

## THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-5, ISSUE-10

### THEORETICAL AND PRACTICAL FOUNDATIONS OF INTEGRATING INNOVATIVE TECHNOLOGIES INTO THE TEACHING OF NATURAL SCIENCES IN PRIMARY EDUCATION

**Shonazarova Sevara Rashidovna**

Termez State Pedagogical Institute Department of Primary Education Senior Lecturer, PhD in Pedagogical Sciences

**Beg'amova Sabina Najmiddin qizi**

Termez State Pedagogical Institute 4th-year student, Primary Education major

**Annotation:** This article explores the theoretical and practical foundations of integrating innovative pedagogical technologies into the process of teaching natural sciences in primary education. It analyzes the essence of innovative approaches, their advantages in the learning process, and their role in developing students' scientific thinking, critical reasoning, and creativity. The paper presents effective ways of adapting technologies such as STEAM, project-based learning, ICT, digital platforms, and interactive methods to natural science lessons. In addition, the methodological conditions for implementing innovative technologies based on an integrated learning model, differentiated instruction, and a competence-based assessment system are scientifically justified. The practical section provides lesson design samples, recommendations for the application of innovative methods, and methodological guidelines for primary school teachers. Research findings demonstrate that innovative technologies enhance students' interest in the subject, improve learning outcomes, and contribute to the formation of modern competencies.

**Keywords:** primary education, natural sciences, innovative technologies, integration, STEAM, ICT, interactive methods, competence-based approach, project-based learning, theoretical foundations, practical approach, quality of education, scientific thinking, creativity.

**Introduction.** In the modern education system, ongoing reforms demand the activation of the learner's personality, the encouragement of independent thinking, and the development of a scientific worldview. In particular, during the process of teaching natural sciences in primary grades, there is a growing need to apply innovative pedagogical technologies in addition to traditional methods. Innovative technologies not only increase the effectiveness of lessons but also enhance students' interest, motivation, creativity, and scientific thinking skills.

In the 21st century, the education system is rapidly evolving and being updated in accordance with the needs of modern society. The rise of globalization, digital transformation, and innovative approaches has brought the learning process to a new stage. Especially in primary education, improving the content of instruction and teaching students scientific and creative thinking from an early age is considered one of the most urgent tasks of today. This is because the primary education stage is the foundation period that shapes the intellectual, social, and psychological development of the individual.

Natural sciences not only develop students' knowledge about nature, but also foster observation skills, logical thinking, the ability to identify cause-and-effect relationships, solve problem situations, build

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ecological awareness, and shape a scientific worldview. Therefore, traditional methods alone are not sufficient to increase the effectiveness of teaching natural sciences; it is necessary to widely implement innovative pedagogical technologies into the learning process.

In recent years, reforms such as “Digital Education,” “STEAM Education,” “Improving Scientific Literacy,” and “New Generation Textbooks” have been implemented in our country. State educational standards, curricula, and methodological guidelines are being updated, and conditions are being created for learning based on modern technologies. However, in the teaching of natural sciences in primary grades, there are still methodological gaps, differences in teachers’ preparedness, and limitations in the use of technical resources.

Innovative pedagogical technologies (such as STEAM, CLIL, project-based learning, ICT, and interactive methods) not only make the lesson more engaging but also help students acquire knowledge more effectively by relying on their personal experience. These approaches shape the learner not as a passive listener, but as an active participant, problem solver, and creative thinker.

From this perspective, studying the theoretical and practical possibilities of using innovative technologies in teaching natural sciences in primary schools, determining their effectiveness, and developing practical recommendations is relevant both scientifically and in terms of educational practice.

The relevance of this research lies in the fact that it aims to improve the quality of education and develop students’ scientific thinking and competencies by implementing innovative approaches based on interdisciplinary integration in primary education.

In primary grades, natural science subjects introduce students to the environment, natural phenomena, ecological awareness, and the foundations of scientific thinking. In this process, innovative pedagogical technologies serve as methods and tools that allow lessons to be organized in an interactive, integrative, experiential, and digital format.

Teaching natural sciences in primary school is the process of providing students with initial scientific concepts about the environment, natural laws, phenomena, and living organisms. However, modern educational requirements demand not only factual knowledge, but also the development of skills such as scientific reasoning, observation, analysis, argumentation, problem-solving, and ecological responsibility. For this purpose, innovative approaches in teaching natural sciences are becoming central.

