About the Methodology of Teaching Mathematics

Prof. Dr. Olga Yanushkevichiene

Vilnius University, Institute of Mathematics and Informatics, Lithuanian University of Educational Sciences,

olgjan@zebra.lt

Abstract

This paper discusses the teaching of mathematics and developing of logical thinking. Based on the psychology of thinking, the best possible forms of teaching are analyzed. As an example, the compliance with the tasks in one of the mathematical textbooks for elementary school and age peculiarities of children is analyzed.

Key words: teaching of mathematics, developing of logical thinking, concept, psychology of thinking, Vygotsky.

About the methodology of teaching mathematics

Construction of mathematics lessons in school requires reliance on the knowledge of the age characteristics of children. Often, however, these characteristics are not included. In our work, we relied on the basic research of Piaget and Vygotsky, who considered peculiarities of children's thinking. Analyzing the examples of tasks offered in the classroom during math lessons, we will indicate those that do not correspond the age characteristics of children.

Let us consider the age characteristics of school children.

In the logical thinking of the students J. Piaget (1958) singled out the following stages:

1) the concrete operational stage (from 7 till 11-12 years);

2) the formal operational stage (from 12 till 17 years).

Fundamental studies of the development of thought were held by L.S. Vygotsky. Over the years, the findings obtained them are not outdated, but on the contrary, are gaining in popularity (see, Miffre L. (2013)). Therefore, in our work we rely heavily on the works of the scientist. Vygotsky wrote that conceptual thinking, but still imperfect, appears in adolescents 11-14 years of age. Initial concepts are formed on the basis of everyday experience and are not backed by scientific evidence. Perfect concepts are formed only in the youth, when the use of theoretical positions allows going beyond their own experience.

So, thinking develops from concrete images to the perfect concepts denoted by the words.

Vygotsky (1994) wrote: "method of determining operates almost exclusively with words, forgetting that the concept, especially for the child, associated with the sensual material from perception and processing of which it is born; sensitive material and the word are both essential moments of the formation of concepts and words, isolated from this material, the whole process of concept construction moves in a purely verbal plan, which is not characteristic of the child".

A similar opinion was shared by other psychologists, for example, psychologist *F.* Rimat wrote: "We can firmly establish that only at the end of the 12th year of life revealed a sharp increase in the ability of self-formation of overall objective

representations. I think it is extremely important to pay attention to this fact. Thinking in the concepts, loss of visual moments, makes demands to the child, which exceed his psychic powers to 12-year life".

Children of primary school age, as a rule, in the formulation of the question imagine the real situation and how to act in this situation. Such thinking, in which the solution of the problem is a result of domestic action with the ideas and images, called visual-imaginative. Its functions are related to the representation of situations and the changes in them. Visually-imaginative - the main type of thinking in the early school years. Verbal expression of thought, which has no support in a visual representation, can be difficult to understand for children.

In this regard, for younger students preferred word problems, which has the integrity and the concept of the number is based on the concrete images of objects. For example, the teacher says: "Here are two apples. If we add to them another, how much happens? ". Then write "2 + 1 = 3". But the child understands what these symbols mean the concrete objects - apples.

According to Vygotsky, only the middle school student is able to understand the abstract concept of number and can adequately for its designation use an abstract designation (eg, "x").

In fact, in elementary school the development of thinking is formed from the understanding of the particular problems and leads to the feeling of general properties of abstract numbers. Later thinking can from the general properties of an object to receive the particular property of the specific situation. For example, Pythagoras, considering the properties of numbers, even tried to interpret such eternal categories of life as justice, death, constancy, man, woman, and so on. But if the stage of visual-imaginative thinking is missing, later the transition from the general laws to the particular meanings and properties will be complicated.

However, often math teachers think that their main task - to learn to perform some actions according to certain "algorithm", and everything else - it's unnecessary decoration. To understand the meaning of these actions is not necessary, it is important only to the answer turned out right. As a result, thinking remains algorithmic without penetration into the meanings.

A. Dimiev (2008), describing the consequences of algorithmization of mathematics education in US schools, says that students of 11-12 grades "may, for example, to divide the ten in the third degree on ten in the second (that is one thousand on one hundred) and produce an answer: Ten in the fifth. The fact that the resulting number is greater than the original does not confuse them. In addition, many of them simply do not understand that ten in the fifth power - it is a hundred of thousands, and just are not able to realize the value of that number. Many do not realize that a thousand is ten hundreds. And if the majority still have heard that a million is thousand of thousands, then imagine a million is hundred times ten thousands only a few are capable of". A. Dimiev wrote that according to the National Center for Education Statistics of US, 70% of graduates of US schools do not understand the written text of medium difficulty, in other words - do not understand what they are read.

