STEAM TECHNOLOGIES IN PRESCHOOL EDUCATION

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Abstract: The integration of science, technology, engineering, art, and mathematics (STEAM) into preschool education is becoming increasingly popular in many countries around the world. The purpose of this article is to provide a comprehensive overview of international experience in the application of STEAM technologies in preschool education. The article begins with a brief review of the theoretical foundations of STEAM education, followed by a discussion of the benefits of STEAM-based learning for young children. It then presents a critical overview of various curricula, pedagogical approaches, and technologies used in preschool education worldwide. The article also examines the experience of implementing STEAM technologies in preschool education in foreign countries and Uzbekistan.

Key words: STEAM education, preschool education, curricula, pedagogy, technology, international experience, differences between foreign countries and Uzbekistan.

In recent years, interest in integrating STEAM education into preschool education (PE) has grown. The integration of STEAM subjects into PE is based on the belief that young children are naturally inquisitive learners and have the potential to develop strong foundational skills in science, technology, engineering, art, and mathematics (STEM) that will be in demand in the future. However, the use of STEAM technologies in PE is not yet standard practice in many countries and requires further research and analysis of

international experience. STEAM education is an approach to learning that integrates science, technology, engineering, art, and mathematics. It promotes the development of creative and critical thinking, problem-solving skills, and teamwork. This approach also helps children develop important social skills such as communication, leadership, and collaboration.

Numerous studies show that STEAM-based education in preschools can significantly improve academic outcomes and increase children's engagement in the educational process. It fosters creative and critical thinking, which can be useful in children's future academic and professional endeavors. Furthermore, STEAM education helps develop important social skills, including communication, leadership, and collaboration. Different countries use different educational programs, pedagogical approaches, and technologies to integrate STEAM into preschools. For example, in the United States, the STEM Starters program covers education from kindergarten to primary school and provides children with opportunities to conduct scientific experiments, master the basics of programming, and build robots. In the UK, the "Early Years STEM" program aims to create a specialized educational environment in which children can explore, experiment with materials, and develop skills in science, technology, engineering, art, and mathematics. In Japan, the concept of "Educational Robotics" involves using robotics to develop problem-solving, programming, and engineering thinking skills in young children. In Israel, the "STEM in Kindergarten" program uses AR/VR technologies to create interactive and engaging lessons in science, technology, engineering, arts, and mathematics. A number of countries, including Finland, are using an innovative approach to education called "phenomenon-based learning," which allows children to explore STEAM subjects through real-world projects and hands-on tasks. In recent years, there has been a steady increase in interest in the use of STEAM (Science, Technology, Engineering, Arts, and Mathematics)

technologies in education, including preschool education. These technologies integrate knowledge from various fields and promote the development of children's problem-solving skills and creative thinking.

The use of STEAM technologies in preschool education offers a number of significant advantages. First, they help children develop the skills and abilities necessary for future careers in science, technology, engineering, mathematics, and the arts. Second, the use of STEAM technologies improves the educational process, making it more engaging, visual, and educationally enriching for children. Many countries have already integrated STEAM technologies into their preschool education systems and achieved significant results. For example, in the United States, the Code.org project offers free programming classes for children aged 4 to 9 years old using game-based and interactive activities. In Japan, children are encouraged to engage in "visual programming" using special construction kits. In Finland, the Luotsi project uses STEAM technologies to improve the quality of education and develop new methods for working with young children. This project provides innovative training for teachers and educators using STEAM technologies in preschool education. One example of the successful implementation of STEAM technologies in preschool education is the RoboMind project in the Netherlands. This project uses a specialized program aimed at teaching children robot programming. Children participate in interactive games, during which they learn to program robot movements and solve logic problems. Furthermore, they develop teamwork and social interaction skills. In Australia, the MakerKids project gives children the opportunity to create their own projects using 3D printing, electronics, robotics, and other STEAM technologies. Through these activities, children learn to solve problems, develop innovative products, and develop their creativity. Furthermore, the use of STEAM technologies in preschool education promotes the development of social adaptation and communication skills in children. Through collaborative activities,

children learn to work in a team, communicate effectively, and exchange ideas, which increases their self-confidence and level of social interaction. One of the key conditions for the successful implementation of STEAM technologies in preschool education is the training of qualified teachers and educators. They must possess sufficient knowledge and practical experience in STEAM technologies to effectively implement them in educational activities. It is also important to consider that the use of STEAM technologies in preschool education should be based on an individual approach to each child, taking into account their interests, abilities, and needs. It is important not only to provide children with access to modern technologies but also to purposefully develop their understanding of how to use these technologies to solve various educational and life challenges.

