IT IS NEVER TOO EARLY TO START DEALING WITH LOGISTICS - SOME IDEAS ON THE USE OF SET LANGUAGE IN THE FIRST CLASSES OF ELEMENTARY SCHOOL

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Abstract: Logistics is the planning, organization and monitoring of materials, information, people and sources flowing through systems. In Mathematics it means the interpretation and analysis of functions, sequences and relations between sets. That is why it is extraordinarily important to present the appropriate concept of sets to elementary school children. As a lecturer teaching the methodology of teaching mathematics, I have often been present in the practising classes of our students, so I have direct experience in what kind of examples and tasks in relation to sets teachers give children in the junior section of elementary school. In this paper, I present some typical, selected examples related to sets taken from workbooks for the junior section. Each of the examples suggests to the students that a set can be characterised with the common property of its elements. With my paper, I should like to draw the attention of teachers of mathematics in the junior section and of lecturers teaching methodology at teacher training colleges to this problem in order to avoid developing a "one-sided" concept of sets in young learners.

Keywords: set language, education, logistics

1. Introduction

In the 1970s the word "set" was not even mentioned in the mathematics material for elementary schools. First, it was introduced in the upper classes of the academic grammar school in the form of a definition like this: "The whole of entities with identical properties is called a set." At that time, no-one was particularly concerned either about this basically incorrect definition or about the following one: "The directional section is called vector." Later, at the university, the misunderstandings involved in these definitions were immediately clarified in the first classes without any big fuss being made about it.

The "New Mathematics" movement of the late 1970s and early 1980s regarded it a task of special importance to teach the basics of set theory and use set symbolism. This was the period when the word "set" was mentioned every now and then in mathematics classes in the junior section of elementary school. Now it is recognised worldwide that this was an unsuccessful attempt at educational reform.

Nowadays, neither set theory nor mathematical logic is taught in the junior section of elementary school. Instead, children get to know some related concepts in practice, which they then use as a device to solve some tasks in a form incorporated into different mathematical topics (e.g. "Arithmetics, algebra", "Geometry, measuring"). Naturally, we do not tell students that the "set" is a basic concept, and a set can be defined if we can

unambiguously decide about all the possible entities (objects, persons, numbers, amounts, plane figures) whether they are elements of the set or not. Children are presented with lots of examples and this is how we expect the right concept of set to develop in their minds.
Are we really successful in developing the correct concept of set in children's minds?
With my present paper, I should like to draw the attention of lecturers teaching the methodology of teaching mathematics, of teachers of mathematics for the junior section and of the students of teacher training colleges to the fact that if we apply the examples and tasks in the present textbooks and workbooks without due attention, then this may develop a distorted set concept in young learners' minds.

2. Development tasks related to sets in mathematics education in the junior section of elementary school

Ministerial order No. 28/2000. (IX. 21.) OM on the issue, introduction and publication of frame curricula uses the term "set" in connection with the following tasks and activities to be performed in classes 1-4 of elementary school:

- comparison, selection, arrangement and grouping of objects, persons and things, forming sets on the basis of shared properties
- union of two sets: in concrete cases by addition
- breaking up a set: in concrete cases by taking away
- the number as a set property
- comparison of sets: counting
- comparison of sets, counting and counting down
- completion of open sentences, finding their truth sets
- the role of basic sets, subsets and complementary sets in the solution of open sentences
- recognition of set properties, characterisation of subsets
- finding the truth set of an open sentence with a trial-and-error method in finite basic sets
- finding the truth set of an open sentence with substitution in a small finite basic set
- rounded-off figures through sets and amounts
- finding the truth set of open sentences in a finite basic set; in simple cases with inference
- sorting out the elements of a given set according to a given property
- the interpretation of the relationship of basic sets, subsets and complementary sets

Government order No. 243/2003 (XII. 17.) on the issue, introduction and application of the national base curriculum "only" uses the term "set" in the following development tasks of junior section mathematics:

- The expression of quantitative properties with numbers; the interpretation of numbers with real amounts: e.g. measurement number and count number (the numerical property of the set); natural, rational and real numbers; exact numbers and approximate numbers.
- Sorting out according to two factors; shared attention; simultaneous monitoring of two or more factors. Using sets as devices.
- Conscious observation in abstract situations; analysis, identification and distinction according to given properties; the development of targeted, deliberate attention; keeping track of factors (highlighting objects, phenomena and the relations between phenomena, as well as the identity and difference between abstract concepts and phenomena; the definition of point sets with a diagram or algebraic formula);

- according to recognised properties and relations (following rules
  - intuitively, the expression of the recognition of regularity, e.g. by
  - continuing or omitting the non-suitable elements; raising
  - awareness of rules with examples; generalisation, general formulation);
- according to varying factors and conditions; independent choice of factors.
- The creation of complexes according to given conditions; creation of sets; creation of defining properties; creation of the negation of the property as a common, defining property of the elements of the complementary set.

