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ŞAGIRDLƏRDƏ MƏNTIQI DÜŞÜNMƏ BACARIQLARININ İNKIŞAF ETDIRILMƏSI YOLLARI

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Xülasə

Müasir təhsil sistemində məntiqi düşünmə bacarıqlarının formalaşdırılması şagirdlərin intellektual inkişafının əsas istiqamətlərindən biri hesab olunur. Qloballaşma, rəqəmsallaşma və informasiya axınının sürətlənməsi şəraitində yalnız faktların mənimsənilməsi kifayət etmir; şagirdlər məlumatları təhlil etməyi, müqayisə etməyi, səbəb-nəticə əlaqələrini müəyyənləşdirməyi və əsaslandırılmış qərarlar qəbul etməyi bacarmalıdırlar. Məqalədə məntiqi düşünmənin nəzəri əsasları araşdırılır, Şərq və Qərb pedaqoji təcrübələri müqayisəli şəkildə təhlil edilir və məktəb təcrübəsində tətbiq oluna biləcək səmərəli metodlar müəyyənləşdirilir.

Məntiqi düşünmənin inkişafında məntiqi məsələlər, Sudoku, şahmat, Go oyunu, kombinatorika tapşırıqları və labirintlər xüsusi əhəmiyyət daşıyır. Bu fəaliyyətlər şagirdlərdə diqqət, strateji planlaşdırma, alternativ həll yolları axtarma və tənqidi təfəkkür bacarıqlarını gücləndirir. Xüsusilə labirintlər şagirdləri müstəqil qərar qəbul etməyə, problemləri mərhələli şəkildə həll etməyə və müxtəlif variantları müqayisə etməyə istiqamətləndirir. Riyazi tapşırıqlar isə məntiqi düşünmənin inkişafının ən təsirli vasitələrindən biri hesab olunur. Standart, problem xarakterli, məntiqi, kombinatorik və tədqiqat yönümlü məsələlər şagirdlərin analitik təfəkkürünü, ümumiləşdirmə bacarığını və yaradıcılığını inkişaf etdirir. Riyazi məsələlərin həlli prosesində şagirdlər faktları təhlil edir, əlaqələr qurur, fərziyyələr irəli sürür və nəticələr çıxarırlar ki, bu da onların intellektual inkişafına mühüm töhfə verir. Nəticə etibarilə, məntiqi düşünmə bacarıqlarının inkişafı məqsədilə müxtəlif metod və vasitələrin sistemli şəkildə tətbiqi şagirdlərdə yüksək səviyyəli idrak fəaliyyətinin formalaşmasına, müstəqil və yaradıcı düşünən şəxsiyyətin yetişməsinə şərait yaradır. Bu bacarıqlar yalnız təhsil prosesində deyil, həm də gündəlik həyatda qarşıya çıxan problemlərin səmərəli həllində mühüm rol oynayır.

Açar sözlər: məntiqi düşünmə, məntiqi məsələlər, tənqidi təfəkkür, tənqidi düşünmə, problem həlli, riyazi təfəkkür, təhsil texnologiyaları, Şərq təcrübəsi, Qərb təcrübəsi, analitik təfəkkür, riyazi tapşırıqlar, problem həlli, kombinatorika, labirintlər, strateji oyunlar, STEM təhsili, qərarvermə, şagird inkişafı.

WAYS TO DEVELOP LOGICAL THINKING SKILLS IN STUDENTS

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Summary

In the modern education system, the formation of logical thinking skills is considered one of the main directions of students' intellectual development. In the conditions of globalization,

digitalization and acceleration of information flow, it is not enough to simply master facts; students must be able to analyze, compare information, determine cause-and-effect relationships and make reasoned decisions. The article examines the theoretical foundations of logical thinking, comparatively analyzes Eastern and Western pedagogical practices, and identifies effective methods that can be applied in school practice.

