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METHODS AND TOOLS FOR DEVELOPING LOGICAL AND CRITICAL THINKING SKILLS IN OLDER PRESCHOOL CHILDREN

Zulfiya Abdurasulova Abdushukur qizi
Guliston state pedagogical institute master's student
E:mail. abdurasulova_zulfiya@gspi.uz
Orcid: 0009-0000-1565-2536
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Abstract: This study investigates the development of logical and critical thinking skills in older preschool children (ages 5-7). The research addresses the need for innovative pedagogical methods that stimulate analytical reasoning beyond traditional teaching. The study utilized a methodological framework involving pedagogical experiments and diagnostic tasks. Key mental operations-analysis, synthesis, and generalization-were assessed through the implementation of specialized logical-mathematical tools and interactive problem-solving exercises. The findings indicate that children engaged with these specialized tools showed significant improvement in identifying cause-and-effect relationships and categorizing objects. Additionally, interactive inquiry led to a measurable increase in the children's ability to formulate and justify independent conclusions. The research concludes that systematic use of interactive cognitive tools is more effective than conventional instruction. Integrating these methods into the preschool curriculum is essential for preparing children for the cognitive demands of primary education.
Keywords: Cognitive development, critical thinking, logical thinking, older preschoolers, pedagogical tools.

Annotatsiya: Ushbu tadqiqot katta maktabgacha yoshdagi (5-7 yoshli) bolalarning mantiqiy va tanqidiy fikrlash ko'nikmalarini rivojlantirish masalalarini tahlil qiladi. Tadqiqot an'anaviy ta'lim usullaridan farqli o'laroq, bolalarda tahliliy mulohaza yuritishni rag'batlantiruvchi innovatsion pedagogik metodlarga bo'lgan ehtiyojni yoritib beradi. Tadqiqot davomida pedagogik tajriba va diagnostik topshiriqlardan iborat metodologik tizimdan foydalanildi. Maxsus mantiqiy-matematik vositalar va interfaol muammoli vaziyatlar orqali bolalardagi asosiy aqliy operatsiyalar-analiz, sintez va umumlashtirish darajasi baholandi. Olingan natijalar shuni ko'rsatadiki, maxsus vositalar bilan ishlagan bolalarda sabab-oqibat bog'liqliklarini aniqlash va ob'ektlarni guruhlarga ajratish qobiliyati sezilarli darajada oshgan. Shuningdek, interfaol so'rov metodlari bolalarning mustaqil xulosalar chiqarish va ularni asoslab berish ko'nikmalarini rivojlantirishga xizmat qildi. Tadqiqot xulosasiga ko'ra, interfaol kognitiv vositalardan tizimli foydalanish an'anaviy ta'lim usullariga qaraganda yuqori samaradorlikka ega. Ushbu metodlarni maktabgacha ta'lim dasturiga joriy etish bolalarni maktab ta'limiga muvaffaqiyatli tayyorlashda muhim ahamiyat kasb etadi.
Kalit so'zlar: Katta maktabgacha yoshdagi bolalar, kognitiv rivojlanish, mantiqiy fikrlash, pedagogik vositalar, tanqidiy fikrlash.

Аннотация: В рамках современной образовательной парадигмы развитие когнитивных способностей высшего порядка в раннем возрасте является приоритетной задачей. Данное исследование посвящено изучению методов развития логического и критического мышления у детей старшего дошкольного возраста (5-7 лет). Работа обосновывает необходимость внедрения инновационных педагогических подходов, стимулирующих

аналитическое мышление, в противовес традиционным репродуктивным методам обучения. В исследовании использовался комплексный методологический инструментарий, включающий педагогический эксперимент и диагностические задания. С помощью специализированных логико-математических средств и интерактивных проблемных ситуаций оценивались ключевые мыслительные операции: анализ, синтез и обобщение. Полученные данные свидетельствуют о том, что у детей, работавших со специальными когнитивными инструментами, значительно повысился уровень выявления причинно-следственных связей и классификации объектов. Кроме того, использование методов открытых вопросов способствовало развитию умения формулировать самостоятельные выводы и аргументировать свою точку зрения. Исследование подтверждает, что систематическое использование интерактивных средств обучения более эффективно для развития гибкости мышления, чем традиционные инструкции. Интеграция данных методов в учебный план дошкольных учреждений является необходимым условием для качественной подготовки детей к обучению в начальной школе.

Ключевые слова: Когнитивное развитие, критическое мышление, логическое мышление, педагогические инструменты, старшие дошкольники.

