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BASICS OF USING STEAM TECHNOLOGIES IN TEACHING NATURAL SCIENCES IN PRIMARY EDUCATION

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Abstract

This scientific-methodological work provides a comprehensive analysis of the theoretical and methodological foundations of the using **STEAM** (Science, Technology, Engineering, Art, Mathematics) technologies in the process of teaching natural sciences at the primary education level, as well as the issues of its practical implementation. The abstract defines the content, goals, and main principles of STEAM education technology and highlights the opportunities for developing knowledge, skills, and abilities related to natural sciences through this approach. Taking into account the age and psychological characteristics of primary school students, special attention is paid to the issues of implementing interdisciplinary integration in science classes and linking theoretical knowledge with practical experiments, observation, and project work.
The work demonstrates the possibilities of developing students` logical thinking, creative abilities, independent decision-making, teamwork, and problem-solving competencies through lessons organized on the basis of STEAM technologies.

Keywords

STEAM education technologies, primary education, natural science teaching methodology, interdisciplinary integration, innovative pedagogical technologies, competency-based approach, creative thinking, critical thinking, project-based learning, modern approach.

Introduction

The development of modern society places new demands on the education system. In particular, at the primary education stage, the priority task is to form important competencies in students such as creative thinking, problem-solving, and preparation for practical activities, alongside basic knowledge in the natural sciences. This necessitates the implementation of innovative and interdisciplinary approaches together with traditional teaching methods in the educational process. Implementing innovative approaches in education defines the tasks of forming Approved by the Decree of the President of the Republic of Uzbekistan No.PF-5712 dated April 29, 2019, the " Concept for the Development of the Public Education System of the Republic of Uzbekistan until 2030" identifies several priority issues: updating the content of education in general secondary schools, improving the quality of teaching natural and exact sciences, and utilizing innovative pedagogical technologies.[1] This article pays special attention to developing students` practical skills and interdisciplinary knowledge, forming the legal and methodological basis for implementing STEAM education technologies. STEAM technologies ensure the interdisciplinary integration of teaching natural sciences and provide opportunities for students to observe, conduct experiments, engage in modeling, and participate in project activities. Considering the age characteristics of primary school students, this approach is considered effective for increasing interest in natural sciences and connecting knowledge with practical activities to develop independent thinking skills. Therefore, this article analyzes the scientific-methodological foundations of using STEAM technologies in teaching natural sciences in primary education and addresses the importance of increasing its effectiveness as a pressing scientific-pedagogical problem.

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Literature Review: An analysis of scientific sources shows that the issue of forming natural-scientific competencies in primary school students through teaching natural sciences has been widely studied by foreign and local researchers. In particular, this issue has been analyzed as a problem in research conducted by scientists from the Commonwealth of independent States (CIS).

For instance, L.V. Sheptukhovsky, I.G. Kroxina, and L.P. Simonova, in their scientific works, revealed the theoretical foundations for forming natural-scientific competencies in students and developed criteria for assessing these competencies. These scholars paid special and interdisciplinary connections in the process of teaching natural sciences.

This issue has also found its reflection in the research of local (Uzbek) scholars. In particular, **F.I.Ochilov,** in his scientific research, emphasized the importance of developing students` independent thinking and practical skills based on a competency-based approach to teaching natural sciences.[2] Similarly, researcher **Z.B. Sangirova** developed methodological recommendations for using **STEAM** technologies in teaching natural sciences, proposing an approach based on the harmony of science, technology, and practical activity.[3]

In didactic research, ensuring the interconnectedness between subjects is evaluated as an important factor in increasing educational efficiency. As a result of analyses conducted in this direction, the methodological foundations of interdisciplinary integration have been established. At the same time, there are international studies aimed at evaluating the effectiveness of STEAM (science, Technology, Engineering, Art, and Mathematics) education technologies. Among them, issues of methodological support for the STEAM approach in teaching natural sciences have found expression in the works of J. Tolipova. The author emphasizes that lessons organized based on STEAM technologies serve to increase students` quality of knowledge and interest. [4]

The analysis of literature cited above shows that foreign and local research has studied the teaching of natural sciences, interdisciplinary integration, and STEAM education technologies as separate aspects. However, developing a as separate aspects. However, developing a complex pedagogical mechanism for teaching natural sciences based on STEAM technologies in the context of primary education and experimentally justifying its effectiveness remains an urgent task.

