THE ROLE OF MATHEMATICAL LOGIC IN DEVELOPING COGNITIVE ABILITIES OF PRIMARY SCHOOL STUDENTS

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Abstract: *This article examines the significance of introducing mathematical logic into the primary school curriculum. Mathematical logic serves as a foundation for algorithmic thinking and problem-solving skills. The study highlights how logical exercises—such as classification, synthesis, and deductive reasoning—enhance a child's ability to process information beyond rote memorization. The findings suggest that early exposure to logic improves academic performance in STEM subjects.*

Keywords: *algorithmic thinking, cognitive development, critical thinking, logical reasoning, mathematics pedagogy, primary education.*

Mathematics is often perceived as the science of numbers, but at its core, it is the science of logic. In primary education, the transition from concrete operational thinking to formal operational thinking is crucial. Mathematical logic helps students identify patterns, build sequences, and understand cause-and-effect relationships. This paper explores the pedagogical impact of logical tasks on the intellectual development of 7-11-year-old learners.

Mathematical logic in early grades is not about complex formulas ($P \rightarrow Q$), but about the process of reasoning. Its importance can be categorized into three pillars:

1. **Algorithmic thinking:** breaking down a complex problem into smaller, logical steps.
2. **Verbal-logical intelligence:** developing the ability to explain mathematical solutions through structured language.
3. **Critical analysis:** teaching students to verify results and identify contradictions.

Types of logical tasks for primary grades:

Task Type	Objective	Example
Classification	Grouping objects by common attributes.	Sorting shapes by color and side count.
Seriation	Arranging items in a logical order.	Ordering numbers or lengths incrementally.
Syllogisms	Drawing conclusions from two premises.	"All squares are rectangles. This is a square. Therefore..."
Combinatorics	Finding all possible combinations.	How many ways to arrange 3 colored blocks?

Integrating logic requires a shift from "answer-oriented" teaching to "process-oriented" teaching.

- The "Why" question: Teachers should consistently ask students to justify their choice of operation.
- Visual models: Using Venn diagrams, Euler circles, and truth tables simplified for children.
- Math games: Utilizing puzzles like Sudoku or "Magic Squares" to make logic engaging.

Mathematical logic is the "grammar" of mathematics. For primary school students, it acts as a mental gymnast, strengthening the neural pathways required for abstract thinking. Without a strong logical foundation, students often struggle with higher-level algebra and geometry in secondary school. Therefore, logic should be integrated into every lesson rather than being treated as an isolated topic.

References:

1. Epp, S. S. The role of logic in teaching proof / S. S. Epp // American Mathematical Monthly. 2003. Vol. 110, No. 10. P. 886-899.
2. Inhelder, B. The Growth of Logical Thinking from Childhood to Adolescence : Monograph / B. Inhelder, J. Piaget. New York: Basic Books, 1958. 356 p.
3. Leitgeb, H. Logic and Philosophy of Mathematics / H. Leitgeb // The Oxford Handbook of Philosophy of Mathematics and Logic. -- 2020. -- URL: https://academic.oup.com (date of access: 13.03.2026).
4. Nunes, T. Development of Maths Capabilities and Confidence in Primary School / T. Nunes, P. Bryant, R. Barros // Department for Children, Schools and Families. -- 2009. -- No. 118. -- P. 12-45.
5. Stenberg, R. J. Critical Thinking in Psychology / R. J. Stenberg, H. L. Roediger, D. F. Halpern. -- Cambridge: Cambridge University Press, 2007. -- 340 p.

6. Zaitsev, D. V. Teaching logic to children: A pedagogical approach/D. V. Zaitsev // Journal of Educational Psychology. -- 2016. -- Vol. 44, No. 2. -- P. 210-225.

7. ХУДАЙКУЛОВА С. З. ИССЛЕДОВАНИЕ ЛИНИИ УРОВНЯ БОЛЬШОГО ПОЛИНОМА С ИСПОЛЬЗОВАНИЕМ КОМПЬЮТЕРНОЙ АЛГЕБРЫ //World of Scientific news in Science. – 2023. – Т. 1. – №. 1. – С. 139-145

8. THE METHODOLOGICAL FOUNDATIONS OF DEVELOPING LOGICAL THINKING IN PRIMARY SCHOOL MATHEMATICS LESSONS KS Zakirovna, R Shokhabbos - ACUMEN: International journal of multidisciplinary …, 2025

9. Xudaykulova , S. (2024). TEXNIK IJODKORLIKNING HOZIRGI HOLATI. Research and Implementation. извлечено от https://rai-journal.uz/index.php/rai/article/view/520

10. Xudaykulova, S. (2024). DARAJALI GEOMETRIYA - KO‘PHADLAR VA NORMAL KONUSLAR. Interpretation and Researches, 1(1). извлечено от https://interpretationandresearches.uz/index.php/iar/article/view/2496