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- 13.00.00 Pedagogika fanlari
- 13.00.01 Pedagogika nazariyasi. Pedagogik ta'limotlar tarixi
- 13.00.02 Ta'lim va tarbiya nazariyasi va metodikasi (sohalar bo'yicha)
- 13.00.03 Maxsus pedagogika
- 13.00.04 Jismoniy tarbiya va sport mashg'ulotlari nazariyasi va metodikasi
- 13.00.05 Kasb-hunar ta'limi nazariyasi va metodikasi
- 13.00.06 Elektron ta'lim nazariyasi va metodikasi (ta'lim sohaları va bosqichlari bo'yicha)
- 13.00.07 Ta'limda menejment
- 13.00.08 Maktabgacha ta'lim va tarbiya nazariyasi va metodikasi
- 13.00.09 Ijtimoiy pedagogika
- 07.00.00 Tarix fanlari
- 19.00.00 Psixologiya fanlari
- 01.00.00 Fizika-matematika fanlari
- 02.00.00 Kimyo fanlari
- 03.00.00 Biologiya fanlari
- 09.00.00 Falsafa fanlari
- 10.00.00 Filologiya fanlari
- 11.00.00 Geografiya fanlari

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DEVELOPING LOGICAL THINKING VIA THE USE OF STEM TECHNOLOGY

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Abstract: This study provides a theoretical justification for the high effectiveness of STEM technologies as an advanced pedagogical tool for the purposeful development of logical thinking foundations in senior preschool children. Based on the analysis of national pedagogical approaches (T. V. Volosovets, I. M. Klimova), STEM technologies, which integrate science, technology, engineering, and mathematics, facilitate the active acquisition of logical operations such as analysis, synthesis, classification, and generalization through problem-based, research-oriented, and practical activities.

The findings indicate that this approach is highly consistent with the leading forms of preschool children's activity, namely play and experimentation. The conclusion presents the author's recommendations and methodological strategies aimed at fostering all components of logical thinking, including algorithmic reasoning and constructive skills.

Key words: STEM technologies, logical thinking, algorithmic thinking, logical operations, robotics, construction activities, senior preschool age, cognitive development.

Annotatsiya: Ushbu tadqiqot maktabgacha katta yoshdagi bolalarda mantiqiy fikrlash asoslarini maqsadli rivojlantirishda STEM-texnologiyalarining samaradorligini nazariy jihatdan asoslab beradi. Mahalliy pedagogik yondashuvlar (T. V. Volosovets, I. M. Klimova) tahliliga ko'ra, STEM-texnologiyalar (fan, texnologiya, muhandislik va matematika integratsiyasi) muammoli, tadqiqotga yo'naltirilgan hamda amaliy faoliyat orqali tahlil, sintez, tasniflash va umumlashtirish kabi mantiqiy operatsiyalarni faol o'zlashtirish imkonini yaratadi.

Tadqiqot natijalari ushbu yondashuv maktabgacha yoshdagi bolalarning yetakchi faoliyat turlari bo'lgan o'yin va tajriba faoliyati bilan eng yuqori darajada uyg'unlashishini ko'rsatdi. Xulosada mantiqiy fikrlashning barcha tarkibiy jihatlarini, jumladan, algoritmik fikrlash va konstruktiv faoliyat ko'nikmalarini rivojlantirishga qaratilgan mualliflik takliflari hamda metodik strategiyalar bayon etilgan.

Kalit so'zlar: STEM-texnologiyalar, mantiqiy fikrlash, algoritmik fikrlash, mantiqiy operatsiyalar, robototexnika, konstruktiv faoliyat, katta maktabgacha yosh, kognitiv rivojlanish.

Аннотация: Данное исследование представляет теоретическое обоснование высокой эффективности STEM-технологий как современного педагогического инструмента для целенаправленного развития основ логического мышления у детей старшего дошкольного возраста. Согласно анализу отечественных педагогических подходов (Т. В. Волосовец, И. М. Климова), STEM-технологии, объединяющие науку, технологии, инженерию и математику, обеспечивают активное освоение логических операций (анализа, синтеза, классификации и обобщения) посредством проблемно-ориентированной, исследовательской и практической деятельности.