Logical problems, Sudoku, chess, Go, combinatorics tasks and labyrinths are of particular importance in the development of logical thinking. These activities strengthen students' attention, strategic planning, search for alternative solutions and critical thinking skills. In particular, labyrinths guide students to make independent decisions, solve problems step by step and compare different options. Mathematical tasks are considered one of the most effective tools for the development of logical thinking. Standard, problem-based, logical, combinatorial and research-oriented problems develop students' analytical thinking, generalization skills and creativity. In the process of solving mathematical problems, students analyze facts, establish relationships, put forward hypotheses and draw conclusions, which makes a significant contribution to their intellectual development. As a result, the systematic application of various methods and tools for the development of logical thinking skills creates conditions for the formation of a high level of cognitive activity in students, the development of an independent and creative thinking personality. These skills play an important role not only in the educational process, but also in the effective solution of problems encountered in everyday life.

Keywords: logical thinking, logical problems, critical thinking, critical thinking, problem solving, mathematical thinking, educational technologies, Eastern experience, Western experience, analytical thinking, mathematical tasks, problem solving, combinatorics, labyrinths, strategic games, STEM education, decision-making, student development.

Introduction

Logical thinking occupies a special place among the skills of the 21st century. One of the main directions of the education system is to form critical and logical thinking skills in students. In conditions of information abundance, a student should not only memorize information, but also analyze it, compare it, determine cause-and-effect relationships and be able to make reasoned decisions. In the modern era, the main goal of the education system is not only to transfer knowledge, but also to form a personality who thinks, analyzes and makes creative decisions. Logical thinking is the process by which a person analyzes facts, establishes connections between events, evaluates arguments and draws substantiated conclusions. The development of analytical and critical thinking of students has been identified as one of the priority directions in the education strategy of the Republic of Azerbaijan. The development of logical thinking, especially in the teaching of mathematics, computer science and natural sciences, has a direct impact on the academic achievements of students. A comparison of Eastern and Western educational models shows that although the goal of both approaches is the same, the methods used differ. While Eastern countries emphasize systematicity, discipline, and repetition, Western schools emphasize problem-based learning, discussion, and creative approaches. Therefore, the development of logical thinking is considered an important component of 21st century skills.

Logical thinking is considered one of the highest forms of human thinking. Aristotle characterized logical thinking as a mental activity that allows one to reach correct conclusions. In later periods, philosophers such as Descartes, Kant, and Hegel extensively studied the role of logic in human cognition. Psychologist Jean Piaget showed that logical thinking develops in children in stages. According to him, after the age of 11–12, students acquire the ability to think abstractly and hypothetically (Piaget, 1972). Lev Vygotsky noted that logical thinking is formed through the

social environment and cooperation (Vygotsky, 1978). According to this approach, interaction with teachers and classmates plays an important role in the development of a student's thinking skills. Logical thinking consists of the following components:

Analyzing,
Comparing,
Generalizing,
Classifying,
Determining cause-and-effect relationships,
Proofing, and drawing conclusions.

One of the factors influencing the development of logical thinking in students is the family environment. Studies show that intellectual conversations with children from an early age have a positive effect on their logical thinking. Parents asking open questions and requiring the child to justify their ideas activates the thinking process. The next factor is the educational environment. Teaching methods applied in school are one of the main factors in the development of logical thinking. Teaching based on memorization limits students' analytical skills, while a problem-solving approach encourages them to think actively. The next environment is digital technologies. Artificial intelligence, digital platforms, and interactive programs create new opportunities for the development of logical thinking. However, passive use of technology can have the opposite effect.

The Japanese education system is considered one of the most successful models in the world in the development of logical thinking. Japanese schools apply the “Lesson Study” approach. Teachers plan lessons together, conduct observations and analyze the teaching process. In mathematics lessons, instead of giving students ready-made formulas, problems are presented and they are encouraged to find solutions themselves. This approach develops logical analysis and proof skills. The advantage of the Japanese model of analysis is that students do not learn the result, but the thinking process leading to the result. Thus, logical operations become automatic and continuous.

Mathematics and logic teaching in Chinese schools is organized at a high level. Chinese students regularly complete logic tasks, participate in mathematical olympiads, and explore various solutions to complex problems. Although the Chinese educational model is systematic and disciplined, there are sometimes criticisms regarding the restriction of creativity. Nevertheless, the results obtained in international assessments show that this model is effective in the development of logical thinking.

Logic in the Islamic educational tradition Al-Farabi, Ibn Sina and Al-Ghazali considered logical thinking to be the main means of scientific cognition. Al-Farabi wrote that logic is a tool that guides a person to think correctly. Logic has been taught in Islamic madrasas for centuries and has served to form analytical thinking.

