

THE ESSENCE OF DEVELOPING THE LOGICAL THINKING OF ACADEMIC LYCEUM STUDENTS

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ABSTRACT

This article describes the development of logical thinking when solving problems using arithmetic and algebraic methods in academic lyceums. The article provides solutions to word problems encountered in entrance tests.

Keywords: Logical thinking, arithmetic method, algebraic method, academic lyceum, method.

INTRODUCTION

New tasks in the training and education of the younger generation require a significant improvement in the organization of the educational process in modern conditions. The training of students at the Lyceum is designed to ensure that students deeply master the basics of science, develop logical thinking, spatial imagination, and research skills. The work of academic lyceum teachers is aimed at developing a creative personality capable of independent thinking and skillfully navigating emerging problems.

The scientific and technological revolution led to significant changes in production technology, to the introduction of automation, robotization, and computer technology, and in connection with this, the role of mathematics increased.

MATERIALS AND METHODS

One of the main goals of studying mathematics is the formation and development of human thinking, first of all, abstract thinking, the ability to abstract and the ability to “work” with abstract, “intangible” objects. In the process of studying mathematics in its purest form, logical (deductive) thinking, algorithmic thinking, and many qualities of thinking can be formed - such as strength and flexibility, constructiveness and criticality, etc.

RESULTS AND DISCUSSION

Logical thinking is a mental process in which a person operates with existing knowledge to obtain a specific conclusion and which is characterized by such characteristics as validity, consistency and coherence. It can be developed throughout life and trained using certain techniques.

In this article we will consider the development of logical thinking when solving problems using arithmetic and algebraic methods.

The arithmetic method is a method of solving a word problem by performing arithmetic operations on the numbers given in the problem.

The algebraic method is a way of solving a word problem by introducing variables and composing the corresponding equation or inequality, or a system of equations or inequalities.

Many people consider the arithmetic method to be artificial, intricate and more complex. Since these are not just operations with numbers, when performing arithmetic operations you need to know what this or that action produces. While the algebraic method is simpler and easier to learn.

The arithmetic solution of many problems requires great resourcefulness and training of thinking, and in this case the reasoning is often artificial. Of course, the benefits of such artificial solutions are negligible. It makes more sense to engage in the arithmetic solution of such problems, which, along with the development of logical thinking, also contribute to a more solid assimilation of theoretical material, prepare students for successful mastery of the algebraic method of solving problems, and show the practical significance of arithmetic.

But it should be noted that problems with artificial arithmetic solutions can sometimes bring great help to algebra. Let me give you a few examples.

1. When studying the method of substitution for solving systems of equations, you can first ask students to solve the following arithmetic problem orally: The boy bought 5 identical notebooks and 7 identical pencils and paid 38 thousand soums. How much does one notebook and one pencil cost separately, if the pencil is twice as expensive as the notebook?

Arithmetic solution:

Since a pencil is twice as expensive as a notebook, the cost of 7 pencils is equal to the cost of 14 notebooks. If 7 pencils are replaced by 14 notebooks, it turns out that $5+14=19$ notebooks cost 38 thousand soums. This means that one notebook costs $38:19 = 2$ thousand soums, and one pencil costs 4 thousand soums.

Algebraic solution:

Let x be the cost of one notebook, and y the cost of one pencil, according to the conditions of the problem we obtain a system of equations:

$$\begin{cases} y = 2x \\ 5x + 7y = 38 \end{cases}$$

After the arithmetic solution of this problem, the process of solving the system by substitution, which logically coincides with the process of arithmetic solving the problem, will be quickly learned.

Students no longer have to explain the essence of the substitution method when solving more complex systems; this simple example is quite sufficient.

2. When studying the method of algebraic addition for solving systems of equations, you can ask students to solve the following problems orally:

a) One student bought 5 notebooks and 3 pencils and paid 19 thousand soums. The second student bought 7 notebooks and 3 pencils at the same prices and paid 23 thousand soums. How much does one pencil and one notebook cost separately? How much would the first student pay if he bought three times as many notebooks and pencils? Five times more? How much would the first student pay if he bought 3 times as many notebooks and 2 times as many pencils?