Introduction

In the modern educational paradigm, the transition from simple knowledge acquisition to the development of complex cognitive structures is considered a fundamental priority. For older preschool children (ages 5-7), establishing a robust foundation in logical and critical thinking is not merely an academic advantage but a cognitive necessity. As highlighted by several scholars, critical thinking should be viewed as a primary educational outcome, serving as a model for intellectual maturity [1][1]. However, traditional pedagogical approaches often struggle to move beyond rote memorization, necessitating a shift toward more dynamic, landscape-based learning environments where children “play to learn” [2].

The complexity of the 21st-century information environment demands that individuals possess the ability to analyze, synthesize, and evaluate information from an early age. The role of cognitive skills in early child development is paramount for long-term socio-economic success [3]. To address this, educators must employ “visible thinking” strategies that allow children to externalize their thought processes and engage in socio-emotional and cognitive growth simultaneously [4]. This is particularly important in the preschool years, which are identified as a critical window for fostering analytical reasoning through structured pedagogical interventions [5].

Global educational trends emphasize the integration of innovative practices that bridge the gap between abstract logic and practical problem-solving [6]. This requires a specialized “toolkit” of methods-ranging from open-ended questioning to structured logical-mathematical games-that challenge a child's mental flexibility [7]. Furthermore, recent research suggests that metacognitive development, specifically the ability to reflect on one's own thinking, can be significantly enhanced through the systematic application of specialized pedagogical tools and methodologies [8].

Despite the recognized importance of these skills, there remains a lack of specific methodological guidelines on how to effectively integrate logical and critical thinking exercises into the daily preschool curriculum. This study aims to fill that gap by evaluating the effectiveness

[1] Zivkovic, S. (2020). “A Model of Critical Thinking as an Educational Outcome”. International Journal of Cognitive Research in Science, Engineering and Education, 8(2), 101-110.

of diverse methods and tools designed to stimulate the analytical capacities of older preschoolers, thereby preparing them for the rigorous cognitive demands of primary education.

Materials and Methods

The study adopted a mixed-methods research design, combining qualitative pedagogical observations with quantitative diagnostic assessments. This approach allowed for a comprehensive evaluation of the effectiveness of specialized tools in developing logical and critical thinking skills among older preschoolers. The research was conducted in a controlled educational environment to monitor the direct impact of the implemented pedagogical interventions. The study involved a cohort of children aged 5 to 7 years, representing the older preschool group. The participants were selected from a preschool educational institution (DMTT) to ensure a standardized learning background. The sample size was divided into an experimental group and a control group to allow for a comparative analysis of cognitive growth. Ethical guidelines were followed, ensuring that all activities remained within the scope of the national preschool curriculum. A specialized "Pedagogical Toolkit" was developed and utilized throughout the intervention phase. The primary materials included:

1. **Logical-mathematical blocks:** tools designed to enhance categorization, seriation, and analytical reasoning.
2. **Problem-solving scenarios:** a set of visual and verbal tasks requiring children to identify cause-and-effect relationships.
3. **STEAM elements:** integrative activities involving simple engineering and artistic tasks to stimulate creative and critical inquiry.
4. **Diagnostic assessment sheets:** standardized forms used to record children's ability to perform mental operations such as analysis, synthesis, and generalization.

The research was carried out in three distinct stages:

1. **Initial assessment (Pre-test):** both groups were evaluated using diagnostic tasks to determine their baseline levels of logical and critical thinking.
2. **Implementation Phase:** the experimental group engaged in daily 20-30 minute sessions utilizing the specialized tools and interactive methods (e.g., open-ended questioning and Montessori-inspired exercises). The control group continued with the standard curriculum.
3. **Final assessment (Post-test):** after a structured period of three months, both groups were re-evaluated using the same diagnostic criteria to measure the degree of cognitive improvement.

Results

The implementation of specialized pedagogical tools led to measurable improvements in the logical and critical thinking capacities of the experimental group. The data obtained from the post-test assessments revealed significant qualitative and quantitative shifts in how children approach complex cognitive tasks.

Improvement in logical operations: the experimental group showed a marked increase in the proficiency of fundamental mental operations. Before the intervention, only 42% of the children could independently categorize objects based on more than two attributes. Following the systematic use of logical-mathematical blocks and STEAM-based activities, this figure rose to 78%. In contrast, the control group, which followed the standard curriculum, showed a marginal increase of only 8% (from 40% to 48%).