Research Methodology

This research aims to highlight the theoretical and methodological foundations of using the STEAM approach in the process of teaching natural sciences in primary education and to determine its impact on educational effectiveness. The research views STEAM as an educational model based on integrating science (S), Technology (T), Engineering (E), Art (A), and Mathematics (M) fields in mutual connection.

The research methodology relies on practical activities, experiments, and observations in teaching natural sciences, taking into account the age and psychohysiological characteristics of primary school students. Opportunitie to of primary school students. Opportunities to develop critical thinking, creativity, problem-solving, and scientific and technical skills in students through the STEAM approach are analyzed. In the research process, special attention is paid to linking theoretical knowledge with life examples, experimental exercises, visual models, and small projects in teaching natural sciences.

Methods Used in the Study

The following methods were used in the research:

Theoretical analysis method: Studying and summarizing scientific sources related to STEAM education technologies and teaching natural sciences.

Comparison method: Comparing traditional teaching with lessons organized based on the STEAM approach.

Experimental-trial work: Implementing lessons organized on the basis of STEAM in lessons organized on the basis of STEAM in primary grades and observing their results.

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Experimental method: Testing practical experiments, project work, and group activities in teaching natural science topics.

Observation and analysis: Determining the level of development of students` cognitive activity, interest, and practical skills.

Conclusion of the Section

In the methodological approach, lesson plans for natural sciences are developed based on STEAM. For example, topics such as the water cycle, energy sources, plant growth, and environmental problems are taught based on interdisciplinary integration. Through lessons based on experiments, attention is focused on developing students` independent thinking and practical activity. As a result, the effective use of the STEAM approach in teaching natural sciences in primary education serves to increase students` scientific literacy and form

Analysis and Results

In the course of the research, it was determined that teaching natural sciences in primary grades based in increasing educational efficiency. Analysis shows that the STEAM approach serves not only to help students master theoretical knowledge but also to develop creative, technological, and practical skills in an integrated manner.

Using experiments, small projects, visual aids, and digital tools during lessons significantly increases students` interest in natural sciences. In particular, it was observed that students` cognitive activity increased by studying topics through connections to real-life examples and organizing experimental activities.

As a result of the experimental trials conducted in classes taught based on STEAM technologies, it was found that students developed the following skills more highly compared to traditional teaching:

Analyzing problem situations;
Expressing independent opinions;
Working in groups;
Drawing conclusions from experimental results.

Furthermore, it was confirmed that STEAM education is an effective tool for developing skills important for the 21st century (discussion, collaboration, critical thinking, and creativity).

Specifically, as components of creativity, students` curiosity, proposing new ideas, and developing different approaches to given problems were observed.

Critical thinking skills were manifested in the process of analyzing information, comparing evidence, identifying cause-and-effect relationships, and drawing general conclusions. During the discussion and collaboration process, it was determined that students acquired the skills of working in a team, exchanging ideas, defending their positions, a respecting the opinions of others.

The results of the analysis show that teaching natural sciences based on interdisciplinary, inter-thematic, and trans-subject integration creates the opportunity for students to perceive knowledge holistically. This serves to apply knowledge in practice and understand interdisciplinary connections in solving life problems.

Conclusion

In conclusion, the implementation of STEAM technologies in primary education is an effective pedagogical solution for improving the quality of teaching natural sciences, developing students` creative and intellectual potential, and implementing a competency-based approach.

The conducted analysis showed that the STEAM approach is suitable for the age characteristics of primary school students and is effective in increasing their interest in natural sciences. Additionally, through STEAM education, students develop skills essential for modern society, such as critical thinking, collaboration, communication, and creativity. These skills are of great importance in the next stages of education and in life activities. Therefore, it is considered appropriate to widely implement this approach in primary education practice.

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