Arithmetic solution:

1) The students bought the same number of pencils, but the second student bought $7 - 5 = 2$ more notebooks and paid $23 - 19 = 4$ thousand soums more. This means that 2 notebooks cost 4 thousand soums, and one notebook costs 2 thousand soums.

2) For 5 notebooks, the first student paid $5 \cdot 2 = 10$ thousand soums, then the cost of pencils is $19 - 10 = 9$ thousand soums and one pencil costs $9 : 3 = 3$ thousand soums.

Algebraic solution:

Let x be the cost of one notebook, and y the cost of one pencil, according to the conditions of the problem we obtain a system of equations:

$$\begin{cases} 5x + 3y = 19 \\ 7x + 3y = 23 \end{cases}$$

Solving these problems takes no more than five to six minutes, but the benefits are great. Arithmetic analogy, which we often turn to, helps to understand many general laws and rules of mathematics (and not only mathematics). The reason for this is that the logic of solving arithmetic problems is the “first stage” of mathematical logic; by its nature, it is more accessible for comprehension, for understanding the mathematical essence of processes and phenomena, than the logic of solving algebraic problems.

Arithmetic, when used skillfully, provides algebra with the most effective help. The very fact that arithmetic is an excellent means of developing logical thinking is of paramount importance for mastering algebra. In addition, the very process of algebraically solving a problem (that is, solving it by composing equations) is ultimately the process of solving some simple arithmetic problems, the given elements of which are expressed in letter quantities.

When solving entertaining problems, the following goals are pursued [5, 235]:

- formation and development of mental operations: analysis and synthesis; comparisons, analogies, generalizations, etc.;
- development and training of thinking in general and creative thinking in particular;
- maintaining interest in the subject, in learning activities (the uniqueness of an entertaining task serves as a motive for learning activities);
- development of qualities of a creative personality, such as cognitive activity, perseverance, perseverance in achieving goals, independence;
- preparing students for creative activity (creative assimilation of knowledge, methods of action, the ability to transfer knowledge and methods of action to unfamiliar situations and see new functions of an object) [1, 43].

In the process of solving logic problems, students will become acquainted with mathematical logic - a separate science, otherwise called “mathematics without formulas.” Logic as a science was created by Aristotle, who was not a mathematician, but a philosopher. And logic was originally part of philosophy, one of the methods of reasoning. In his work “Analytics,” Aristotle created 20 reasoning schemes, which he called syllogisms. One of his most famous syllogisms is: “Socrates is a man; all people are mortal; So Socrates is mortal.” Logic (from ancient Greek Λογική - speech, reasoning, thought) is the science of correct thinking, or, in other words, “the art of reasoning.”

There are certain techniques for solving logical problems [4]:

a method of reasoning with the help of which the simplest logical problems are solved. This method is considered the most trivial. During the solution, reasoning is used that consistently takes into account all the conditions of the problem, which gradually lead to a conclusion and the correct answer;

method of tables used in solving text logic problems. As the name suggests, solving logical problems consists of constructing tables that allow you to visualize the conditions of the problem, control the reasoning process and help you draw correct logical conclusions;

the method of graphs consists in enumerating possible options for the development of events and the final selection of the only correct solution;

the block diagram method is a method widely used in programming and solving logical transfusion problems. It consists in the fact that first operations (commands) are

allocated in the form of blocks, then the sequence of execution of these commands is established. This is a flowchart, which is essentially a program, the execution of which leads to the solution of the task;

the billiards method follows from trajectory theory (one of the branches of probability theory). To solve the problem, you need to draw a billiard table and interpret the actions by the movements of the billiard ball along different trajectories. In this case, it is necessary to keep records of possible results in a separate table.

