

METHODOLOGY FOR DEVELOPING STUDENTS' LOGICAL THINKING SKILLS DIAGRAMMATIC PROBLEMS IN PRIMARY SCHOOL MATHEMATICS CLASSES

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Abstract: *This article discusses the methodology for developing logical thinking skills of primary school students in mathematics lessons through diagram-based problems in developing logical thinking skills of primary school students. It substantiates that diagram-based tasks contribute to students' analytical thinking, problem-solving abilities, and conscious understanding of mathematical concepts. Furthermore, the effectiveness of this methodology is highlighted from a pedagogical perspective, and recommendations for its implementation in the educational process are provided.*

Key words: *Analytical thinking, diagrammatic problems, diagrams, logical thinking, mathematics education, primary education, thinking development.*

Introduction. The formation and development of students' logical thinking skills at the primary education stage is an integral part of the modern pedagogical process. Logical thinking includes not only the ability to solve mathematical problems, but also the ability to analyze problems, understand cause-and-effect relationships, and make

independent decisions [1]. Therefore, the development of logical thinking in primary school is in the focus of scientific attention and serves to increase the effectiveness of the educational process. Recent studies have shown that the use of mathematical problems, in particular diagrammatic and logical problems, is recognized as an effective method for developing students' thinking skills [3]. By encouraging students to think analytically, analyze the problem step by step, and try different strategies in the process of solving problems, their independent thinking skills are significantly developed [2, 4]. At the same time, the methodological aspects of the formation of logical thinking are closely related to the selection of problems in the educational process, their gradual solution, and ensuring the active participation of students [5, 6]. Pedagogical experiences show that teaching using logical problems helps not only to develop mathematical skills, but also to form creative and imaginative thinking in students. Therefore, the systematic use of logical problems in primary school makes the educational process interactive and interesting [7, 8]. Methodological studies aimed at developing students' logical thinking in primary school mathematics lessons are not only of theoretical importance, but also important for practice. The relevance of the study is that it offers teachers specific ways to effectively use logical problems in the lesson and supports the intellectual development of students. In this regard, the study of the methodological aspects of logical problems serves to improve the quality of primary school mathematics education and develop independent and systematic thinking in students. To identify effective methods for developing logical thinking skills in primary school students and to put them into practice. To this end, the article scientifically analyzes the pedagogical

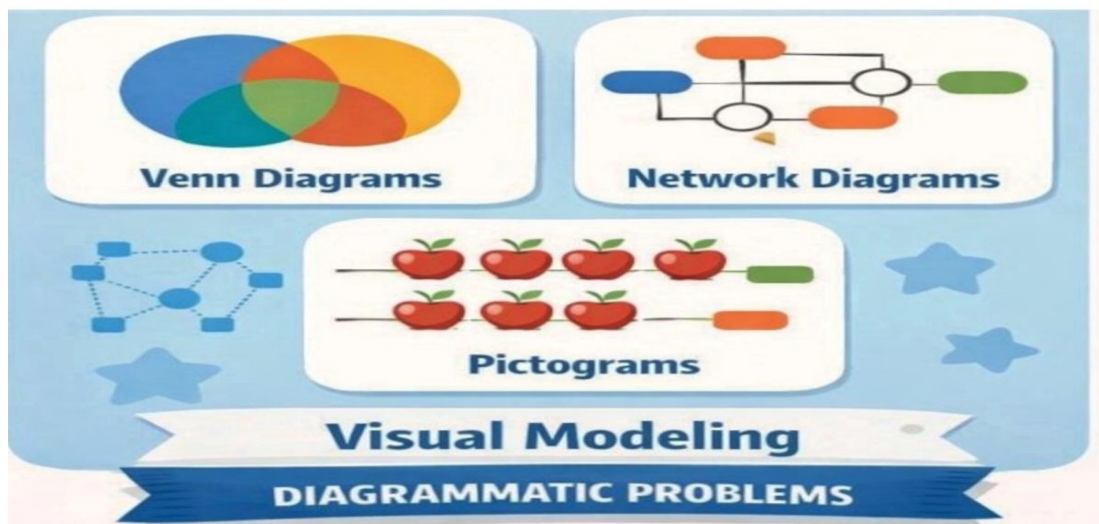
significance of logical problems, methods of their use in lessons, and their impact on the development of students' thinking.