International examples demonstrate that the use of STEAM technologies in preschool education yields significant results. In Japan, for example, preschools offer robotics classes where children can create, program, and control their own robots. Furthermore, children in Japan learn the basics of architecture and construction using Lego and other modeling kits. In the United States, children in preschools have access to 3D printing equipment, electronic components, and other STEAM technologies. They create their own toys, design, and develop prototypes of their inventions. Gaming platforms and apps are also widely used in the United States, helping children explore science, technology, engineering, art, and mathematics through play. In Sweden, preschools teach children the basics of programming, multimedia projects, electronics, and robotics. The use of STEAM technologies promotes the development of technological skills, creative thinking, and social adaptation in children. When discussing the main differences in the implementation of STEAM technologies in preschool education (PE) in foreign countries and Uzbekistan, it is worth noting the differences in approaches to their integration into the educational process and the

teaching methods used. In foreign countries, including the United States, Europe, and Asia, STEAM technologies have long been actively used in PE. Specialized programs and methods have been developed there to foster a lasting interest in science, technology, engineering, mathematics, and art in children. In preschools abroad, children are introduced to various aspects of STEAM at an early stage of development through games, project-based activities, experiments, and other interactive teaching methods. This allows them to learn problem-solving, develop creative and critical thinking, and improve their communication skills.

In Uzbekistan, STEAM technologies are in the early stages of implementation in preschool education. Currently, they are primarily used at the higher education level and in scientific research. Despite efforts to integrate STEAM technologies into preschool education, their use remains limited. They are typically implemented as additional classes rather than as part of the core curriculum. Furthermore, teaching methods in preschool education in Uzbekistan are largely based on traditional approaches, which do not always foster children's sustained interest in STEAM technologies. Thus, the key difference between the use of STEAM technologies in preschool education in other countries and in Uzbekistan lies in the scale and systematicity of their implementation. In other countries, STEAM technologies are widely integrated into the educational process from an early age, relying on interactive teaching methods, whereas in Uzbekistan this process is still in its infancy and remains limited. However, in recent years, steps have been taken in Uzbekistan to accelerate the implementation of STEAM technologies in preschool education. Thus, in 2020, the Ministry of Education of the Republic of Uzbekistan signed an agreement with UNESCO on the development of STEAM education, which could serve as impetus for expanding this practice and developing modern teaching methods. It should also be taken into account that the cultural and historical characteristics of foreign countries and Uzbekistan influence the

implementation of STEAM technologies. In the context of Uzbekistan, it is advisable to develop adapted programs and teaching methods that take into account national traditions and the cultural context. For example, incorporating elements of Uzbek culture and history into project activities can increase children's interest in STEAM technologies and strengthen their motivation to learn. Overall, despite existing differences, the importance of STEAM technologies for child development in the modern world is undeniable. The rapidly changing technological environment requires the younger generation to adapt and effectively solve new problems, and the STEAM approach contributes to the development of these skills. It is important to continue scientific research and the development of new models for implementing STEAM technologies in preschool education in order to improve the quality of education for future generations. Based on an analysis of international experience, the following key principles of effective STEAM education in preschools can be identified: integrating science, technology, engineering, art, and mathematics into a unified system that allows children to understand the interrelationships between various fields of knowledge; ensuring engaging and motivating learning; creating a favorable educational environment that incorporates modern technologies, materials, and tools; organizing group work and communication to develop social skills; implementing an individualized and differentiated pedagogical approach that takes into account the needs of each child. Thus, the use of STEAM technologies in preschool education has significant potential for developing the skills and abilities children need for future professional and social fulfillment. International experience confirms that the introduction of STEAM technologies contributes to a more effective educational process. It is also important to consider the individual characteristics of children and ensure the training of qualified teachers and educators to successfully implement the STEAM approach in preschools. Furthermore, the use of STEAM technologies in preschool education can contribute to

the development of values in children related to environmental thinking and sustainable development. For example, children can explore the principles of renewable energy sources and create prototypes of devices powered by solar or wind energy. The use of STEAM technologies can also help reduce social inequality in education. One pressing issue is the limited access of certain groups of children to high-tech equipment and software. Incorporating STEAM technologies into the preschool education system can narrow this gap, ensuring equal access to modern knowledge and technology for all children.

In conclusion, the use of STEAM technologies in preschool education can contribute to the development of not only technical skills but also creative, social, and cognitive skills in children. For example, by creating STEAM-based projects, children learn to work in teams, develop decision-making and problem-solving skills, and refine their communication and leadership skills. Overall, international experience shows that the use of STEAM technologies in preschool education has significant potential for improving the quality of education and developing children's skills and abilities. However, the implementation of these technologies should be tailored to the individual needs of each child and supported by qualified teachers and educators capable of delivering effective STEAM-based learning.

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