In accordance with the content of the abovementioned educational documents, we make the students of the junior section compare, sort out, order and classify objects, persons, numbers, amounts and figures first according to one and later according to two or more given or recognised factors. We observe and express the changes which we try to describe with mathematical symbols. We make simple statements about the selections and decide on the truth of statements related to the particular selections. We learn how to apply the expressions 'non', 'and', 'or', 'all', 'there is', 'not all', 'there is no' and 'none' in connection with concrete, finite sets.
First, we do not use the term 'set' for a concrete selection but simply say: 'Mary's books', 'the students of the class wearing glasses', or 'red triangles without a hole'. Later, when it would overcomplicate matters to avoid the use of the term and when it is no longer too highbrow to mention it, we are free to say 'the set of Mary's books', 'the set of the students of the class wearing glasses', or 'the set of red triangles without a hole'. Sooner or later, children learn that a set is the whole of objects, persons, numbers, amounts or figures belonging together in some sense. This belonging together is then illustrated with Venn diagrams, with which we should take care lest students should think that sets are these closed lines. The relation basic set-subset-complementary set as well as the shared part (intersection) and union of sets can be illustrated without using the terms themselves.
The logical set is used in a considerable number of tasks. A set consists of 48 coloured plastic cards, all different. The 48 possible cases are given by all the possible combinations of four colours (green, red, blue, yellow), three shapes (triangle, square, circle), two sizes (large, small) and two topological characteristics (with or without a hole). Unfortunately, the names of the properties are not the best; we know that the names 'large' and 'small' do not say anything in themselves, and teachers rather refer to the property 'without a hole' as 'plain' but they say this causes no misunderstanding in children's minds.

3. Typical junior section tasks in relation to sets

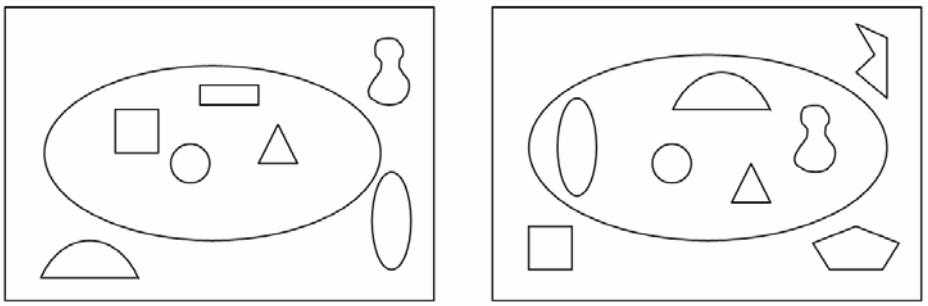
There is now a very rich supply of textbooks and workbooks on the market. Looking through the publications of Apáczai, Dinasztia and National Educational Publishing Houses, I have selected some typical tasks related to sets.

3.1. Choose from among the toys.

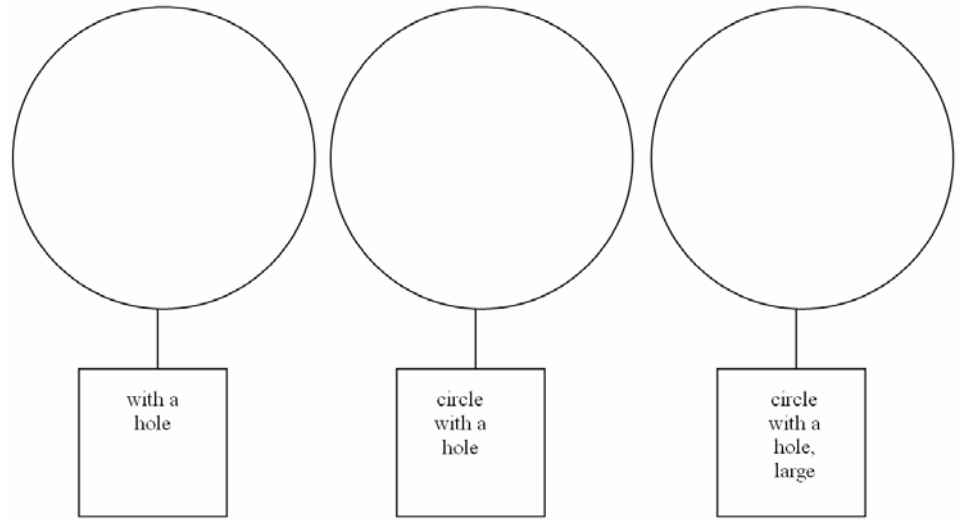
(In the basic set, we can see three dolls, four animal figures, three cars, two of which are exactly identical, a toy locomotive and two skipping-ropes of different lengths.)

