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SCIENTIFIC-METHODICAL BASES OF CREATIVE THINKING, PROBLEM SOLVING AND CREATIVE COMPETENCES IN CHILDREN THROUGH STEAM TECHNOLOGIES IN PRESCHOOL EDUCATION

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Abstract: This article broadly covers the scientific and methodological foundations of the use of STEAM technologies in the process of preschool education, especially their role in developing creative thinking, problem-solving and creativity competencies in children. The effectiveness of methods that base the educational process on interdisciplinary integration, provide children with knowledge through experience and observations, and encourage independent solution of problem tasks is analyzed based on theoretical sources. The mechanisms of activating children's thinking processes through the STEAM approach, forming their environmental study skills, and developing their competencies through constructive activities and creative experience are explained.

Keywords: STEAM technologies, creative thinking, problem situation, competency, preschool education, creativity, integrated education, scientific and methodological foundations.

Introduction. Preschool education is one of the most important educational stages of society, which lays the foundation for the personal, intellectual and social development of children. In recent years, Uzbekistan has paid great attention to a radical reform of the education system, expanding the opportunities and improving the quality of preschool education. As our President Shavkat Mirziyoyev noted, “By developing children from an early age, we are creating a solid foundation for their full self-expression in the future”[1] — the principle that is at the heart of our country’s policy.

In global educational practice, the STEAM (Science, Technology, Engineering, Arts, Mathematics) approach is emerging as an effective model aimed at developing creative thinking, problem-solving and creativity competencies. Integrating STEAM elements in preschool children allows them to combine theoretical and practical knowledge through games, experiments and project activities. Research shows that STEAM-based activities develop children’s logical thinking, learning through trial and error, and the ability to create new solutions.

The educational reforms and state policy of the Government of Uzbekistan encourage the gradual introduction of STEAM pedagogy into the school and preschool education system. Noting the need to create a healthy and effective education system, the Head of State admitted that “If we do not change the teaching methodology, there will be no positive changes in education”[2]. This indicates a high demand for updating the content and methodological aspects of education, improving the skills of teachers, and introducing modern educational materials.

As a result of the attention paid to STEAM areas in our country and projects such as “One Million Programmers”, the number of educational institutions and programs specializing in mathematics, physics, chemistry, and information technology is expanding. This once again

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confirms the need to interest preschool children in science and technology from an early age, and to promote their creativity and problem-solving competencies.

The purpose of this article is to systematically study the scientific and methodological foundations of the formation of creative thinking, problem-solving, and creativity competencies in children through STEAM technologies in preschool educational institutions and to develop practical recommendations.

Main part. Theoretical foundations of STEAM pedagogy. STEAM pedagogy (Science, Technology, Engineering, Arts, Mathematics) is an integrated approach that combines science, technology, engineering, arts, and mathematics in the education of preschool children. This pedagogy is aimed at developing children's creative thinking, problem-solving, and creativity competencies. In the learning process, STEAM methodology is implemented through games, experiments, projects, and constructions. Through this method, children have the opportunity to combine theoretical knowledge with practical activities. Becker and Park's research shows that an integrated STEM/STEAM approach significantly develops logical and creative thinking skills in children.[3]

National sources also confirm the effectiveness of STEAM pedagogy. As Gafurova noted, STEAM elements in preschool education increase children's ability to analyze problems and find independent solutions. At the same time, STEAM activities also build children's social skills, namely the ability to work collaboratively, exchange ideas, and evaluate their own solutions.[4]

The main principles of STEAM pedagogy are as follows:

1. The principle of integration - combining elements of science and art.
2. An activity-oriented approach - involving children as active participants, not observers.
3. Project activities - consolidating knowledge through games and mini-projects.
4. Creative freedom - giving children the opportunity to try different solutions.

Practical application of STEAM activities:

1. Learning through play. Children carry out STEAM activities in the form of play. For example, through building with colored blocks, experiments with water and sand, and combinations of shapes and colors, children combine elements of science and art.[5]
2. Experimental and project activities. Experiments develop children's independent decision-making skills in problem situations. For example, through projects on controlling water flow and stabilizing structures, children increase their ability to think analytically and find creative solutions.
3. Art and creative integration. Adding elements of art enhances children’s imagination and creativity. Working with colors, shapes, and materials, and dramatic play make STEAM activities more effective.
4. Methodological recommendations.

Use active learning methods — involve children as active participants.
Mini-project and game-based activities — organize each lesson in the form of a mini-project.
Learning through mistakes — focus on learning through experimentation.
Encourage creative freedom — support diverse solutions and ideas.
Integrate STEAM into the daily program — combine science, technology, art, and mathematics.

Methodological integration of STEAM technologies in the preschool educational process

The process of applying the STEAM concept in preschool education practice requires not only the use of technical means, but also a fundamental change in the pedagogical process. Educational activities organized according to the STEAM approach support children's

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acquisition of knowledge through play, experimentation, discussion, and discovery. Piaget's constructivist theory emphasizes that children acquire knowledge not in a ready-made form, but through active experience, which indicates that the STEAM process is suitable for preschool age.[6]

The main principles of methodological integration for preschool children are as follows:

Observational learning - the child independently analyzes the properties of the object.

Direction through problematic questions - the educator does not give direct answers, but awakens the child's need for research.