Review of relevant literature. An analysis of scientific research conducted on this topic shows that the development of logical thinking skills in primary school students has been recognized as one of the main areas of pedagogical research in recent years. In their study, Abdulazizov and Karaboyeva systematically describe methods for developing students' logical thinking in primary school mathematics lessons [1]. The authors emphasize, in particular, that students' analytical abilities can be improved through step-by-step problem solving and the use of visual diagrams. This work brings the topic closer to practical pedagogical experience and serves as the basis for developing methodological recommendations. Bakhtiyorova studies the methodology for teaching primary school students to solve logical problems through research in an international context [2]. The author's results show that giving students logical tasks in a creative and interactive form encourages them to think independently and increases their ability to apply mathematical knowledge in practice. This approach serves to increase the effectiveness of the learning process. Ibragimova and Pardayeva empirically analyze the effectiveness of using logical problems in elementary mathematics lessons [3]. Their study shows that by systematically presenting logical problems to students and ensuring their active participation in the learning process, thinking skills can be significantly developed. This indicates the importance of logical problems not only for mathematical knowledge, but also for general intellectual development. Mamasaidova and Khakimova consider logical problems as a strategic tool for developing students' independent thinking [4]. The authors propose

methods aimed at increasing students' ability to think critically and analyze the problem from different angles in the process of reaching a solution. This study allows us to develop individual approaches for elementary school students in pedagogical practice. Mahkamova and Mominova analyze in detail the methodological aspects of using logical problems in lessons [5]. They show that thinking skills can be formed by solving logical problems step by step, observing the thinking process of students, and involving them in active participation. Rakhmatova, considering practical ways to develop logical thinking in students, emphasizes the effectiveness of presenting problems in interactive and playful ways during the lesson [6]. At the same time, she identifies the importance of developing thinking skills in the pedagogical process through individual and group work. Siddikov and Tursinalieva scientifically study the role and importance of problems in developing logical thinking skills in primary school students [7]. Their results show that the systematic use of logical problems significantly enhances students' analytical thinking and ensures that the learning process is interesting and interactive. Akramova analyzes the process of forming logical thinking from a pedagogical point of view and develops methodological foundations for the practical application of logical problems in primary school students [8]. The author's research shows that the use of logical problems in the classroom helps to develop independent and systematic thinking in students. Scientific research on this topic serves to ensure the integration of pedagogical theory and practice and is methodologically relevant.

Research methodology. In order to achieve the set goals of the study and determine the effectiveness of using the methodology for

developing students' logical thinking skills through diagrammatic problems in elementary mathematics lessons, a comprehensive approach was used. To ensure the objectivity of the study, participants were divided into two groups: visual-model (experimental) and standard-algorithm (control) groups.