a) How have we selected these toys? (The three dolls make one set, the four animal figures another, the two different cars and the toy locomotive go into the third.)
b) Which toy has been left out from the groups?
c) Choose a characteristic and group the toys according to it.

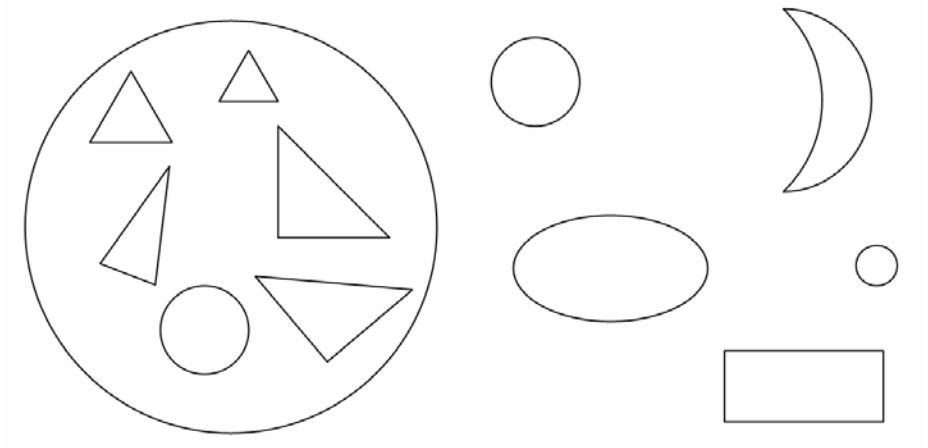
3.2. Which plane figure does not belong to the set? Cross it.



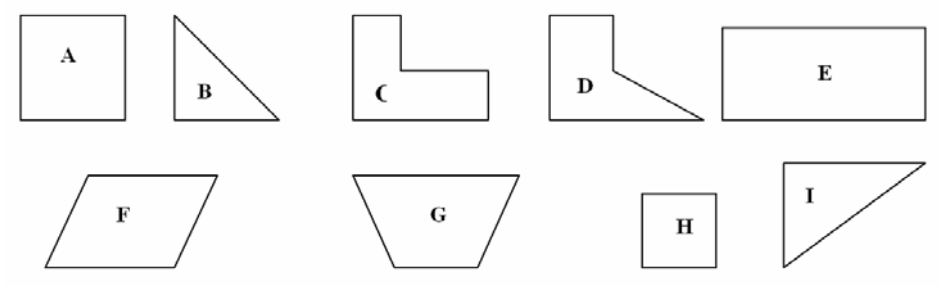
3.3. Draw shapes according to the instructions. Give reasons for your decision.



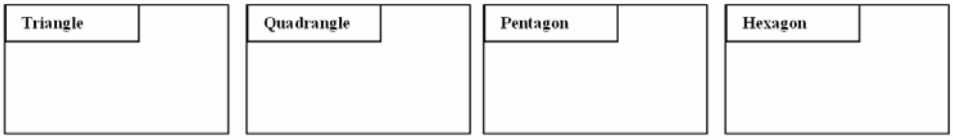
3.4. One of the shapes is an odd man out. Find and draw it in your copybook. Name the shape you have drawn. Give reasons for your decision.



