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# The Theoretical Significance of Teaching Natural Sciences Based on the Steam Approach in Primary Education

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**Abstract:** This article analyzes the scientific and methodological foundations of teaching natural sciences in primary education based on the STEAM (Science, Technology, Engineering, Art, Mathematics) approach. It is substantiated that STEAM integration contributes to the development of such competencies as observation, experimentation, problem-solving, creative thinking, and practical project design among young learners. The article also presents state policies on implementing STEAM in Uzbekistan's education system, methodological recommendations for teachers, and examples of practical projects that can be applied in primary school classrooms.

**Keys words:** STEAM, integration, natural sciences, primary education, project-based learning, creative thinking, experiments, problem-solving, technological competence.

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In today's digital society, competencies such as scientific and technical thinking, creative reasoning, and the ability to generate innovative ideas are considered among the most essential global skills. The “*New Uzbekistan Development Strategy*” (PF-60, 2022, <https://lex.uz/docs/5884007>) outlines the tasks of widely introducing STEAM directions at all levels of education, fostering engineering thinking among students, and teaching natural science subjects through content integration. Furthermore, Presidential Decree PQ-4884 (2020) identifies the modernization of school education, the development of interdisciplinary project-based approaches, and the advancement of students' scientific research skills as priority directions. International experience also confirms that the use of STEAM in primary education plays a significant role in fostering early interest in science, deepening understanding of natural phenomena, and shaping technological thinking (UNESCO, 2022). Therefore, developing a methodology for teaching natural sciences based on STEAM is a highly relevant direction for improving the quality of primary education.

The term STEAM was initially introduced in the United States to cultivate 21st-century competencies. Its central idea is to enhance interdisciplinary integration and develop learners' scientific-technical thinking, creativity, and innovative problem-solving abilities. Initially applied as STEM (Science, Technology, Engineering, Mathematics), the Arts component—representing design, creativity, and artistic expression—was later added, forming the present STEAM model. Since 2006, the framework developed by Georgette Yakman has been widely incorporated into educational systems. According to this model, STEAM is a pedagogical system that unifies distinct fields of knowledge, is oriented toward solving real-world problems, and places the learner at the center of the educational process.

The five components of STEAM encompass the following:

**S — Science.** Science in the STEAM framework refers not only to observing natural phenomena but also to developing a deep understanding of scientific laws and patterns governing the world. It includes formulating hypotheses, conducting structured experiments, collecting and interpreting data, and using evidence-based reasoning. Through scientific inquiry, learners cultivate curiosity, critical thinking, and a research-oriented mindset that enables them to explore real-life problems and propose scientifically grounded solutions.

**T — Technology.** Technology involves the use of digital devices, multimedia tools, educational platforms, and innovative software applications. Within STEAM education, technology serves as both a tool and a medium for learning. Learners apply technological skills for information searching, data visualization, simulation, coding, and creating digital content. This component prepares students for the digital age, fostering digital literacy, media competence, and responsible use of technological resources.

**E — Engineering.** Engineering encompasses problem-solving through design thinking, constructing models, testing prototypes, and optimizing solutions. In a STEAM context, engineering encourages students to identify real challenges, brainstorm ideas, create conceptual designs, and refine structures based on feedback. This hands-on, iterative process strengthens spatial reasoning, resilience, and innovation, helping learners understand how theoretical knowledge can be transformed into functional, real-world applications.

**A — Arts.** The Arts component broadens STEAM beyond technical skills by integrating visual arts, design principles, creative storytelling, music, and aesthetic expression. Through artistic activities, learners develop creativity, imagination, emotional intelligence, and the ability to communicate ideas in expressive ways. Arts enrich the learning process by enhancing engagement, promoting divergent thinking, and supporting the interdisciplinary connections necessary for holistic education.

**M — Mathematics.** Mathematics supports the entire STEAM framework by providing tools for measurement, estimation, calculation, modeling, and analytical reasoning. It develops students' ability to identify patterns, interpret quantitative data, construct graphs and models, and apply logical thinking to solve complex problems. Mathematical skills form the foundation for engineering design, scientific investigation, and technological innovation, ensuring precision and systematic thinking across all STEAM components.

Together, these five components transform the learning process into a holistic, conceptually integrated, and practice-oriented system.