Therefore, in elementary school is so important to create a visual image of the object under discussion. However, in practice this is not always followed. Consider, for example, a number of tasks encountered in the first class textbooks.

In the textbook of Peterson (2009) on p. 1 the first 5 tasks devoted to the introduction of closed intervals and operations with them. Closed intervals are denoted by endpoints, the letters, they add, subtract. Such operations have the high level of abstraction, inaccessible to the primary school pupil. First grader, still feeling number bad, in such a situation can only mechanically, without proper understanding remember, what is required of him.

Next, consider the Task 7 on p. 1 of the same textbook. It is proposed to add flowers and house. Can you imagine a real situation where number of flowers would be going to account alongside with houses? Of course - no! But imaginative thinking starts in life so there is the destruction of imaginative thinking.

P. 2, Task 3. The assignment is to write a sign of inequality between 3 big and 7 small triangles. The question also arises in the adult: that is estimated - the number or area? In the mind of a child creates a bifurcation of thinking, it confused the concept of a large in size and large in quantity, that is, again suffering imaginative perception.

The list goes on. As a result of such training the child gets lost, no longer understand the meaning of what he is doing and only memorize some answers algorithm.

Solution of text tasks develops child logic. Even in IV c. BC. Aristotle, learning the "rules of thought", the first time gave a systematic exposition of logic. Exploring the various forms of reasoning, Aristotle introduced the concept of syllogism, in which the set of the two judgments is derived the third. Gradually solving the problem child implicitly learns the law of syllogism, as well as other laws of logic: the law of contradiction, the law of the excluded middle, and others.

Modern Schools also face the following problem. Analyzing the process of concept formation, L. S. Vygotsky pointed out the importance of social dialogue in this process. He cites Uznadze, who wrote that without "functional moment of mutual understanding no sound complex could not be a bearer of any meaning and could not form any concept". That is, for the formation of concepts not only the presence of creative thinking is necessary, but also the requirement of understanding from the others. In traditional school lesson was built just so: scientific concepts arose in the process of communication with the teacher and classmates. However, in the modern school teacher is gradually disappearing from the learning process, and educate children the technologies, in particular computer. The requirement of understanding are no longer comes from personality and the process of concept formation stops. Gwen D. (2009-2015) writes, that “TV is linked with slower language acquisition because TV time tends to displace conversation time between babies and adults”, similarly in the study of mathematics exactly the will of the teacher, who expects from the student solutions, allows the student to successfully assimilate the material. Stoll C. (1999) says that time on the computer means time taken away from real interaction with teachers and other students. He also says that over the past fifteen years in universities has increased significantly the number of auxiliary courses in mathematics. They teach beginning of algebra, the material of the seventh-eighth grade, because 2/3 of the students do not own these school materials.

Discussion

As outlined previously, there were investigated the possibility of using various types of tasks in mathematics lessons in primary school. This issue requires comprehensive and long-term studies. Nevertheless, the psychological characteristics of this age children need to perform the task which are not abstract and based on the imaginative thinking of this age children. Another problem is the computerization of primary schooling, should be study in depth the benefits and potential harm to the use of computers.

References

[1] Stoll C. (1999). High Tech Heretic: Why Computers Don't Belong in the Classroom and Other Reflections by a Computer Contrarian. Doubleday, New York

[2] Dimiev A. (2008). Cool America (in Russian). Moscow: Paradigm.

[3] Gwen D. (2009-2015). The effects of television on language skills: Does TV really prevent learning? - http://www.parentingscience.com/effects-of-television-on-children-learning-speech.html#sthash.N4kK3Hwk.dpuf

[4] Miffre L. (2013). To form with Vygotstki. Psychology of the activity of teacher in situation, Presses Universitaires de Bordeaux

[5] Peterson L.G. (2009). Mathematics, textbook (in Russian). Grade 1. - Part 2. - Moscow: "Juventas".

[6] Piaget, J. (1958). The growth of logical thinking from childhood to adolescence. *AMC*.

[7] *Rimat F.* (*1925).* Intelligen zu *Untersuchungen anschliessend und die Ach'sche Such methode,* Leipzig.

[8] Vygotsky L.S. (1994). Thought and Language. Alex Couslin (Ed.). Cambridge, MA.: The MIT Press.