Step-by-step construction - the "Engineering" component of STEM develops the child's skills in building, making, and developing.

Strengthening conceptual understanding through Art – Through creative expression, children strengthen scientific understanding.

These principles support children's natural curiosity and active cognitive processes, strengthening their motivation for inquiry.

Developing problem-solving skills through STEAM projects

Problem solving is one of the key competencies that preschoolers need to develop. In his philosophy of education, John Dewey defined a problem situation as “an unexpected event or intellectual challenge” and emphasized that the child’s thinking is actively engaged in solving it.[7] STEAM projects create problem situations naturally. For example: “Build the Strongest Bridge” project – the child analyzes a problem situation, selects materials, tests them, and studies their properties. “Drop the Egg Without Breaking It” experiment – the child tries different solutions to the problem, understands cause and effect. “Make the Robot Step” task – the child learns the basic concepts of technical thinking, sequencing, and coding.

In this process, the child acquires the following skills:

the ability to connect cause and effect,

choosing the most appropriate solution from among alternatives,

the correct use of trial and error,

invention and creativity,

working collaboratively in a group.

Vygotsky's educational theory emphasizes that children's collaborative work expands their "zone of proximal development," and STEAM projects use this mechanism.[8]

Creative thinking and problem-solving competencies.

Creative thinking is the ability to develop new and original ideas. In preschool children, it is formed through play, experimentation, construction, and artistic activities. The competence to solve problem situations depends on children's analytical thinking and independent decision-making ability. STEAM activities provide children with the following opportunities:

Learning about mistakes and successes through experimentation.

Solving problem situations in different ways.

Developing and evaluating creative solutions.

The element of art is of particular importance in the STEAM approach, which forms children's abilities to express themselves through creative thinking, imagination, and color. Regarding the psychological impact of art, Gardner's "Theory of Multiple Intelligences" notes that visual-spatial intelligence is a key factor in a child's creative development.[9]

The art component performs the following functions in preschool age:

-encourages abstract thinking,

-helps to perceive scientific concepts figuratively,

-inspires creative problem-solving,

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-creates an opportunity to openly express the child's inner feelings.
For example: assembling mosaics from geometric shapes, experiments with colors, creating models from natural materials, tasks that combine movement, musical rhythm and technology develop artistic and aesthetic thinking in children.
Thus, art is an integral component of STEAM, developing not only children's technical-automated thinking, but also intuitive, figurative thinking.

Methodological problems in the implementation of STEAM technologies in preschool education

In practice, there are a number of problems in the application of STEAM:
1. Insufficient methodological training of teachers in STEAM. Studies show that teachers working in preschool institutions often do not have special training in the use of technical means.
2. Limited material and technical base for STEAM. Many kindergartens do not have enough laboratories, sensory centers, and zones equipped with LEGO constructors.
3. Weak family cooperation - parents do not always understand the content and benefits of STEAM activities.
Nevertheless, according to the OECD (2019) report, the use of STEAM education from an early age is noted as one of the most effective directions in creating competitive human capital in the future.[9]
In recent years, innovative approaches close to the principles of STEAM have been widely introduced in the preschool education system of the Republic of Uzbekistan. The concept for the development of the preschool education system until 2030 sets the task of developing integrated educational technologies for early childhood development, based on foreign experience.
Distinctive features of the national model:
- introduction of STEM elements based on didactic games;
- development of construction and graphic activities from an early age;
- enrichment of the sensory development environment;
- phased introduction of digital pedagogical tools;
- art activities harmonized with national values.

Also, the establishment of advanced training courses in STEAM for local teachers is giving impetus to the development of the industry.

Conclusion. The use of STEAM technologies in preschool education has a multifaceted impact on the intellectual, social and creative development of children. This approach is based on the principle of teaching subjects not in isolation, but in an interconnected manner, and therefore simultaneously activates active cognitive processes in the child, such as observation, experimentation, comparison, modeling, creation. This serves to form competencies in early childhood such as comprehensive knowledge of phenomena, the ability to generate new ideas, and the ability to independently propose solutions in various situations.
The effectiveness of STEAM activities for preschool children is determined by their correspondence to their natural curiosity, movement, experience, and learning through intuition and imagination. As analyzed in the main part, the use of science (S), technology (T), engineering (E), art (A) and mathematics (M) in a single system develops analytical and creative thinking in parallel in each activity of the child. By creating problem situations, the child is encouraged to independently explore, experiment with different materials, shapes, and constructions, and find the right solution through trial and error. This process also develops the

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child's socio-psychological qualities, such as the ability to work on himself, determination, reasoning, communication with a group, and responsibility.

Although there are specific aspects of introducing these technologies in preschool educational organizations, factors such as the methodological preparation of the teacher, the proper organization of the learning environment, and family support significantly increase the effectiveness of STEAM activities. Existing scientific views and state education policy confirm the importance of an integrative approach and recognize it as an important pedagogical mechanism that improves the quality of early childhood education. On this basis, it can be said that STEAM technologies effectively serve to form modern competencies in preschool children, such as creative thinking, creative research, finding solutions to problem situations, and the harmonious development of technical and artistic thinking. In the future, the gradual and widespread introduction of this approach into national educational practice will create a solid foundation for the innovative development of the preschool education system.

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