The development of logical thinking is one of the main tasks of the comprehensive development of children, which should be given serious attention. Thinking is the highest form of human cognitive activity, the process of searching and discovering something essentially new. Developed thinking enables a child to understand the patterns of the material world, cause-and-effect relationships in nature, social life and interpersonal relationships. Logical thinking is fundamental to achieving success in life. With its help, a person is able to analyze any situation and choose the best course of action under the current conditions.

Logical thinking must be constantly trained, best of all, from early childhood, in order to avoid stereotypical thinking, which is characteristic of the majority of people. With the help of logical thinking, you will be able to separate the essential from the unimportant, find relationships between objects and phenomena, create conclusions, search and find confirmations and refutations.

The development of thinking is possible with the help of logical thinking tasks. They contribute to [6]:

- increasing the speed of thinking;
- meaningful thinking;
- increasing flexibility of thinking;
- increasing the depth of thinking;
- development of freedom and efficiency of thinking.

Adults can also train their thinking with the help of thinking games and logical thinking tasks. After all, age-related problems with memory and logic are the result of inaction and lack of mental exercise: a person either uses his brain or degrades.

To determine the level of development and qualitative characteristics of your thinking, I suggest taking a logical thinking test. The quality of thinking is determined by the following characteristics [5]:

- quick thinking is the ability to find the right solutions in conditions of lack of time;
- flexibility of thinking characterizes the ability to change the planned course of action when circumstances change;
- depth of thinking is the degree of penetration into the essence of a situation or phenomenon and the ability to grasp and identify logical connections between the objects of the problem.

These qualities are present to varying degrees in all people. Some of them are more significant for solving theoretical problems, others - for solving practical issues.

In the process of human growth, when he enters social life, the development of thinking occurs sequentially in several stages [7]:

- objective-active thinking, characteristic of the age from 1 to 3 years, is thinking in the form of practical actions. Children at this age learn about the world around them by tasting and smelling objects, touching them with their hands, taking them apart and breaking them;

- visual-figurative thinking is more developed at the age of 4 to 7 years, but is also present in adults in the form of visual images and ideas: visual, auditory, tactile. This type of thinking is most developed among people of creative professions (artists, musicians, etc.);
- abstract-logical or abstract thinking is presented in the form of abstract concepts, symbols and numbers. For example, the mathematical terms “integral” and “derivative” are abstract concepts that cannot be perceived by the human senses.

The thinking process is activated, as a rule, when any problem or task arises, the solution of which can be carried out in various ways depending on the level of development of logical thinking. The most primitive technique is the trial and error method, during which there is not even awareness of the problem, not to mention the construction of tactics for solving it and testing hypotheses. In adults, logical thinking develops into the ability to explore assigned tasks and determine goals, create a plan and ways to achieve a goal. Developed thinking is the ability to think creatively, not to use stereotyped knowledge, but to invent and invent something new. Solving logical problems and games to develop thinking develop not only logic, but also intelligence, fantasy, and imagination.

When solving problems on logical thinking or in games for the development of thinking, it is necessary to follow the steps [9]:

- Motivation, that is, the desire to win;
- Analysis of the conditions of the task or game situation;
- Finding a solution to a problem based on logical reasoning, analogies, heuristic and empirical techniques. In mental games, sometimes a simple insight leads to victory;
- Proof and justification of the correctness of the decision;
- Checking the solution; if necessary, its correction.

CONCLUSION

1. Arithmetic problem solving is the most effective means of developing logical thinking, a means of logical preparation of students for mastering further courses in mathematics and other disciplines.

2. Any algebraic solution to a word problem (that is, solving it by composing equations) is a sequential process of arithmetic problem solving, therefore, arithmetic solutions serve as the basis for algebraic ones.

Our students must master the techniques of logical mathematical thinking and learn to think outside the box using the skills of analysis, comparison, synthesis, abstraction, measurement, coordination, structuring, design, systematization, etc. in professional and scientific activities in the future.

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