As for the experience of Western countries, the Finnish model, a student-centered approach prevails in the Finnish education system. Project-based learning, research activities, discussions, and group work are applied in lessons. The main goal of the Finnish model is not to find the right answer, but to teach how to think correctly. Students are encouraged to compare different arguments and justify their positions. In the US experience, the concept of “Critical Thinking” is a major part of educational programs in schools in the United States of America. Students are presented with open-ended questions, debates, research projects, and problem-oriented tasks. This approach develops independent decision-making and logical argumentation skills in students. However, the weakness of the system is the sometimes uneven application of academic standards. One of the ways to develop logical thinking is problem-based learning. Problem-based learning

encourages students to explore rather than simply acquire knowledge. For example: “In a village, only those who tell the truth and only those who lie live. How can you determine which group the person in front of you belongs to?” This type of task strengthens analysis and inference skills. Mathematics is one of the most effective tools for developing logical thinking. Students should be introduced to logic problems, combinatorics tasks, chess, sudoku (a popular number puzzle that develops logical thinking and problem-solving skills), mazes, mathematical tasks, and strategy games.

Logical problems help to understand the cause-and-effect relationships between events and facts. The student learns to predict in advance what outcome a certain decision will lead to. This skill is important not only in mathematics, but also in everyday life for making the right decisions. Logical problems encourage students to look for different solution strategies. In the process of solving a problem, they put forward hypotheses, check these hypotheses and determine the most optimal result. Such activities develop students' problem-solving competencies. Logical problems prevent students from blindly accepting information. They check the correctness of the given ideas, evaluate arguments and draw conclusions based on evidence. This is one of the main indicators of critical thinking. One of the main goals of mathematics is to form the ability to think logically in students. Logical problems facilitate the understanding of mathematical regularities, develop abstract thinking and enable the practical application of mathematical knowledge.

In Eastern countries, especially in the Japanese and Chinese education systems, logical problems are an integral part of mathematics lessons. Here, students are tasked with finding different solutions to a problem, which develops their flexible thinking skills.

The problem-based learning model is widely used in Western countries, especially in Finnish and Canadian schools. In this model, logical problems are used to develop students' independent research and decision-making skills. The main advantage of logical problems is that they put the student in the position of an active researcher, not a passive learner. Such tasks activate higher-level cognitive activities of the brain, develop metacognitive skills, and allow the student to control his or her own thinking process. According to modern pedagogical theories, logical problems serve to form thinking methods rather than to master knowledge.

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higher-level cognitive activities of the brain, develop metacognitive skills, and allow the student to control his or her own thinking process. According to modern pedagogical theories, logical problems serve to form thinking methods rather than to master knowledge.

Let's look at the given task as an example. For example, how many different two-letter words can be formed from the letters A, B, and C? Solution: AB, AC, BA, BC, CA, CB Total: 6 options. Even this simple task develops the student's ability to systematically count options. In Chinese and Japanese schools, combinatorics problems are one of the main directions of preparation for mathematical olympiads. Here, students are presented with non-standard problems and their various solutions are explored. In Russian mathematics schools, combinatorics is also considered an important tool for the development of logical thinking. The famous Soviet mathematician Andrei Kolmogorov considered it important to pay special attention to the development of combinatoric thinking in schools. In Western countries, especially in the Finnish and Canadian education systems, combinatorics is applied as an integral part of the problem-based learning model. Scientific Analysis Pedagogical and psychological studies show that combinatoric tasks develop high-level cognitive skills of students. When solving such problems, working memory, attention, analysis and synthesis operations are activated. For this reason, combinatorics is considered an important tool not only for mathematical knowledge, but also for general intellectual development. Combinatorics tasks have a significant impact on the formation of logical thinking, analytical analysis, systematic decision-making and problem-solving skills in students. Their regular application in the educational process not only strengthens the mathematical preparation of students, but also serves to develop the thinking competencies required by modern society. Therefore, combinatorics should be considered one of the important components of school mathematics and logical thinking training.

The goal of the Sudoku game is to fill a 9×9 grid with numbers from 1 to 9 in such a way that each of the numbers 1–9 appears only once in each row, each of the numbers 1–9 appears only once in each column, and each of the numbers 1–9 appears only once in each 3×3 square.

