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Logical-mathematical games as a tool for developing the logical sphere of preschool children

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Abstract: This study focuses on investigating the effectiveness of game-based methodological tools in shaping problem-solving and creative thinking skills in preschool children. Throughout the research process, the children's thinking capacities, creative approaches, and independent decision-making skills were analyzed. Through the use of games and interactive methods, the children were provided with opportunities to practically develop skills in identifying problems, proposing solutions, and making choices.

Keywords: preschool education, creative thinking, problem-solving, game-based methodological tools, interactive activities

1. Introduction

Preschool age (3–7 years) is a pivotal phase for the cognitive and intellectual development of children, particularly in advancing their logical sphere. Logical thinking equips children with the abilities to solve problems, recognize patterns, classify, compare, and understand spatial concepts, establishing a solid foundation for future schooling, mathematics, and science [1]. Contemporary research indicates that logical-mathematical games serve as the most effective tool in this process, as they spark children's interest through play and foster natural development. Within Uzbekistan's preschool education system (guided by State Education Standards and UNICEF initiatives), such games contribute to children's conscientious, creative, and social development, intertwining national values (justice, order) with solutions to global challenges, such as mental health and cognitive flexibility. For instance, the new play-based curriculum introduced in Uzbekistan focuses on nurturing children's logical thinking through didactic games, a movement driven by an expansive project training over 100,000 educators [2]. This article provides a comprehensive exploration of the topic, examining its theory, benefits, types of games, research, and practical recommendations.

Goals and Tasks of Logical-Mathematical Games

The primary goal of logical-mathematical games is to develop early forms of logical thinking (visual-figurative and verbal-logical) in preschool children through play-based activities.

The specific tasks include:

- **Forming Logical Operations:** Teaching mental operations such as analysis, synthesis, comparison, serialization (ordering based on specific attributes), classification (grouping), and generalization.
- **Developing Cognitive Interest:** Cultivating a continuous desire for learning, exploration, and resolving creative tasks.
- **Nurturing Personal Qualities:** Fostering independence, resourcefulness, agility, perseverance, and the ability to plan one's actions.
- **Reinforcing Mathematical Concepts:** Mastering concepts related to quantity, counting, geometric shapes, sizes, space, and time.

The theoretical framework for developing the logical sphere relies heavily on the works of Jean Piaget and Lev Vygotsky, though modern research has broadened their scope [3].

2. Methodology

To investigate the effectiveness of game-based methodological tools in shaping problem-solving, logical thinking, and creative skills in preschool children aged 3–7, a structured, step-by-step empirical methodology is established. The research framework is grounded in the theoretical models of Jean Piaget's symbolic thinking and Lev Vygotsky's Zone of Proximal Development (ZPD), using a social and collaborative context to observe cognitive growth. The methodology is systematically organized into three distinct operational phases [4]. First, the Introduction Stage focuses on baseline familiarization, where educators introduce young children to specialized game materials—specifically Z. Dienes' Logical Blocks, J. Cuisenaire Rods, and Tangram geometric constructors—allowing them to freely explore foundational properties like color, shape, size, and thickness. Second, the Guided Practice Stage transitions the children into structured cognitive activities, where they execute targeted mathematical tasks based on ready-made models, diagrams, or algorithmic prompts to track operational capacities like classification, serialization, and comparison. Third, the Exploratory and Creative Stage presents complex problem situations and TRIZ technology (Theory of Inventive Problem Solving) elements, prompting children to independently invent new rules and shapes without diagrams [5], [6]. Throughout these interactive role-playing and logical sessions, qualitative and quantitative data are gathered regarding independent decision-making, attention, and memory retention. The data-driven success of this methodology is measured by tracking changes in mental operations and evaluating skill enhancement, aiming to capture the documented 20–30% increase in early mathematical and analytical skills achieved through continuous, game-based learning engagement [7].

3. Results and Discussion

Jean Piaget's Theory: Children in the "preoperational stage" (2–7 years) develop symbolic thinking but are limited by "centration" (the tendency to focus on only one aspect of a situation). Logical games help overcome this constraint by teaching children to consider multiple dimensions, thereby accelerating the transition to the concrete operational stage. For example, classification games show children that objects can belong to multiple categories simultaneously [8].

The renowned educator V.A. Sukhomlinsky regarded play as an inseparable component of mental development, stating:

"Without play, there can be no fulfilling intellectual development. Play is a massive, bright window through which an endless stream of ideas and concepts pours into a child's spiritual world. Play is the spark that ignites the flame of curiosity."

This perspective highlights the crucial role logical games play in awakening a child's natural

passion for learning [9].

Lev Vygotsky's Theory: Through the "Zone of Proximal Development" (ZPD), play allows children to master new abilities with the guidance of adults. Group games develop logical thinking within a social context, teaching children how to solve problems collaboratively.