3.5. Group the forms in several different ways writing their letters in the appropriate places.



a)



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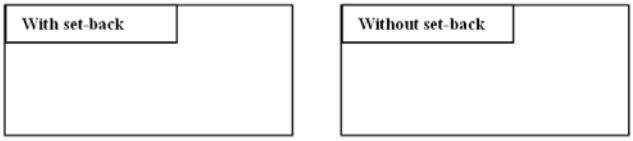
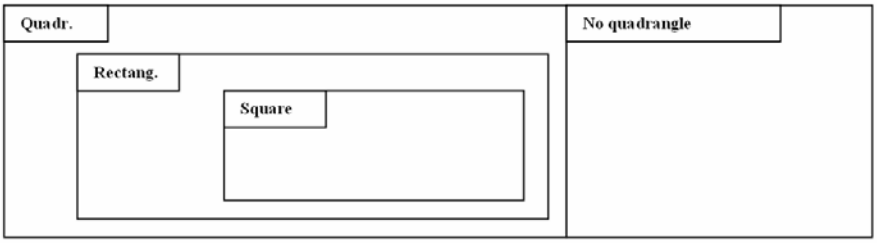


c)



3.6. Which numbers do not fit in the set? Why? Give reasons.

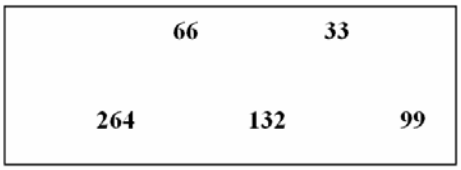
a)

125	280	225	175	115	250
275	75	25	85	150	
50	200	300	100	235	270

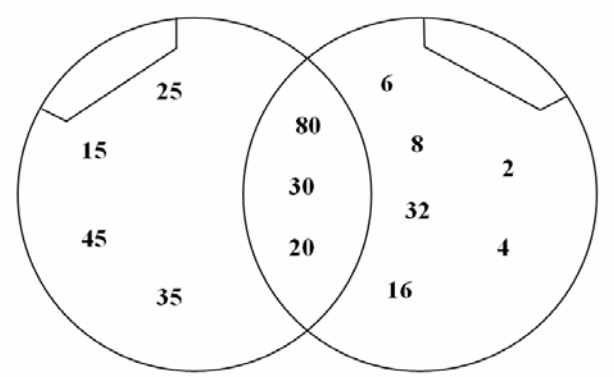
b)

333	665	999	55
933	242	888	
889	666	444	222

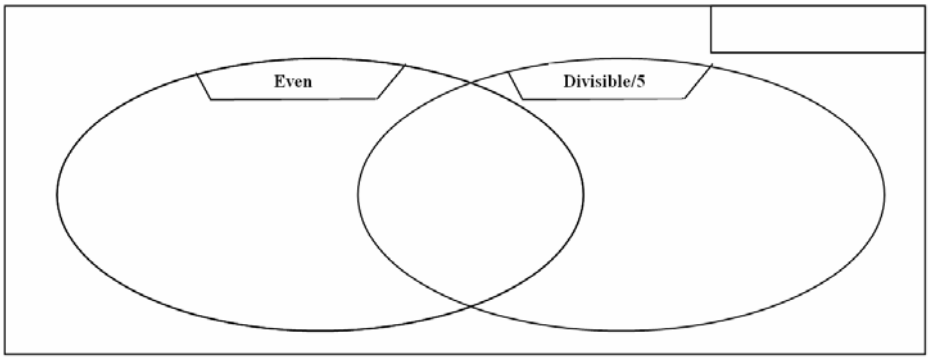
c) These five numbers are left from a set. Which other numbers may belong to this set? Give at least ten.



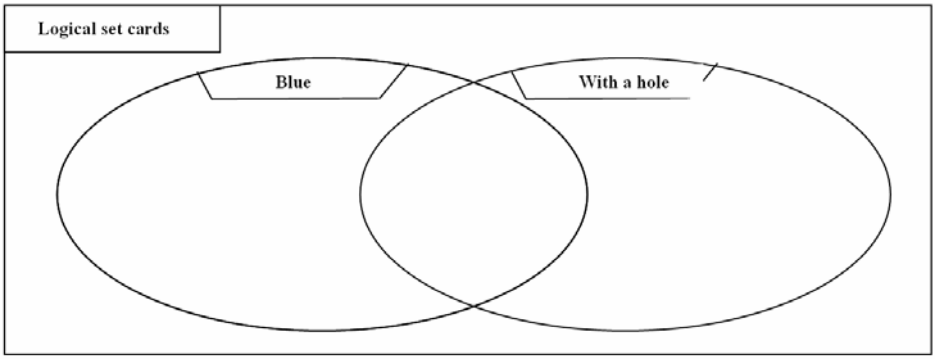
3.7. What can be written on the labels? Make true statements.



