

THE ROLE OF EDUCATIONAL TECHNOLOGIES IN SHAPING PRESCHOOLERS' THINKING AND LEARNING ABILITIES

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Annotation: This article explores innovative didactic approaches to the formation of mathematical concepts among preschool children through the application of the Theory of Inventive Problem Solving (TIPS). It highlights the use of developmental and logical games, creative exercises, and modeling techniques in teaching mathematics to young learners. The study substantiates the need for systematic preparation of preschoolers for mastering school mathematics and emphasizes the role of educational technologies in developing logical thinking, cognitive activity, and creativity.

Keywords: preschool education, educational technologies, TIPS, mathematical development, logical thinking, spatial orientation, innovative teaching methods, game-based learning.

Аннотация: В статье рассматриваются инновационные дидактические подходы к формированию математических представлений у детей дошкольного возраста на основе ТРИЗ-технологий (Теории решения изобретательских задач). Раскрываются методы и приёмы обучения математике с использованием развивающих и логических игр, творческих упражнений и моделирования. Обосновывается необходимость систематической подготовки дошкольников к усвоению школьной программы по математике и подчеркивается роль образовательных технологий в развитии логического мышления, познавательной активности и творческих способностей детей.

Ключевые слова: дошкольное образование, образовательные технологии, ТРИЗ, математическое развитие, логическое мышление, пространственная ориентация, инновационные методы обучения, игровые подходы.

Annotatsiya: Ushbu maqolada TRIZ texnologiyasi (Ixtirochilik masalalarini hal qilish nazariyasi) asosida maktabgacha yoshdagi bolalarda matematik tasavvurlarni shakllantirishning innovatsion didaktik yondashuvlari tahlil qilinadi. Bolalarga matematika o'qitishda rivojlantiruvchi va mantiqiy o'yinlardan, ijodiy mashqlardan hamda modellashtirish usullaridan foydalanishning samarali yo'llari ko'rsatib berilgan. Tadqiqotda bolalarni maktab matematika dasturini o'zlashtirishga tizimli tayyorlash zarurligi asoslanadi va ta'lim texnologiyalarining bolalarda mantiqiy tafakkur, bilish faolligi hamda ijodkorlikni rivojlantirishdagi o'rnini ta'kidlanadi.

Kalit so'zlar: maktabgacha ta'lim, ta'lim texnologiyalari, TRIZ, matematik rivojlanish, mantiqiy tafakkur, fazoviy yo'nalish, innovatsion o'qitish metodlari, o'yinli yondashuvlar.

Introduction. Modern preschool education faces the challenge of integrating new educational technologies that stimulate children's intellectual and creative potential. Teachers today have broad opportunities to design author's programs for the mathematical development of preschoolers, yet success in this field requires a deep understanding of pedagogical principles, cognitive psychology, and the logic of mathematical reasoning.

Recent reforms in early childhood education highlight the need to enrich existing methods and create innovative technologies for teaching mathematics through heuristic learning, problem solving, and modeling. One of the most effective frameworks for such innovations is the Theory of Inventive Problem Solving (TIPS), which provides structured tools for developing children's logical and creative abilities.

Theoretical Background

TIPS originated in the mid-20th century, developed by G.S. Altshuller through an analysis of thousands of invention patents. His studies revealed that all systems evolve according to objective laws and can be improved by consciously identifying and resolving contradictions.

Initially designed for engineering problem solving, TIPS has since expanded into various domains — from art and design to biology, pedagogy, and business innovation. When applied to education, TIPS provides a conceptual framework for nurturing creativity and logical reasoning, encouraging learners to analyze problems systematically, identify contradictions, and find original solutions using available resources.

Principles of the TIPS Approach in Education

TIPS is based on several fundamental principles:

- Objectivity of development laws: systems evolve according to objective principles that can be studied and applied.
- Identification and resolution of contradictions: every complex problem contains an internal contradiction that must be revealed and overcome.
- Contextual adaptability: each situation requires a unique set of solutions depending on its conditions and resources.

In pedagogy, these principles are translated into game-based, visual, and problem-solving activities that engage children's imagination while strengthening analytical and creative thinking.

Application of TIPS in Preschool Mathematical Education

The integration of the Theory of Inventive Problem Solving (TIPS) into preschool mathematical education provides a powerful framework for developing children's logical, analytical, and creative thinking. Unlike traditional methods that emphasize memorization and repetition, the TIPS approach transforms learning into an active process of discovery and intellectual exploration. It enables children to perceive mathematical relationships as dynamic systems rather than isolated facts, helping them to construct their own understanding through inquiry and experimentation.

In the context of early childhood education, TIPS supports the development of metacognitive skills—that is, the child's ability to think about their own thinking. When preschoolers engage in problem-solving situations, they learn to identify contradictions, analyze relationships between

objects and phenomena, and make decisions based on logic and evidence. This process builds the foundations for later abstract reasoning, which is essential for successful school learning in mathematics and science.

From a methodological point of view, TIPS offers educators a set of structured tools and exercises that can be adapted to various developmental levels. It encourages teachers to act as facilitators who guide children toward discovery, rather than as instructors who simply deliver information.