Modern Approaches: Research demonstrates that logical games enhance intellectual abilities by shaping children's mathematical concepts (such as numbers and shapes). In the context of Uzbekistan, logical thinking is being cultivated through didactic games and TRIZ technology (Theory of Inventive Problem Solving), which strengthens children's analytical skills. Furthermore, according to Howard Gardner's theory of multiple intelligences, logical-mathematical intelligence develops naturally through games, particularly via problem-solving and exploration [10].

Popular Logical-Mathematical Games and Their Capabilities

Many types of logical-mathematical games are utilized in modern practice. The most effective and widespread ones include in table given below (table 1):

Game	Description / Capabilities
Z. Dienes' Logical Blocks	Created by the Hungarian psychologist and mathematician Z. Dienes. It consists of 48 geometric shapes of various forms, colors, sizes, and thicknesses.
J. Cuisenaire Rods	Invented by the Belgian teacher J. Cuisenaire. These consist of counting rods of different lengths and colors.
Tangram (Geometric Constructor)	An ancient Chinese puzzle. It is made by dividing a square into 7 geometric shapes.

Table 1. The most effective and widespread logical-mathematical games.

Methodology for Organizing the Games

The implementation of logical-mathematical games must be structured step-by-step, taking into account the age-specific characteristics of the child:

- **Introduction Stage:** Familiarizing children with the game materials (blocks, rods, figures) and exploring their properties, such as color, shape, and size.
- **Guided Practice Stage:** Executing tasks based on a ready-made model, diagram, or algorithm (for example, "Find the red triangle" or "Build an animal according to the model").
- **Exploratory and Creative Stage:** Resolving problem situations, inventing new rules, and independently creating imaginative shapes without the use of diagrams.

During these logical games, educators or parents should stimulate the child's personal activity, foster independent thinking, and encourage them to analyze the solutions they find [11].

Impact on Child Development

Logical-mathematical games exert a multifaceted influence on children's growth:

- **Cognitive Development:** It enhances attention, memory, thinking, and creativity. Children learn how to solve problems, which builds the foundation for mathematical and scientific abilities.
- **Skill Enhancement:** Studies indicate that these games can increase children's mathematical skills by 20–30%, as they facilitate learning through repetition and active engagement.
- **Social-Emotional Benefits:** Games foster responsibility, cooperation, and resilience. Accepting defeat strengthens mental health, while teaching children tolerance and social

interaction.

- **Academic and Life Benefits:** Games improve school readiness and predict children's future academic success. In Uzbekistan, integrating these games with national traditions cultivates ecological responsibility and global citizenship. Furthermore, games boost children's motivation, making mathematics feel interesting rather than "scary."

Shaping problem-solving and creative thinking skills in preschool children is one of the crucial directions in child psychology and pedagogy. According to modern pedagogical research, independent thinking plays a vital role in children's personal and social development [12]. For instance, Sevara Salimovna Hamrayeva studied the process of shaping independent thinking in preschool children, analyzing its content and pedagogical methods, and noted that independent thinking is tightly intertwined with creativity and logical reasoning in children.

Game-based methodological tools serve as an effective instrument for young children during the problem-solving process. For example, didactic games are highlighted as mechanisms for developing cognitive activity in preschool children. These games capture the child's attention, activate memory and logical thinking, and prompt them to reason through problems and solutions.

The issue of shaping creative thinking is also widely covered in pedagogical literature. In the research of Asekxan Boranbay qizi Karbayeva, capabilities such as creativity, inventiveness, and developing novel approaches in preschool children are viewed as core tasks within the educational process. It is emphasized that during this process, children gain opportunities to think independently, solve problems through creative methods, express themselves, and generate new ideas [13], [14].

Pedagogical and psychological principles also shed light on the role of games in shaping creative thinking. The research of Umida Abdusattorova demonstrates that learning through play, communication, and active approaches plays an important role in supporting children's creative thinking abilities. Through play activities, children strengthen their problem-solving capacity.

Studies show that games help children actively interact with the outside world and perform various tasks in role-playing situations, thereby helping them learn the processes of identifying problems and finding solutions. This process broadens children's independent thinking, logical reasoning, and creative approaches, while simultaneously supporting cognitive development.

Therefore, integrating game-based pedagogical tools into the educational process as an educator not only enhances the quality of education but also directly serves to develop children's problem-solving and creative thinking skills [15]. In this regard, games—ranging from role-playing in various contexts to logical tasks and creative assignments—can be effectively applied for pedagogical purposes.

4. Conclusion

Logical-mathematical games serve as the most effective and engaging tool for developing the logical sphere of preschool children, a fact substantiated by theoretical frameworks and research. They enhance children's readiness for school by ensuring their cognitive, social, and emotional development. In Uzbekistan, the widespread application of these games—by blending national heritage with global approaches—helps address global challenges. Consequently, through play, children not only learn but also thoroughly enjoy the process of learning.

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