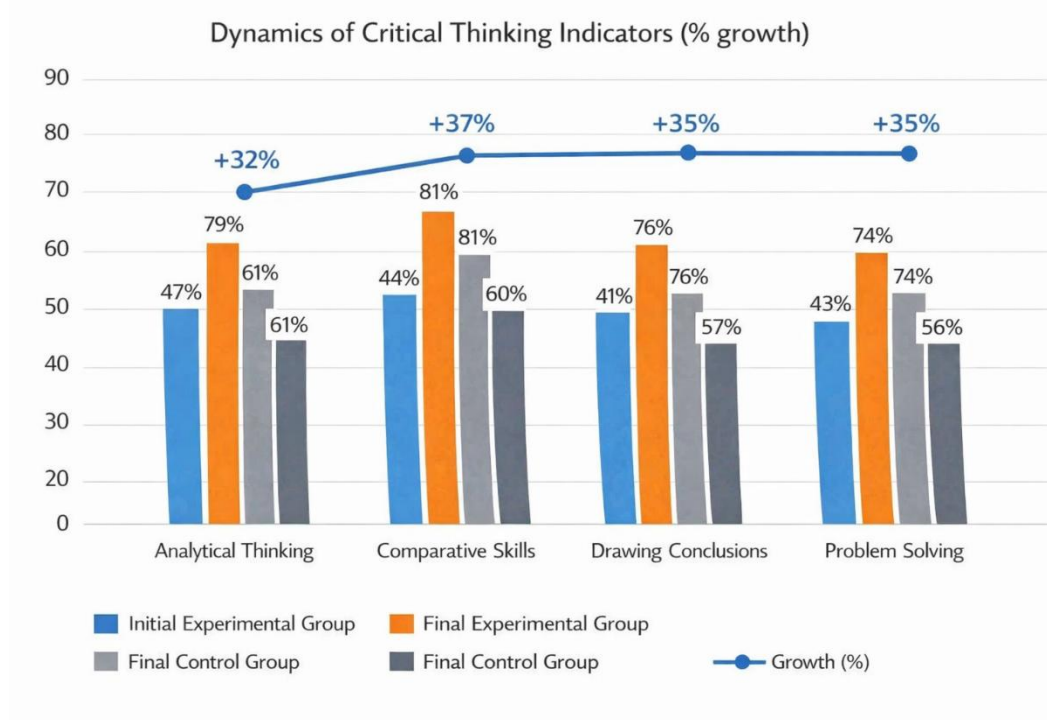


In the visual-model (experimental) group, mathematics lessons were organized on the basis of diagrams, including Venn diagrams, network diagrams, and pictograms. In this process, the visual modeling method was used as the main didactic tool, and special attention was paid to the development of students' skills in receiving and processing information in graphic form. In the standard-algorithm (control) group, teaching was carried out on the basis of traditional methods, that is, relying on text problems and standard algorithms for solving them. The research process was carried out in three stages. At the diagnostic stage, the initial level of logical thinking of students and skills in working with diagrams were determined using test tasks and oral surveys. The results of this stage served as the basis for determining the initial level of preparation of students and planning the next stages. At the formative, that is,

formative stage, diagrammatic problems were systematically introduced into the educational process in the experimental group. During the lessons, students were given the task of analyzing data based on diagrams, identifying relationships between them, representing information in graphical form, and justifying solutions. In particular, tasks based on pictograms were an effective tool for activating students' logical thinking. Students learned to encode information given through visual symbols, that is, to determine the quantity expressed behind each symbol, to compare different indicators, and to draw generalized conclusions. They also developed the skills of solving problem situations by determining the relationship between the elements in the diagram and restoring the logical sequence. Since the learning process in the standard-algorithm group was mainly focused on working with textual information, students had certain difficulties in identifying complex logical relationships. This situation further demonstrated the importance of visual aids in the learning process. At the final analytical stage of the study, the results obtained in both groups were compared and statistically analyzed. The results of the analysis showed that the use of diagrammatic problems significantly developed students' logical thinking, analysis, and conclusion-making skills.

Analysis and results. At the final stage of the study, conducted in accordance with the current research methodology, a comparative analysis of the logical thinking indicators of students in the experimental visual-model and control standard-algorithm groups was carried out. The students' analytical thinking, comparison, conclusion-making and problem-solving skills were selected as the evaluation criteria. Each

indicator was expressed in percentages based on the results of the diagnostic (initial) and final stages.



According to the data presented in the table, in the visual-model (experimental) group, a significant positive change was observed in all indicators. In particular, the increase in comparison skills by 37%, in inference and problem-solving indicators by 35% confirms the high effectiveness of diagrammatic tasks. The level of analytical thinking also increased by 32%, indicating a significant development of students' ability to process information and logically analyze. Although positive changes were also noted in the standard-algorithm (control) group, their growth rate was much lower, averaging around 12–14%. This indicates that traditional teaching methods are not sufficiently effective in developing students' logical thinking. The diagrammatic tasks used in the visual-model (experimental) group, in particular, tasks based on pictograms and graphic images, allowed students to visually perceive information more quickly, identify connections between them, and draw

informed conclusions. As a result, the level of independent thinking of students increased and their confidence in solving complex problems strengthened. The results obtained show that the use of diagrammatic tasks is an effective method for developing logical thinking skills in primary school students. Lessons organized on the basis of visual modeling increase the intellectual activity of students and significantly improve their effectiveness in the educational process.

Conclusions and suggestions. The above-mentioned methodology for developing students' logical thinking skills through diagrammatic problems in elementary school mathematics lessons is highly effective. Lessons based on visual modeling significantly developed students' analytical thinking, comparison, and conclusion skills. Diagrams (Venn diagram, network diagram, pictogram) made it possible to master complex mathematical concepts in a simple and understandable form. In the visual-model (experimental) group, students' logical thinking indicators showed a much higher growth dynamics compared to the standard-algorithm (control) group. Students' skills in solving problem situations, making independent decisions, and drawing informed conclusions were formed. Diagrammatic problems increased students' cognitive activity and strengthened their participation in the lesson process. The results of the experiment confirmed that the visual approach is more effective than the traditional standard-algorithmic approach. Visual tools facilitated students' processes of receiving, processing, and systematizing information. In general, the use of diagrammatic problems has been proven to be an effective methodological approach to developing students' thinking in primary education.

Based on the conclusions, we put forward the following proposals:

1. Establishing regular and systematic use of diagrammatic tasks in primary school mathematics lessons.
2. Organizing special methodological manuals and trainings for teachers on visual modeling methods.
3. Increasing the share of diagram-based tasks in textbooks and study guides.
4. Creating a bank of interactive and visual tasks aimed at developing students' logical thinking.
5. Widely introducing problem-solving tasks based on pictograms and graphic images.
6. Expanding the possibilities of diagrammatic teaching using information technologies (multimedia, interactive whiteboards).
7. Developing differential diagrammatic tasks taking into account the individual characteristics of students.
8. Continuing scientific research aimed at studying the effectiveness of using diagrammatic methods in other subjects in the future.

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