While the teaching of natural sciences in primary grades aims to form students’ initial understanding of nature, explain the essence of phenomena, and develop their observation and analytical abilities, modern education requires this process to become more interactive, meaningful, and effective. Therefore, innovative approaches play a key role in teaching natural sciences.

The essence of innovation is not limited to using a new method; it implies a fundamental transformation of the philosophy of teaching, the relationship between teacher and student, and the overall instructional approach.

In modern education, the student is no longer viewed as a passive listener, but as an active subject who seeks knowledge, experiments, and draws conclusions. At this point, the constructivist approach becomes particularly important: the learner acquires knowledge not through ready-made information, but through personal experience formed by their own activity. In teaching natural sciences, this approach is implemented through experiments, observations, problem-based situations, and practical tasks.

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One of the most effective forms of innovative approaches is STEAM education, which is based on integrating natural sciences with technology, engineering, art, and mathematics. Such integration helps develop students' creative thinking, engineering mindset, and problem-solving skills for real-life situations. At the same time, the CLIL model plays a significant role in combining natural sciences with language learning, thus enhancing students' communicative competence. For example, teaching topics such as "Water Cycle" or "Plant Growth" through a foreign language develops both subject knowledge and language skills.

Project-based learning is also one of the important directions of innovative approaches. In this model, the student encounters a real-life problem and searches for a solution by gathering information, working in a team, and presenting the result. This process develops responsibility, collaboration, critical thinking, and problem-solving competencies. For instance, the project "Transforming Our School into a Green Zone" involves not only theoretical knowledge but also practical activity.

Another essential component of modern instruction is the use of ICT. Multimedia, virtual laboratories, 3D models, online tests, mobile applications, and simulations make the teaching of natural sciences more engaging, comprehensible, and interactive. Through these tools, students acquire knowledge more deeply by seeing, hearing, and performing tasks hands-on. Moreover, digital technologies create opportunities for individualized learning and adapt to each learner's pace of development.

Interactive methods also play an invaluable role in innovative approaches. Methods such as "Brainstorming," "Cluster," "Fishbone," "Debate," and "Role-play" encourage students to think, discuss, provide evidence, and defend their point of view. These methods make the lesson dynamic, engage learners as active participants, and develop their social and psychological skills.

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One of the important aspects of innovative approaches in teaching natural sciences is relying on experimentation and observation. Through direct observation of natural phenomena, simple laboratory work, modeling, mini-experiments and experiments, students feel the spirit of scientific inquiry. They acquire skills such as identifying cause-and-effect relationships, analyzing results, and drawing conclusions.

Innovative approaches apply not only to methods, but also to content. Natural sciences today are not only theoretical knowledge, but also include values such as ecological culture, sustainable development, global issues, and careful attitude toward nature. Therefore, natural science lessons aim to educate the learner as a conscious, responsible, and initiative-taking individual.

Thus, the essence of innovative approaches in teaching natural sciences is integrating lessons, gamification, digitalization, practice-based learning, strengthening the thinking process, placing the learner at the center, and organizing result-oriented active learning. As a result of these approaches, lessons become lively, meaningful, interesting and effective, and most importantly, scientific thinking and competencies are developed in students.

The use of innovative pedagogical technologies in natural science lessons helps to achieve the following results: Scientific thinking and observation skills develop in students; The lesson content is connected with real-life situations; Independent and creative thinking is formed; Interest in subjects increases; Skills and competencies develop systematically.

For the effective use of innovative technologies, the teacher should plan the lesson in an integrated manner; involve students as active participants; use digital tools and platforms; apply game technologies for didactic purposes; and organize assessment based on competencies. For example, virtual laboratories are effective for observing natural phenomena, project work is useful in solving environmental problems, and simulations give effective results in explaining the water cycle or plant growth.

Conclusion. Innovative pedagogical technologies in teaching natural sciences in primary grades are among the most important requirements of modern education. These approaches not only equip students with knowledge, but also nurture them as individuals who can think independently, analyze, and solve problems. Therefore, primary school teachers must thoroughly master innovative methods and consciously integrate them into the teaching process.

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