Установлено, что данный подход наиболее полно соответствует ведущим видам деятельности дошкольников - игре и экспериментированию. В заключении представлены авторские предложения и методические стратегии, направленные на развитие всех компонентов логического мышления, включая алгоритмическое мышление и конструкторские навыки.

Ключевые слова: STEM-технологии, логическое мышление, алгоритмическое мышление, логические операции, робототехника, конструирование, старший дошкольный возраст, когнитивное развитие.

INTRODUCTION

As a direct result of the Federal State Educational Standard (FSES) for Preschool Education's criteria for cognitive development, one of the main goals of contemporary preschool education is the development of logical thinking. Successful classroom learning is based on logical thinking, which is defined as the capacity to work with ideas, draw conclusions, and create cause-and-effect links.



A significant shift from visual-imaginative to verbal-logical thinking occurs in senior preschool age (5-7 years), which fosters the deliberate development of sophisticated mental processes. However, conventional labor methods, which are mostly focused on verbal instructions and passive observation, often fail to provide the required practical participation and do not align with preschoolers' primary activities, which are play and experimenting. This results in a slowdown in the growth of creativity and independence as well as inadequate command of logical processes (analysis, synthesis, and categorization).

The primary contradiction is the lack of systematization of the use of STEM technologies as the primary pedagogical tool to address the psychological and pedagogical characteristics of senior preschool age, and the high social and educational need to develop a creative and logically thinking child personality.

The need to create and use strategies and tactics in preschool education that would guarantee the active, fun, and thorough development of all logical thinking components is a prerequisite for the study's applicability. STEM technologies, which combine science, technology, engineering, and mathematics, function as a synthetic kind of activity, focused on the application of knowledge in real-world situations, the connections between academic subjects, and the visualization of scientific phenomena. This makes the process of learning intricate logical regularities approachable and emotionally appealing for senior preschoolers.

The article's goal is to use STEM technology as the most efficient way to help senior preschoolers build the foundations of logical thinking. It does this by providing theoretical support, analyzing methodological methods, and proposing practical strategies.

LITERATURE REVIEW

The problem of developing logical thinking in senior preschool age has acquired particular relevance in modern pedagogy due to the increasing complexity of primary school curricula and the rapid digitalization of education. According to the Federal State Educational Standard (FSES) for preschool education, the formation of cognitive independence, problem-solving abilities, and basic logical operations constitutes the foundation of a child's intellectual readiness for school.

In recent years, STEM technology (Science, Technology, Engineering, and Mathematics) has emerged as a highly effective, integrated pedagogical approach. By shifting the educational paradigm from passive perception to active, constructive-engineering activity, STEM methods visualize abstract scientific and logical concepts, making them emotionally appealing and accessible to senior preschoolers.

The comprehensive nature of STEM education in early childhood has been substantiated by T.V. Volosovets, S.A. Averin, and V.A. Markova, who developed the partially modular program "STEM Education for Preschool Children". Furthermore, I.M. Klimova and S.N. Kashtanova highlighted the capacity of integrated technological solutions to stimulate verbal-logical thinking and overcome barriers in the verbalization and argumentation of logical conclusions.

The practical utility of STEM tools, such as the programmable "Robot Mouse," has been validated by E.A. Galashova, who demonstrated their effectiveness in developing basic algorithmization, spatial orientation, and logical operations in preschool children.

International researchers also emphasize the impact of technological and engineering experiences on computational and logical thinking. Mitchel Resnick argues that creative and logical reasoning are best developed through project-based activities that imitate playful experimentation. Similarly, Douglas H. Clements and Julie Sarama demonstrated that young children can grasp sophisticated structural and geometric regularities when provided with manipulable engineering and mathematical models.

Marina Umaschi Bers conceptualizes programming languages and programmable tools as an expressive medium where children naturally acquire structural logic, problem decomposition, and sequential planning. Likewise, Papadakis, Kalogiannakis, and Zaranis found that visual programming tools such as ScratchJr foster computational thinking, debugging skills, and problem-solving abilities.

