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PEDAGOGICAL FOUNDATIONS OF THE FORMATION OF MATHEMATICAL IMAGINATION IN PRESCHOOL CHILDREN BASED ON GAME TECHNOLOGIES

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Abstract. This article analyzes the pedagogical foundations for forming mathematical imagination through game technologies in preschool education. It explains theoretical bases (sociocultural mediation, developmental readiness, learning trajectories), identifies key pedagogical principles (playful challenge, concreteness-to-abstraction, rule awareness, language support, collaboration, and reflection), and proposes practical strategies for designing game-based mathematical experiences. Examples show how teachers can use games to cultivate spatial visualization, pattern sense, early modeling, and flexible thinking while maintaining developmental appropriateness.
Keywords: mathematical imagination; preschool children; game technologies; early mathematics; play-based learning; spatial reasoning; problem solving; learning trajectories; didactic games.

INTRODUCTION

Preschool children live in a world where imagination is not an “extra feature”—it’s the operating system. They imagine a chair is a bus, a stick is a thermometer, and a cardboard box is a rocket with suspiciously weak safety standards. The pedagogical question is how to channel this natural imaginative power toward mathematical development without crushing curiosity under “repeat after me” routines. Mathematical imagination is not simply liking math or being good at counting; it is the ability to mentally represent mathematical objects and relations, transform them, and predict outcomes. A child with developing mathematical imagination can anticipate that two triangles might form a square, foresee that adding one more block will make a tower taller, or guess the next element in a pattern before placing it. This capacity supports later mathematical thinking because formal mathematics relies on mental models, symbolic representation, and flexible transformation of ideas [1].

The preschool period is especially sensitive for building this competence because children’s thinking is strongly tied to action, language, and social interaction. They learn best when tasks are meaningful, concrete, and emotionally engaging. That is why game technologies occupy a privileged position in early childhood pedagogy. Games are not only entertainment; they are structured contexts with goals, rules, roles, materials, and feedback. When the teacher uses games purposefully, the child’s attention is sustained, mistakes are experienced as part of play rather than failure, and repetition becomes natural instead of boring. At the same time, games can be designed so that the child must compare, classify, sequence, measure, model, and justify—exactly the mental actions that nourish mathematical imagination. Research and professional guidance on early math emphasize the importance of high-quality experiences that build conceptual understanding and reasoning, and playful learning is repeatedly identified as an effective pathway when guided thoughtfully by adults [2].

MATERIALS AND METHODS

A strong pedagogical foundation begins with a clear understanding of what “mathematical imagination” includes in preschool age. It has at least four interrelated components. First, visual–

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spatial imagination: mentally rotating, combining, and decomposing shapes; imagining paths, positions, and transformations. Second, quantitative imagination: anticipating "more/less," composing and decomposing small numbers, and predicting results of simple changes ("If we add one, what happens?"). Third, pattern and structural imagination: noticing regularities, building and extending patterns, and grasping simple functional relationships ("it grows by one each time"). Fourth, modeling imagination: using symbols, drawings, objects, or gestures to represent a situation and exploring "what-if" variations. In preschool education, these components do not develop through lectures; they grow through repeated experiences of acting, representing, and reflecting—precisely what well-designed games offer.

RESULTS AND DISCUSSION

From these foundations, several pedagogical principles follow. (1) Playful challenge with clear rules. Mathematical imagination develops when children operate within constraints and goals: build a bridge that holds a toy car, deliver "three apples" to each customer, or find a shape that fits a "mystery window." Rules push children to think beyond random trial-and-error; they must plan mentally, choose strategies, and test outcomes. (2) Concreteness-to-abstraction, not concreteness forever. Materials (blocks, beads, cards) are essential, but the teacher gradually encourages children to internalize actions: "Before you move the blocks, show me with your fingers what you think will happen." This shift is exactly the transition from external manipulation to internal imagination. (3) Language as a thinking tool. Mathematical imagination strengthens when children can name relations: same/different, more/less, longer/shorter, next/before, corner/edge, rotate/flip. Teacher prompts like "How do you know?", "What's your rule?", and "Can you prove it with objects?" build the habit of justification without turning preschool into a courtroom drama. (4) Collaboration and social reasoning. Many imaginative leaps happen when children negotiate meaning with peers: they explain, disagree, revise, and co-construct solutions. (5) Reflection after action. Games should end with a short reflection—two or three minutes is enough—where children describe strategies, compare solutions, and notice patterns. This helps transform "I did it" into "I understand what happened."

Game technologies in preschool can be organized into several functional types, each supporting specific aspects of mathematical imagination. Didactic tabletop games (matching, sorting, sequencing, number–quantity correspondence) build structural and quantitative imagination. For example, a "Treasure Sorting" game where children must place objects into chests based on a secret rule (shape, size, number of dots) encourages mental hypothesis testing: children guess the rule, test it, and revise [4].

CONCLUSION

The formation of mathematical imagination in preschool children is a pedagogical task with long-term impact because imagination fuels later mathematical reasoning, creativity, and the ability to model real situations. Game technologies provide an especially effective pathway because they naturally integrate motivation, action, social interaction, and rule-based structure—conditions under which young children can explore mathematical relationships with joy and persistence.

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