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**RESEARCH ARTICLE**

# Theoretical Foundations of The Methodology for Teaching Natural Sciences in Primary Education Based on Steam Technologies

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## Abstract

This article highlights the theoretical foundations of the methodology for teaching natural sciences in primary education based on STEAM technologies. In the modern education system, the development of students' creative thinking, problem-solving abilities, and practical skills is of great importance. The STEAM approach contributes to a more effective organization of the educational process through the integration of science, technology, engineering, art, and mathematics. The article analyzes the role of innovative methods, interactive approaches, and experience-based learning in teaching natural sciences to future primary school teachers. It also demonstrates the opportunities for developing students' independent thinking, research abilities, and creative approaches through the use of STEAM technologies.

**KEYWORDS**

STEAM education, primary education, natural sciences, innovative methods, integration, interactive learning, creative thinking, research activity, educational technologies, learning process.

## INTRODUCTION

Today, the modernization of the education system and the development of students' independent thinking, creativity, and problem-solving skills have become one of the most pressing issues. In the context of modern society, educating the younger generation as competitive, knowledgeable, and innovative thinkers requires the introduction of new pedagogical approaches into the educational process. In this regard, the use of STEAM technologies serves as an important tool for increasing the effectiveness of education.

The STEAM approach involves the integrated teaching of science, technology, engineering, art, and mathematics. This approach helps combine students' theoretical knowledge with practical activities. In particular, the application of STEAM technologies in teaching natural sciences at the primary education level contributes to the development of students' scientific thinking, observation skills, and research abilities.

This article analyzes the theoretical foundations of the methodology for teaching natural sciences in primary education and examines the role of STEAM technologies in the educational process. STEAM education is an integrated approach that ensures the interconnection between different disciplines. While in the traditional education system subjects are taught separately, the STEAM approach allows them to be studied as a unified system.

The main goal of STEAM education is to develop students' critical thinking, problem-solving abilities, creative approaches, the ability to generate innovative ideas, and teamwork skills. Within this approach, students not only acquire theoretical knowledge but also reinforce it through various projects, experiments, and practical activities. This, in

turn, increases students' interest in learning.

STEAM technologies help organize the educational process in an interactive, engaging, and effective way. This method ensures the active participation of students and encourages them to conduct independent research.

The STEAM approach was initially implemented in design schools in the state of Rhode Island, where the role of art in revealing the functional and aesthetic aspects of design and natural sciences was emphasized.

At the center of this technology are active collaboration among learners, social interaction, learning through solving problem-based tasks, and the process of acquiring integrated knowledge [3]. According to the conclusions of the U.S. National Research Council, the implementation of STEAM technologies is an important tool for preparing competent specialists with a strong scientific foundation capable of solving technological problems emerging in modern post-industrial society.

It should be noted that the STEAM model was initially introduced in the United States by companies operating in the high-tech sector with the aim of preparing highly qualified specialists in certain fields of science. In 2015, President Barack Obama developed a special government program aimed at further developing this direction, particularly providing state financial support for STEAM schools.

STEAM technology is manifested through an integrative approach that creates a special educational environment aimed at developing future primary school teachers' scientific research skills, technical creativity, and project-based activities. Science is interpreted through technology, engineering, and art, and all of these are understood through mathematical elements. In order to better understand the essence of these ideas, a modified version of the "STEAM logo" developed by one of the theorists of this technology, G. Yakman, is proposed, which reflects the main content of each discipline.

The importance of teaching natural sciences in primary education lies in the fact that through the study of natural sciences, students learn to understand natural phenomena, develop ecological awareness, acquire observation and analytical skills, and form a scientific worldview.

Natural sciences also play an important role in shaping students' attitudes toward nature. In this process, teachers should not only provide theoretical knowledge but also involve students in practical activities.

The use of STEAM technologies in primary education makes it possible to organize the educational process more effectively. Through this approach, students study subjects in an interconnected manner. When studying topics related to nature, the following integration can be implemented: science – explaining natural processes; technology – using digital tools; engineering – creating simple models; art – creative representation; and mathematics – calculation and analysis. This process helps students acquire knowledge more deeply and meaningfully.

The following STEAM methods are considered effective in teaching natural sciences in primary education:

Project-based learning. Project-based learning develops students' independent working skills. For example, students can conduct a small experiment on the topic "Plant Growth."

Experiment-based learning. Experiments play an important role in strengthening students' knowledge. Simple experiments related to the states of water or plant growth can be conducted.

Problem-based learning. Problem situations activate students' thinking processes. In solving a problem, students engage in independent inquiry and research.

Interactive methods. Interactive methods increase students' active participation in the learning process. Examples include group work, discussions, and brainstorming activities.

The following stages are considered important in organizing STEAM-based lessons:

- identifying the problem

- conducting research

- developing ideas

- creating a model or project

- presenting the results

These stages help develop students' independent working skills. The pedagogical significance of STEAM technologies is manifested in developing students' creative thinking, organizing the learning process in an engaging way, forming practical skills, ensuring integration between different disciplines, and improving students' ability to work independently. As a result, students acquire deeper

knowledge and are able to apply it in practice.

However, there are also certain challenges in implementing STEAM technologies in the educational process. These include insufficient methodological preparation of teachers, a lack of modern technical equipment, and the insufficient reflection of the STEAM approach in textbooks and educational materials. Therefore, it is important to retrain teachers, develop modern teaching and methodological resources, and provide the educational process with appropriate technical equipment.

The use of STEAM technologies plays an important role in improving the effectiveness of teaching natural sciences in primary education. This approach helps students acquire knowledge in an integrated manner and contributes to the development of creative thinking and problem-solving skills.

Lessons organized on the basis of STEAM methods contribute to the formation of students' scientific worldview, the development of their research abilities, and the increase of their interest in the learning process. At the same time, this approach creates a foundation for students to successfully engage in technological and scientific fields in the future.

In the primary education system, the wide use of STEAM technologies in teaching natural sciences, improving teachers' methodological preparation, and introducing innovative pedagogical technologies are considered among the most important tasks.

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