Critical thinking and evidence-based reasoning: one of the most significant results was the development of the children's ability to justify their conclusions. During the "problem-solving scenarios" phase:

Experimental group: 65% of the children were able to provide a logical explanation for "why" a certain outcome occurred, moving beyond simple "yes/no" answers. They demonstrated the ability to identify cause-and-effect relationships in 8 out of 10 presented cases.

Control group: Only 30% of the children could provide evidence-based justifications, often relying on intuitive or repetitive answers without analytical depth.

Quantitative comparison of cognitive markers: the following table summarizes the average performance scores (on a 10-point scale) across key cognitive parameters:

Cognitive parameter	**Control group (Post-test)**	**Experimental group (Post-test)**	**Improvement gap**
Analysis & synthesis	5.2	8.4	+3.2
Generalization ability	4.8	7.9	+3.1
Hypothesis formulation	3.5	7.2	+3.7
Speed of puzzle solving	4.1	8.1	+4.0

Qualitative observations: pedagogical observations indicated that children in the experimental group became more intellectually persistent. When faced with "impossible" or "trick" puzzles designed to test critical thinking, children in the experimental group spent an average of 4 minutes longer attempting to find a logical inconsistency, whereas children in the control group tended to lose interest or seek adult assistance within the first 90 seconds.

Discussion

The results of this study provide empirical evidence that the cognitive architecture of older preschoolers is highly receptive to structured pedagogical interventions. The significant disparity between the experimental and control groups suggests that while cognitive development occurs naturally with age, the quality and depth of logical and critical thinking are directly dependent on the "mediating tools" used in the educational process.

The findings align with the theoretical framework of Zivkovic (2020), who posits that critical thinking must be treated as a deliberate educational outcome rather than a byproduct of general instruction. The 78% proficiency in categorization observed in the experimental group confirms that when children are provided with logical-mathematical blocks, they transition from "transductive reasoning" (typical of younger preschoolers) to more sophisticated inductive and deductive processes. This supports Mincemoyer's (2022) assertion that structured interventions act as a catalyst for analytical reasoning during this critical developmental window.

Furthermore, the improvement in "evidence-based reasoning" (65% in the experimental group) highlights the effectiveness of open-ended inquiry. Unlike the control group, which often provided

superficial answers, the experimental group's ability to justify "why" an outcome occurred suggests the development of metacognitive awareness. This resonates with the "visible thinking" strategies proposed by Salmon (2021), where the externalization of thought processes leads to stronger cognitive consolidation.

The role of STEAM elements and Montessori-inspired tools cannot be overstated. By engaging in tasks that require identifying cause-and-effect relationships, children in the experimental group developed what Cottrell (2023) describes as a "critical thinking toolkit". The qualitative shift in intellectual persistence-where children spent significantly more time analyzing puzzles rather than giving up-indicates that these tools foster not only cognitive skill but also a psychological disposition toward problem-solving.

However, the study also reveals certain limitations. While logical operations showed rapid improvement, the formulation of complex hypotheses remains a challenge for some children, suggesting that language development and vocabulary size may act as a ceiling for critical thinking expression. This implies that future pedagogical tools should integrate more linguistic scaffolding alongside logical tasks.

Conclusion

The findings of this research underscore the transformative potential of integrating specialized pedagogical methods and tools into the preschool educational framework. The study successfully demonstrated that logical and critical thinking in older preschoolers (ages 5-7) are not merely innate traits but are skills that can be significantly enhanced through systematic, evidence-based interventions.

The quantitative data revealed a substantial improvement in the experimental group's ability to perform mental operations such as analysis, synthesis, and categorization. The shift from a 42% to a 78% proficiency level in complex classification tasks confirms that the use of logical-mathematical blocks and STEAM-inspired activities provides the necessary cognitive scaffolding for children to move toward more sophisticated reasoning. Furthermore, the qualitative development of "evidence-based reasoning" suggests that children are capable of metacognitive reflection when provided with the right inquiry-based environment.

In conclusion, the transition from traditional rote learning to an interactive, tool-oriented approach is essential for modern preschool education. By fostering intellectual persistence and analytical inquiry, these methodologies do more than prepare children for the primary school curriculum; they equip them with the fundamental cognitive competencies required for lifelong learning in an increasingly complex world. It is recommended that educational policymakers and practitioners prioritize the inclusion of structured logical challenges and critical thinking "toolkits" in the national preschool curriculum to ensure the holistic cognitive development of the next generation.

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