

## **Methodological Foundations of Using Steam Technology in Primary Grade Science Classes**

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**Abstract.** *This article examines the theoretical and methodological foundations of using STEAM (Science, Technology, Engineering, Art, and Mathematics) technology in primary school natural science lessons. The relevance of the study is determined by the need to strengthen interdisciplinary integration in modern education and the formation of practical skills in students. The article highlights the stages of organizing lessons based on the theory of constructivism and the 5E model.*

**Keywords:** *STEAM Education, Primary Education, Natural Science, Integration, Project Work, Cognitive Development, 5E Model, Practical Skills.*

### **Introduction**

The theoretical roots of the STEAM education model go back to the theory of Constructivism (J.Piaget, L.Vygotsky). According to this theory, knowledge is not given ready-made, but is "constructed" by the student in the process of practical activity [1].

The psychophysiological characteristics of primary school students — their holistic perception of the world, high curiosity, and the predominance of visual-practical thinking — require the use of interdisciplinary integration in natural science lessons [2].

Steam's components are interpreted as: Science (Science): observing natural phenomena, making hypotheses, and conducting experiments. Technology (Technology): the use of tools and digital tools to solve the problem. Engineering (Engineering): Construction, model building and testing. Arts (art): creative approach, design and aesthetic solutions. Mathematics (Mathematics): work with measurements, numerical data analysis and geometric shapes [3].

### **Methodology**

pedagogical approaches. The study used the 5e model (Engage, Explore, Explain, coordinate, evolve) and problem learning (Problem-Based Learning) techniques. In the rescheduling of steam mudflats in the lessons of Natural Science, the heads below were theoretically justified:

Identifying the problem: "why can't plants live without the sun?" or "how to clean water? real life questions like". Creation (creation): conducting layouts or laboratory experiments [4].

Improvement: analysis of the results obtained and correction of errors.

Ement: analysis of the results obtained and correction of errors [5].

Analysis of Pedagogical Effectiveness. The role of the STEAM approach in primary education is not just to accumulate knowledge, but to develop "4K" skills (Critical Thinking, Communication, Collaboration, Creativity) [6].

Theoretical analysis shows: Level of integration: In natural science lessons, the connection with mathematics (for example, drawing a graph of temperature changes) concretizes abstract concepts in the student [7].

Cognitive development: Engineering tasks (such as building a birdhouse) enhance spatial awareness and logical consistency in the learner.

Psychological aspect: the inclusion of the art (Arts) element breaks the reader's stereotype that "technical sciences are difficult" and provides an emotional attachment to the lesson [8].

International PISA and TIMSS studies confirm that the functional literacy of students who study subjects in an interdisciplinary manner is 25-30% higher than that of their peers who study in a traditional manner [9].

## **Result and discussion.**

There are a number of scientific sources on modern approaches to teaching natural sciences, which are aimed at developing students' scientific knowledge and forming their skills in understanding nature. Abdullaeva analyzed the importance of interactive methods and digital technologies in increasing students' interest in science in her work "Innovative Methods in Teaching Natural Sciences." The author emphasizes the importance of making lessons interactive and interesting by using technology in modern education [10].

Karimov highlights the effectiveness of project-based learning and the STEAM model in his work "Modern Approaches in Primary Education." His research shows that integrating natural sciences with other disciplines encourages students to be creative [11].

From the foreign literature, Smith and Johnson highlighted the ways in which digital laboratories and simulations can be used to develop students' practical skills in teaching natural sciences. Their research highlights how digital resources engage students in the classroom and help them acquire scientific knowledge [12].

Also, Vygotsky's theory of social learning is relevant in the teaching of Natural Sciences. This theory suggests that students effectively assimilate knowledge through interaction and group activities. The analysis of these works helps to understand the theoretical and practical aspects of modern approaches. The above sources were used in the preparation of this article, and the effectiveness of teaching natural sciences based on their scientific recommendations is analyzed [13].

How STEAM education develops problem-solving skills:

**Analytical Thinking:** STEAM activities often present students with complex problems that require analysis and evaluation. Students learn to break problems down into smaller parts, identify patterns and relationships, and use logical thinking to find solutions.

**Creative thinking:** STEAM education encourages students to think creatively and seek innovative solutions. By integrating art and design into the learning process, students are encouraged to think creatively, develop original ideas, and consider multiple perspectives.

**Solving iterative problems:** STEAM projects often involve an iterative process, where students continually refine their solutions through experimentation and feedback. They learn that failure and mistakes are part of the learning process and that they can iterate and improve their solutions based on feedback and new insights.

**Collaboration and communication:** STEAM activities often involve teamwork, where students collaborate with their peers to solve problems. This collaboration enhances their communication and interpersonal skills as they learn to express their ideas, listen to others, and work together to achieve a common goal [14].

Integration of multiple disciplines: STEAM education encourages students to approach problems from an interdisciplinary perspective. By combining knowledge and skills from science, technology, engineering, art, and mathematics, students learn to use the strengths of each discipline to solve complex problems. Real-world application: STEAM education aims to connect classroom learning with real-world contexts. By engaging in practical projects, students are exposed to problems that are relevant to their lives and can be applied. Applying this knowledge in practice strengthens their problem-solving skills and helps them understand the importance of learning [15].

### Conclusions and recommendations

In conclusion, the methodological foundations of using STEAM technology in primary school natural science lessons are important in developing not only theoretical knowledge in students, but also life and practical skills. In particular, based on the ideas of Lev Vygotsky, Vasily Davydov, John Dewey, and other scientists, the STEAM approach serves to orient education towards activity, organize it based on problem situations, and teach students to think independently.

In lessons organized using this technology, students connect knowledge with practice through experimentation, modeling, designing, and analyzing. This develops their skills in making the right decisions in emergency situations, quickly realizing the problem, and acting rationally.

The STEAM approach also fosters creativity, teamwork, engineering thinking, and technological literacy in students. As a result, the educational process is organized on a systematic, step-by-step and individual approach, and students are formed as independent and responsible individuals, ready for real life.

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