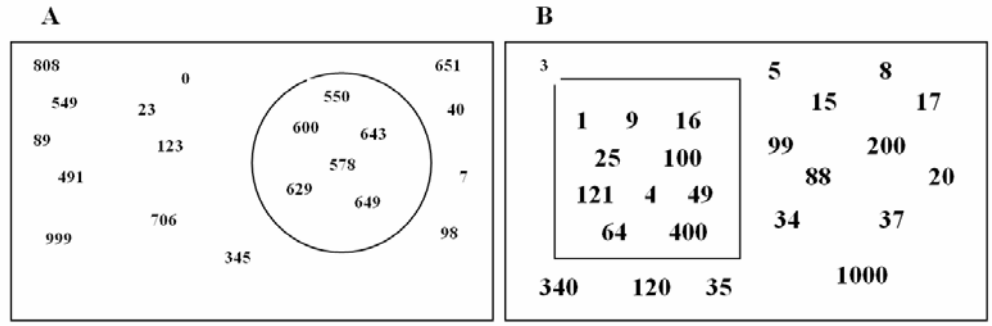
3.8. In the sets, write numbers larger than 25 but smaller than 50. Which numbers may belong to both sets?



3.9. Let us draw.



3.10. Look at the sorting of the numbers. Find a characteristic which justifies precisely these sortings in the figures.



4. Some remarks

It can be said about each of the sets in the abovementioned examples that their elements have some identical property in which they are equal. If we systematically look at textbooks and workbooks for the junior section of elementary school, we can see that in the overwhelming majority of cases the term "set" is used for a whole of such objects, persons, numbers, amounts and plane figures which possess some common property that can be named. However, in their teacher's book entitled "Kézikönyv a matematika 1. osztályos anyagának tanításához" ['Guide to teaching mathematics in the first class'], the authors, Eszter Cervanekné Neményi, dr László Göndöcs, László Merő, Lászlóné Merő and dr Tamás Varga underline:

"The elements of a set need not be constituted by entities that are in some way identical like the red cards in the logical game. Entities of any kind that are selected at random may also form a set, e.g. three randomly chosen cards, to which we can add the dear reader as the fourth element and the set of the letters of the Hungarian alphabet as the fifth. These will make a set of five elements where the fifth element is itself a set (with 40 elements); so the elements of sets may be sets themselves but then this set is considered one element..."

The only problem is that we cannot really find an example for such a set in the workbooks for the junior section. The overwhelming majority of the existing examples suggest to the students that they should always look for some common property among the elements of a set. It is especially true of tasks in which we ask the children to find the elements "not fitting in the set". (See tasks 2, 4, 6.a, 6.b.) Methodologists have even given a special name to this group of tasks: "correction of incorrect sorting" as if it were possible to select the elements of a set defined by the listing of its elements incorrectly! What is more, there is another group of tasks called "Make it wrong." The essence of the game is this: we show the children a "correct" set, e.g. we put all the triangles in the logical set within the set boundary. Then we ask the children to close their eyes, and in the meantime, we put a square among the triangles. Then we ask the students to look at the set again and say what has made it "wrong". The game may be made more difficult if the elements of the starting set are not selected on the basis of one but rather two or three properties.

Let us notice that in most cases it is not the set itself that is important but rather to make students recognize certain properties of the entities selected, make true or false statements about the selection, or decide whether statements about the selection are true or false. In such cases, when it is not important that the objects, persons, numbers, amounts and figures make a set, we should not force the use of the term "set".

5. Summary

Lots of concepts can be appropriately taught without using the language and symbolism of sets. At the same time, the use of set language may help in understanding the relation of concepts. It may be a particularly useful teaching aid in the case of numbers and geometrical figures. Therefore, if the class is up to it, we may use it with care even in the junior section. However, we must take care not to develop a "one-sided" set concept in young learners. If possible, we should present them with examples where the elements of the set possess no common property. If children are given such a task as No. 6, 7 or 10, we should not conceal that "labelling" involves the responsibility that the set characterised with a common property must include all the elements (of the basic set) possessing the property named in the label and not just some of them. In connection with tasks of the type "correction of incorrect sorting", it must be emphasised that the elements of the 'incorrect' sorting also make up a set although a different one. In the "Make it wrong" game, it is not the set that "goes wrong", but the case is rather that the properties that are true for the elements of the starting set are not true for the elements of the other set that comes into being this way.

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