A labyrinth is a complex system of paths, passages and obstacles through which a person tries to find a way out of a certain starting point. Historically, labyrinths appeared in ancient civilizations as both an architectural element and structures with symbolic meaning. In modern education, labyrinths are one of the effective tools used to develop students' logical thinking, problem-solving and decision-making skills. Labyrinth tasks force students to think independently, moving them away from receiving ready-made answers. The student makes a choice at every step, compares alternative paths, analyzes his mistakes and looks for the optimal solution. This process develops the main components of logical thinking - analysis, synthesis, comparison and generalization skills. Psychologists note that when solving labyrinths, the prefrontal cortex, which is responsible for planning and decision-making, is more active. This has a positive effect on the development of attention, memory and spatial thinking. Labyrinths can be used in mathematics lessons in the following directions.

1. Comparing numbers,
2. Developing calculation skills,
3. Recognizing geometric shapes,
4. Solving equations,
5. Developing combinatorial thinking,
6. Building algorithms

Such activities make mathematics more interesting and practical for students. Labyrinths are not just an entertaining task, but a powerful pedagogical tool for forming logical thinking skills.

They serve to develop important intellectual qualities such as analysis, planning, decision-making, attention and strategic thinking in students. In modern educational conditions, the systematic integration of labyrinths into the teaching process makes a significant contribution to the formation of high-level cognitive activity of students and the development of 21st century skills.

Mathematical tasks are one of the main didactic tools that form students' knowledge, skills and habits, and at the same time develop their logical thinking. What distinguishes mathematics from other subjects is that each result here is based on logical reasoning and evidence. Therefore, solving mathematical problems serves to form students' skills of systematic thinking, analysis and drawing conclusions. The well-known Swiss psychologist Jean Piaget noted that the development of logical operations occurs in the process of concrete activities and problem solving. Mathematical problems also perform this function. When solving each mathematical problem, the student first analyzes the given and required, and then builds a solution plan by linking them. This process leads to the development of analysis and synthesis skills. For example, when solving a geometric problem, the student analyzes the properties of the figure, connects them with known theorems and obtains a result. Mathematical problems show the student that each result arises for a certain reason. This forms the ability to create a logical sequence. When solving various problems, students identify general patterns. This process plays an important role in the development of abstract thinking. Many problems have several solutions. The student develops decision-making skills by choosing the most effective method. The types of mathematical problems are as follows:

1. Standard problems. Based on the application of previously learned rules. Example: The length of a rectangle is 12 cm, the width is 5 cm. Find its area. This type of tasks serves to consolidate basic knowledge.

2. Problem-based problems. Does not provide a ready-made algorithm and requires a creative approach from the student. Example: The sum of the ages of three brothers in a family is 30. The eldest brother is 4 years older than the middle brother, and the middle brother is 2 years older than the youngest. Find their ages.

3. Logical problems. The main goal of these tasks is to make logical judgments rather than mathematical calculations. Example: There are three boxes. One contains only apples, one contains only pears, and one contains both. All labels are incorrectly attached. How can you determine all the boxes by taking one fruit?

4. Combinatorial tasks. Based on determining the number of possible options. Example: How many different two-digit numbers can be made from 3 digits? These tasks develop systematic thinking and analysis of options skills.

5. Research-based tasks. The student is required to observe, hypothesize, and draw conclusions. Example: Calculate the sum of the first 20 odd numbers and determine the regularity of the result. Modern educational approaches evaluate mathematical tasks not only as a means of calculation, but also as a tool for thinking. In particular, problem-based learning; STEM approach; research-based learning; project activities further increase the role of mathematical tasks in the development of logical thinking skills. The teacher should select tasks not only to obtain results, but also to activate the student's thinking process. For this, open-ended questions should be used; problems with several solutions should be given; students should be provided with opportunities to justify their opinions; elements of discussion and debate should be applied.

Mathematical tasks are an indispensable tool in the development of students' logical thinking skills. They activate cognitive processes such as analysis, synthesis, generalization, comparison, establishing cause-and-effect relationships, and decision-making. Purposeful and systematic application of mathematical tasks forms not only mathematical literacy in students, but also the

ability to solve life problems logically. For this reason, mathematical tasks are considered one of the most effective means of developing logical thinking in the modern education system.