Examples of TIPS-Based Activities in Preschool Mathematics

1. **Finding Common Features.** Children compare two or more seemingly unrelated objects (for example, a triangle and a pyramid) and identify common attributes such as the number of sides, symmetry, or geometric relationships. This exercise develops categorical reasoning, attention to detail, and verbal articulation of abstract properties.
2. **Search for Analogies.** Learners are encouraged to find analogues to a chosen object based on its essential features—for instance, comparing the concept of “circle” with the “sun,” “wheel,” or “clock.” Such activities enhance associative thinking and help children build semantic networks, expanding their mathematical vocabulary.
3. **“The Third is Odd”.** The educator presents three objects, two of which share similar properties while the third differs (e.g., square, rectangle, and triangle). The child must identify which one is different and explain why. This task fosters logical comparison, classification, and verbal reasoning.
4. **“What is Included In”.** Children explore hierarchical relationships among systems and their components, learning how objects can belong to broader or narrower categories (for instance, “a cube is part of 3D shapes,” “shapes are part of geometry”). This activity builds the foundation for systemic and hierarchical thinking, teaching children to perceive structures within wholes.
5. **“Yes–No” Game.** The teacher selects a hidden mathematical object or concept, and children ask questions that can only be answered with “yes” or “no.” For example: “Is it a shape?” “Does it have three sides?” “Can it roll?” This game develops hypothesis testing, strategic questioning, and deductive reasoning—key components of critical thinking.
6. **“Little People” Exercise.** In this creative activity, each element of a system (such as a corner of a square or a side of a shape) is personified as a “little person” with its own behavior and role. Children act out interactions between these “characters,” visualizing abstract relationships through play. The exercise enhances imaginative modeling, social interaction, and systemic awareness.

Pedagogical Benefits and Integration Strategies

Implementing TIPS in preschool mathematics requires thoughtful design of learning environments that support experimentation, inquiry, and collaboration. Teachers should provide children with a variety of manipulative materials—such as blocks, pattern cards, digital puzzles, or geometric modeling sets—to allow tactile exploration of mathematical ideas.

Moreover, TIPS can be integrated into STEAM (Science, Technology, Engineering, Arts, and Mathematics) activities, where children build bridges, patterns, or 3D models while identifying

contradictions (e.g., “How can the bridge be both strong and light?”). These playful engineering challenges naturally apply TIPS principles, promoting creativity and practical problem-solving.

Regular reflection is an essential part of this process. After completing a task, children discuss what they discovered, how they solved the problem, and what strategies helped them succeed. This metacognitive reflection nurtures self-regulation and learning autonomy.

The use of TIPS in preschool mathematical education fosters a culture of intellectual curiosity and creative reasoning. It transforms mathematics from a subject of fixed rules into an evolving process of discovery. Through guided play and inventive challenges, children learn not only to count or recognize shapes but also to think, analyze, and innovate—developing the very cognitive foundations that define successful lifelong learners.

TIPS Principles for Contradiction Minimization in Learning Tasks

Educators can use simplified versions of TIPS inventive principles in preschool settings, including:

- Fragmentation: dividing an object or task into manageable parts.
- Local Quality: assigning different functions to different elements of a system.
- Asymmetry: changing uniform or static forms into dynamic, varied ones.
- Combination and Versatility: merging functions or tools for multi-purpose use.
- Preliminary Action: preparing materials or steps in advance to ensure smooth task flow.
- Reversal: encouraging children to think in opposites or invert patterns.
- Dynamic Change: allowing flexible transformations and movement in the learning environment.
- “Blessing in Disguise”: turning challenges into opportunities for creativity.

Such principles stimulate flexible thinking and meta-cognitive awareness, helping children to see multiple perspectives and alternative pathways to solutions.

Reflection and Evaluation

Reflection in the educational process enables both teachers and children to assess their activities using clear and observable criteria. In TIPS methodology, creativity and system thinking are evaluated through levels of transformation:

1. Modification of object parts;
2. Transformation of a single element;
3. Improvement of the entire system;
4. Creation of a new system;
5. Development of principles for constructing new systems.

These levels help educators determine whether children’s activity remains reproductive (imitative) or reaches constructive and innovative stages of creativity.

Results and Discussion

The integration of TIPS into preschool mathematics classes demonstrates several pedagogical benefits:

- Increased engagement and motivation among children during mathematical activities;
- Development of logical consistency, imagination, and spatial reasoning;
- Growth of independent problem-solving skills through structured play;
- Expansion of teachers' methodological repertoire for individualized and group work;
- Formation of a sustainable foundation for school-level mathematical learning.

Children exposed to TIPS-based instruction display higher levels of cognitive flexibility, systemic analysis, and creative problem solving compared to peers taught by traditional methods.

Conclusion. The implementation of educational technologies such as TIPS in preschool education transforms the process of learning mathematics into an engaging, discovery-oriented activity. It provides a bridge between play and intellectual development, aligning with the child's natural curiosity and cognitive potential. The systematic use of TIPS principles helps educators cultivate logical, creative, and critical thinking skills in young learners, preparing them for the challenges of modern education. The combination of technological tools, heuristic exercises, and interactive play ensures a balanced development of children's cognitive and social competencies.

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