The reasoning is similar to those described for the figures.



A problematic situation arises: How will the questions be answered, if the girls and boys are not arranged in two lines, but are depicted scattered? It is necessary to count the children, find the difference 14 – 9 = 5 and establish what the number 5 means.

After these preliminary actions, the word problems for comparing two numbers by their difference are included. Here are the first of them:

In the park, 15 boys are skateboarding and 8 girls are riding bicycles. How many more are the boys than the girls?
In the park, 16 boys are skateboarding and 8 girls are riding bicycles. How many less are the girls than the boys?

The system of word problems is enriched by discussing and solving a number of problems of this type by changing the plot, the data and the way they are set (numerically or in words), but their mathematical nature is preserved. The choice of arithmetic action is justified.

On the basis of these actions and reasoning, we draw the following conclusion:

In order to find out how much one number is greater or less than another number, the smaller number should be subtracted by the larger number.

For each word problem, the five steps related to the process of its solving must be implemented

In addition, word problems are included, involving quantities with their specific word combinations.

Examples:

Angel bought 12 kg of apples and 9 kg of pears from the market. How many more kg are the apples than the pears?

A teddy bear costs 16 leva and a teddy bunny costs 8 leva. How much leva is the teddy bunny cheaper?

Asya drew a section with a length of 13 cm and Bistra drew a section with a length of 7 cm. How many centimeters is Asya's section longer than Bistra's? How many centimeters is Bistra's section shorter than Asya's?

The construction of the system of word problems includes analysis, comparison and solving of pairs of problems of different types. This helps developing the way of thinking of the pupils.

In order to consolidate and improve the skills for solving word problems, the following types of word problems are solved: in the question of the one participate the words *"how much more"* and in the question of the other one – *"how much less"*.

Examples:

Zlati and his father dug 15 poplars and 9 birches. How many more are the poplars than the birches?

Pupils planted 14 pine trees and 8 fir trees. How many less are the fir trees than the pine trees?

This is continued by a comparison of different types of word problems: in one of them the word combinations *"more than" ("less than")* are in the condition and in the other one – in the question.

Examples:

First-graders made 9 paper frogs and 7 more paper boats. How many paper boats did they do?

First-graders made 9 paper frogs and 16 paper boats. How many more are the paper boats than the paper frogs?

Sasho found 16 mushrooms and Ana – 9 mushrooms less. How many mushrooms did Anna find?

Sasho found 16 mushrooms and Ana found 9 mushrooms. How many less mushrooms did Anna find?

The construction of the system of problems is followed by comparison and solving of different types of word problems: in one of them the word combinations *"more than"* (*"less than"*) are in the condition and in the other one the word combinations *"more than"* (*"less than"*) are in the question.

Examples:

Elitsa has 17 leva and Hristo – 8 leva less. How many leva does Hristo have?

Vaniya saved 14 leva and Vesi – 8 leva. How much more leva did Vaniya save?

The pupils establish that in these two problems the relations *"less than"* or *"more than"* are involved, but they are solved with the same action – subtraction.

In order to consolidate the modeling skills with numerical expressions of word problems of the considered kind ones should be included, which require adding data or formulating a question. Here are some examples:

- ✓ *Complete the data and solve the problem.*
  A housewife bought ☐ kg of potatoes and ☐ kg of peppers. How many more kg of potatoes did she buy?
- ✓ *Ask a question, so the problems can be solved with a subtraction action.*
  Dimitar has 12 leva and Elena – 7 leva.

The composition of word problems with one calculation by illustration and numerical expression is one of the competences that are an expected learning outcome reflected in the new curriculum for mathematics for the first grade. Here are some of the problems included in the presented system:

Compose a word problem on the illustration (the illustration depicts sheep and lambs weighing 14 kg and 8 kg respectively), which is solved as follows: 14 – 8 = ☐ .

With this requirement, the problem is to compare two numbers by their difference.

Compose two word problems on the illustration: one is solved by the addition action and the other one – by the subtraction action (the illustration depicts a crate with pears weighing 20 kg and an apple container – 80 kg).

Compose a word problem that is solved with the addition of 9 + 5.

Compose a word problem that is solved by the difference 14 – 5.

It is good for pupils to draw up problems of different kinds.

Thus far we have presented the ideas of the constructed system of word problems and the methods of their solving.

3. FINDINGS

The proposed content and technology of the solving of word problems of the multitude-relation-multitude type in the first grade reflects the main focus of the study on the topic. Their application will contribute to the development of thinking and creativity of first graders.

4. CONCLUSION

The presented work is based on the new curriculum in mathematics for the first grade of the secondary school.
The established system and technology, which includes word problems of finding a number that is a number of units greater or less than a given number and of comparing two numbers by their difference, can be used, elaborated and pored over according to the learners' abilities – during the lesson or during extracurricular forms of education.

REFERENCES

[1] Angelova, V. System and technology for studying word problems in the first grade of primary school. In: KNOWLEDGE – International Journal Scientific paper Vol. 14.1., p. 387 – 392, 2016. ISSN: 1857–92
[2] Angelova, V., Topalska, R. Mathematics for 1. grade. Sofia, Prosveta plus, p. 140, 2016. ISBN: 978–619–222–020–4
[3] Angelova, V., Topalska, R., Kadeva, V., Nikolova, A. Mathematics for 1. grade. Sofia, Prosveta plus, electronic textbook, p. 142, 2016. ISBN: 978–619–222–036–5
[4] The mathematics curriculum for the first grade. Sofia, Ministry of education, 2015.
[5] Frenkev, D. About word problems in primary mathematics education. Plovdiv, p. 138, 2004. ISBN: 954–8667–11–2