Strategy games are one of the most effective tools that have a positive impact on the intellectual development of students. These games require the participant not only to assess the current situation, but also to plan future steps, predict possible outcomes, and make optimal decisions. Therefore, strategy games play an important role in the formation of logical thinking, analytical analysis, and problem-solving skills. During strategy games, the student tries to analyze the consequences of each decision in advance, which paves the way for the development of logical thinking. This process strengthens the understanding of cause-and-effect relationships. For example, in a chess game, each move affects the next situation, and the player is forced to think several steps ahead. This, in turn, develops logical judgment and forecasting skills. Strategy games require the analysis of complex situations, which is the formation of analytical thinking. The student compares different options, identifies their strengths and weaknesses. This process strengthens the skills of comparison, classification, and generalization, which are the main components of analytical thinking. Modern pedagogical research notes that strategy games increase students' ability to solve non-standard problems. Various solutions are sought to overcome obstacles that arise during the game and the most effective option is selected. This skill later helps to achieve success in education and professional activities. Strengthening attention and memory Strategy games require high concentration. The student follows the course of the game, remembers previous steps and builds his future plan accordingly. As a result, the continuity of attention and the activity of working memory develop. Social and communicative skills Strategy games played in teams help to form cooperation, communication and leadership qualities. Students exchange ideas, justify their arguments and learn to make joint decisions. Strategy games in Eastern and Western practice Chess, Go and various logic games are widely used in Eastern countries, especially in Chinese and Japanese schools. Go (Japanese 囲碁 – Igo, Chinese 围棋 – Weiqi) is one of the oldest strategy games in the world. It originated in China about 2500 years ago, and later became widespread in Japan, the Republic of Korea and other countries. The game is played with black and white pieces on a board consisting of 19×19 lines. The goal is to control more territory than the opponent. The main rules of the game involve two players. One side plays with black and the other with white pieces. Players take turns placing their pieces at the intersections of the board. When the opponent's pieces are completely surrounded, they are removed from the board. At the end of the game, the player who has the most territory wins. The educational importance of the game of Go is that the game of Go forms logical thinking, strategic planning, analytical analysis, patience and attention, and forecasting skills in students. Unlike chess, the number of possible moves in the game of Go is very large. Therefore, the player learns to assess the situation as a whole, not just a few steps. In Eastern practice, Go has been used as a means of intellectual development of children in schools in China, Japan, and the Republic of Korea for many years. Researchers believe that this game has a positive effect on the development of strategic thinking and decision-making skills. These games develop patience, consistency, and strategic planning skills in children. In Western countries, schools in Finland, Germany, and the United States use strategic board and digital games as teaching tools, along with problem-based learning. The main goal here is to develop creative and critical thinking.

Strategy games have a significant impact on the development of logical thinking, analytical analysis, problem solving, decision-making and planning skills in students. Therefore, their integration into curricular and extracurricular activities should be considered one of the

important directions of modern education. Strategy games are not only a means of entertainment, but also a powerful pedagogical tool that forms the intellectual potential of students.

These activities activate the analytical thinking mechanisms of the brain and increase the speed of decision-making. Debates and discussions are also of great importance. During debates, the student builds an argument, analyzes the opinion of the other side, presents evidence, and draws logical conclusions. This process acts as a practical application of formal logic. As for the Socratic method, the Socratic approach is based on deepening thinking through sequential questions. For example, Why do you think so? What is the evidence for this? Is the opposite opinion not possible? Such questions develop the student's reflective thinking. Coding activities, robotics, artificial intelligence-based platforms, and mathematical simulations can be used to develop logical thinking in the application of digital technologies. These tools provide students with algorithmic thinking skills.

The conducted analyses show that logical thinking is one of the main priorities of 21st century education. In Eastern practice, systematicity, discipline and deep mathematical preparation come to the fore, while in Western practice, creativity, independent thinking and problem-based learning come to the fore. The most effective model can be considered the integration of these two approaches. For the development of logical thinking in Azerbaijani schools, it is advisable to expand problem-based learning, increase mathematical logic tasks, apply debate methods and integrate digital technologies. These approaches will ensure not only academic achievements of students, but also their success in future professional activities.

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