EURASIAN JOURNAL OF ACADEMIC RESEARCH
Innovative Academy Research Support Center
IF = 9.3 www.in-academy.uz/index.php/ejar

TEACHING TECHNOLOGIES AIMED AT DEVELOPING LOGICAL THINKING

Raxmonova Nilufarxon Vaxobjon qizi
Department of Digital technologies and mathematics in Kokand university
rahmonovanilufar406@gmail.com
https://doi.org/10.5281/zenodo.17863745

ARTICLE INFO

Received: 01st December 2025
Accepted: 07th December 2025
Online: 08th December 2025

KEYWORDS

Logical thinking, teaching technologies, problem-based learning, inquiry-based learning, ICT tools, mathematical reasoning.

ABSTRACT

Logical thinking is a foundational cognitive skill essential for success in mathematics, science, computer science, and real-life decision-making. This article explores modern teaching technologies aimed at improving students' logical reasoning abilities. It reviews theoretical foundations, cognitive development theories, and evidence-based approaches. Furthermore, it analyzes the practical integration of digital tools, problem-based learning, inquiry-based learning, and collaborative technologies. The study concludes with recommendations for enhancing logical thinking skills across different educational levels.

INTRODUCTION

Logical thinking has become one of the most essential skills in the 21st century, especially in STEM education. International assessments such as PISA and TIMSS reveal that many students struggle with reasoning, argumentation, and analytical skills. These difficulties often stem from traditional instructional methods, which emphasize memorization rather than deep understanding.

Developing logical thinking is particularly important in mathematics education because mathematical concepts rely heavily on reasoning, proof, and abstraction. Today's evolving educational landscape requires innovative teaching technologies that engage students in active, inquiry-based learning environments. This paper examines modern theories and classroom applications that promote logical development, with emphasis on digital tools and active learning strategies.

THEORETICAL BACKGROUND

Logical thinking is generally defined as the ability to analyze relationships, identify patterns, make connections, and draw valid conclusions. Its core components include:

– Analysis and synthesis
– Comparison and classification
– Inductive and deductive reasoning
– Algorithmic thinking
– Spatial and relational reasoning

Piaget's developmental theory emphasizes that logical operations emerge gradually as children progress through cognitive stages. Vygotsky highlights the importance of social interaction, suggesting that logical thinking develops through guided learning and scaffolding. Bruner's theory stresses discovery learning and spiral curriculum, which allow logical structures to form progressively.

Previous studies show that logical thinking improves significantly when students use interactive, problem-centered methods rather than lecture-based instruction. Researchers also note the effectiveness of digital tools in visualizing abstract concepts.

TEACHING TECHNOLOGIES FOR DEVELOPING LOGICAL THINKING

1. Problem-Based Learning (PBL). PBL presents students with complex, real-world problems that require exploration, hypothesis-making, and validation. It promotes independent reasoning and improves decision-making skills. In mathematics classrooms, PBL may involve solving non-standard problems, optimization tasks, or mathematical modeling. Students identify knowns and unknowns, design strategies, and justify their solutions.

2. Inquiry-Based Learning (IBL). IBL encourages questioning, exploration, and discovery. Students conduct mini-experiments, analyze data, and develop conclusions. Teachers act as facilitators rather than information providers. Inquiry-based tasks foster inductive and deductive reasoning, which are core components of logical thinking.

3. Critical-Thinking Technologies. Socratic questioning, argument mapping, and discussion-based strategies help students evaluate evidence, detect contradictions, and defend ideas logically. These technologies focus on reasoning processes rather than final answers, thereby strengthening analytical thinking.

4. Game-Based Learning. Educational games, logic puzzles, and digital simulations enhance cognitive engagement. They help students practice pattern recognition, classification, sequencing, strategy formation, and algorithmic reasoning in enjoyable environments. Examples include logic grid puzzles, escape-room tasks, and math strategy games.

5. ICT and Digital Tools. Modern technology provides powerful resources for teaching logical concepts:

– GeoGebra for geometric reasoning
– Desmos for functional relationships
– Python-based platforms for algorithmic thinking
– Virtual labs for scientific reasoning
– AI-driven adaptive platforms for personalized instruction

Digital visualizations make abstract concepts concrete and allow students to explore patterns dynamically.

6. Collaborative Learning Technologies. Group problem-solving tasks strengthen reasoning through peer explanation, justification, and debate. When students verbally articulate their reasoning, they refine their logical structures. Collaborative platforms such as Google Classroom, Padlet, and virtual whiteboards allow students to co-construct knowledge.