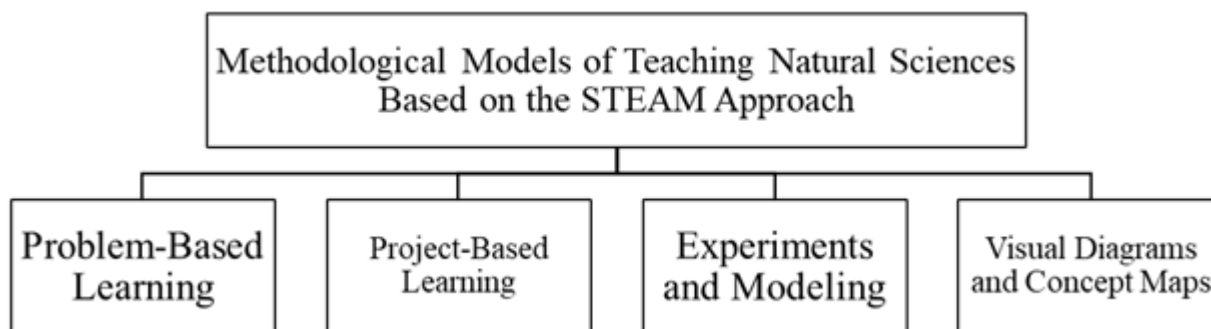
STEAM education is based on the following principles: **Interdisciplinary integration:** teaching topics not in isolation but in interconnected forms; **Problem-based learning:** mastering content through solving real-life tasks; **Inquiry-based learning:** learners observe, measure, analyze, and draw conclusions independently; **Project-based learning:** creating concrete products, models, and prototypes; **Creativity and innovation:** proposing new ideas, designs, and creative solutions; **Digital literacy:** integrating digital technologies into the learning process.

These principles contribute to deeper understanding among primary school students and enable them to apply their knowledge in real-life contexts.

STEAM (Science, Technology, Engineering, Art, Mathematics) is a methodology that teaches academic disciplines not separately but in an integrated manner through meaningful and practical tasks. It develops the following competencies: **Scientific thinking** (observation, experimentation, conclusion drawing); **Technological competence** (working with digital tools); **Engineering reasoning** (modeling and constructing solutions); **Creativity** (innovative and artistic thinking); **Mathematical literacy** (measurement, calculation, comparison); **Project-based skills** (planning, implementing, and presenting).

In primary education, the main purpose of STEAM in teaching natural sciences is to ensure that students understand natural phenomena through hands-on exploration, ask meaningful questions, conduct experiments, and solve problems using logical and creative thinking.

Primary school learners are naturally inclined toward activities such as modeling, experimenting, crafting, drawing, and building. Therefore, STEAM fully corresponds to their developmental needs. This approach enhances visual-conceptual thinking, sensory development, creativity, understanding of logical sequencing, and collaborative skills. For example, in the topic “States of Water,” children conduct experiments to freeze water, observe evaporation, draw the process, and perform mathematical measurements—thus engaging all five STEAM components simultaneously.



**Picture 1. Methodological Models of Teaching Natural Sciences Based on the STEAM Approach**

The methodological models of teaching natural sciences based on the STEAM approach include the following. **Problem-Based Learning (PBL)**. Students are presented with a real-life question such as: “*Why do birds migrate south in winter?*” The learner conducts research, analyzes various resources, and develops small-scale projects. **Project-Based Learning (PBL)**. Mini-projects are designed around natural science topics, such as: “*Constructing a windmill,*” “*Building a mini greenhouse for plants,*” or “*Creating a model of the Earth.*” These projects simultaneously develop students’ worldview, technical reasoning, and creativity. **Experiments and Modeling**. Simple laboratory activities—such as observing water evaporation, light refraction, magnetic fields, or plant growth—enable students to conduct experiments, represent results through drawings, and formulate conclusions in written form. **Visual Diagrams and Concept Maps**. Tools such as Venn diagrams (e.g., comparing animals and plants), cluster maps, pictograms, and modern AR (Augmented Reality) applications support conceptual modeling and help make scientific topics more comprehensible for young learners. To effectively implement STEAM, teachers must possess the ability to work with digital technologies, organize laboratory experiments, facilitate project-based learning, ensure safety protocols, and apply creative instructional methods.

Teaching natural sciences in primary education through the STEAM approach is one of the most effective ways to foster scientific inquiry, independent thinking, observational skills, and experimental competence among learners. This methodology strengthens interdisciplinary integration, connects learning with real-life contexts, and contributes to the development of modern competencies. The strategic priorities defined within Uzbekistan’s education system — the broad implementation of STEAM, the enhancement of students’ technological literacy, and the promotion of creative thinking — are fully aligned with these objectives.

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