The analysis of previous studies confirms the effectiveness of robotics, coding, and engineering activities; however, there remains a need to systematize these tools into practical methodological strategies for developing logical thinking in senior preschool children.

RESEARCH METHODOLOGY

The study employed a theoretical-analytical methodology based on the examination, comparison, and synthesis of domestic and international scientific literature concerning STEM technologies and the development of logical thinking in preschool education.

Special attention was paid to the analysis of methodological approaches proposed by leading scholars in the field of preschool STEM education. The research also involved the development and systematization of practical pedagogical strategies aimed at fostering logical operations through STEM-based activities.

The proposed methodological strategies include:

1. Engineering Disassembly and Synthesis Technique

Children analyze a simple mechanical structure by separating it into components and subsequently reconstructing it from memory or a schematic representation.

2. Attribute Matrix Technique

Children classify objects according to multiple characteristics simultaneously and justify their classification choices.

3. Route Programming Technique

Using programmable robots such as Robot Mouse or Bee-Bot, children create algorithms to achieve specific goals while overcoming obstacles.

4. Constructor-Researcher Technique

Children solve engineering problems by formulating hypotheses, testing alternative constructions, and evaluating the effectiveness of different designs.

ANALYSIS AND RESULTS

The analysis of domestic and international pedagogical studies demonstrates that STEM technologies create favorable conditions for the development of logical operations, including analysis, synthesis, classification, generalization, algorithmization, and causal reasoning.

The examined literature indicates that STEM-based educational activities successfully transform abstract logical concepts into practical and meaningful experiences. Engineering tasks, robotics, coding activities, and research-based projects promote active cognitive engagement and increase motivation among preschool children.

The proposed methodological strategies facilitate the transition from visual-imaginative thinking to verbal-logical thinking by enabling children to manipulate objects, test hypotheses, solve problems, and construct logical explanations based on direct experience.

The findings further suggest that STEM technologies support not only logical thinking but also creativity, independence, communication skills, and cognitive flexibility, all of which contribute to school readiness.

CONCLUSION AND RECOMMENDATIONS

Therefore, it is clear from the theoretical analysis and assessment of domestic educators' perspectives that STEM technologies are an essential and crucial tool for helping senior preschoolers acquire logical thinking. Because of their practice-oriented, integrated, and project-based orientation, STEM technologies enable the systematic development of logical processes within the framework of research activity.

A high level of engagement and motivation is ensured by the comprehensive use of the methodological procedures proposed in this study, which guarantees the transition from visual-imaginative to verbal-logical thinking.

The deliberate implementation of STEM-based activities can significantly increase the level of logical thinking formation among senior preschool children and provide a solid foundation for successful future learning and personal development.

It is recommended to expand the use of STEM technologies in preschool educational institutions, develop specialized methodological materials, and conduct further empirical research to evaluate the long-term effectiveness of STEM-based pedagogical strategies.

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- 13.00.00 Pedagogika fanlari
 - 13.00.01 Pedagogika nazariyasi. Pedagogik ta'limotlar tarixi
 - 13.00.02 Ta'lim va tarbiya nazariyasi va metodikasi (sohalar bo'yicha)
 - 13.00.03 Maxsus pedagogika
 - 13.00.04 Jismoniy tarbiya va sport mashg'ulotlari nazariyasi va metodikasi
 - 13.00.05 Kasb-hunar ta'limi nazariyasi va metodikasi
 - 13.00.06 Elektron ta'lim nazariyasi va metodikasi (ta'lim sohaları va bosqichlari bo'yicha)
 - 13.00.07 Ta'limda menejment
 - 13.00.08 Maktabgacha ta'lim va tarbiya nazariyasi va metodikasi
 - 13.00.09 Ijtimoiy pedagogika
 - 07.00.00 Tarix fanlari
 - 19.00.00 Psixologiya fanlari
 - 01.00.00 Fizika-matematika fanlari
 - 02.00.00 Kimyo fanlari
 - 03.00.00 Biologiya fanlari
 - 09.00.00 Falsafa fanlari
 - 10.00.00 Filologiya fanlari
 - 11.00.00 Geografiya fanlari



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