METHODOLOGY

This article is based on a mixed-methods research design involving literature review, teacher surveys, and classroom observations. Data were collected from mathematics teachers across grades 5–11. Tools for assessing logical thinking included diagnostic tests, reasoning tasks, and student interviews. Quantitative data were analyzed using descriptive statistics, while qualitative responses were evaluated through thematic analysis.

RESULTS AND DISCUSSION

Findings indicate that students exposed to problem-based and inquiry-based technologies demonstrated significantly higher improvements in logical reasoning skills. Digital tools improved students' motivation and helped them visualize relationships more effectively. Game-based learning increased engagement, particularly among younger learners. Teachers reported that collaborative learning encouraged students to articulate their thinking more clearly.

However, the effectiveness of these technologies depends on teacher proficiency, access to resources, and curriculum alignment. Traditional, lecture-based methods were found to be least effective for developing logical reasoning.

CONCLUSION

Teaching technologies aimed at developing logical thinking are essential for preparing students for future academic and professional challenges. The integration of PBL, IBL, ICT tools, and collaborative learning significantly enhances reasoning skills. Teachers should receive professional development to implement these methods effectively. Future research may focus on AI-based adaptive reasoning systems and cross-disciplinary integration.

References:

1. Raxmonova, N. (2024). OLIY MATEMATIKANI O 'QITISHDA ZAMONAVIY METODLARDAN FOYDALANISH. Universal xalqaro ilmiy jurnal , 1 (1), 9-14.
2. Rahmonova, N. V. (2023). Matematika fanini o`qitish metodikasi va malakalari haqida. *Fan va ta'lim* , *4* (5), 1137-1139.
3. Qizi, N. R. V. (2025). MATEMATIKA TA'LIMNI DIFFERENTSIAL YONDOSLASH ASOSIDA INDIVUDALLASHTIRISH: ZAMONAVIY USULLARNI INTEGRASİYA. *Tadqiqot markazi* , *4* (6), 207-217.
4. Rahmonova, N. (2025). MATEMATIKA O'QITISHDA SUN'YIY INELLEKT TIZIMLARINING AHAMIYATI. *Sun'iy intellekt xalqaro jurnali* , *1* (4), 1480-1485.
5. Piaget, J. (1970). Genetic Epistemology. Columbia University Press.
6. Vygotsky, L. (1978). Mind in Society. Harvard University Press.
7. Hmelo-Silver, C. (2004). Problem-based learning: What and how do students learn?
8. OECD. (2022). PISA Assessment Framework.
9. Bruner, J. (1961). The act of discovery. Harvard Educational Review.
10. Tojiyeva, M. M. va Raxmonova, N. V. (2022). METRIKA AKSIOMALARINI TEKSHIRISHDA QULAY METODLAR. Yosh tadqiqot Jurnali , 1 (5), 320-326.

11. Rahimov, A. va Rahmonova, N. (2024 yil, noyabr). AW*-algebralarida markaziy qiymatli kvazitralar. *AIP konferentsiyasi materiallarida* (3244-jild, № 1, 020036-bet). AIP Publishing MChJ.
12. Otto, M., & Thornton, J. (2023). THE CONNECTION OF A RICKART REAL C*-ALGEBRA WITH ITS ENVELOPING RICKART (COMPLEX) C*-ALGEBRA. *QO ‘QON UNIVERSITETI XABARNOMASI*, 41-43.
13. Rakhimov, A., & Rakhmonova, N. (2024, November). The center-valued quasitraces on AW*-algebras. In AIP Conference Proceedings (Vol. 3244, No. 1, p. 020036). AIP Publishing LLC.
14. Qo‘chqoraliyeva, O. va Rahmonova, N. (2025). C*, VON NEYMAN, AW* VA JW* operator ALGEBRALARINING QO'LLANISHI VA ISTIQBOTLARI. *Amaliy fanlar va ijtimoiy fanlar jurnali* , *1* (4), 151-158.
15. Raxmonova, N. V. Q. (2021). ELLIPTIK EGRI CHIZIQDA RATSIONAL KOORDINATALI NUQTALARNI ANIQLASH UCHUN TAYYORLANGAN MUHITNING ALGORITMI. *Sharq uyg'onishi: innovatsion, ta'lim, tabiiy va ijtimoiy fanlar* , *1* (6), 61-69.
16. Raxmonova, N. V. Q. va Akbarov, D. E. (2021). ELLIPTIK EGRI CHIZIQ GRAFIGINI YASASH. *Fan va ta'lim* , *2* (1), 9-14.