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MODERNIZING PRIMARY EDUCATION BASED ON THE STEAM APPROACH

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Abstract
This article analyzes the theoretical and practical aspects of modernizing primary education through the STEAM approach. In modern education, interdisciplinary integration has become a crucial issue in developing students' critical thinking, creativity, and problem-solving skills. The article provides an in-depth discussion of the role, benefits, and implementation strategies of STEAM (Science, Technology, Engineering, Arts, Mathematics) in the primary education process. Additionally, based on advanced practices, the article examines the impact of the STEAM approach on students' learning quality and motivation. The author draws conclusions based on theoretical analysis, pedagogical observation, and a review of relevant literature.

Keywords: STEAM, primary education, interdisciplinary integration, creative thinking, modern pedagogy, innovative methods, problem-based learning, critical thinking.

Introduction

Nowadays, in the field of education, as a result of globalization, digitalization, and technological progress, there is an increasing necessity not only to provide students with fundamental knowledge but also to develop their creative thinking, critical approach, problem-solving, and teamwork skills. Especially at the primary education stage, the formation of these skills lays a solid foundation for further education levels and life success. From this perspective, the introduction of the STEAM (Science, Technology, Engineering, Arts, Mathematics) approach into modern education is recognized as one of the important directions for profound reform and modernization of the pedagogical process. The STEAM approach enables students to understand interdisciplinary connections, integrate

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knowledge with practice, and encourages creativity and initiative. This approach is becoming a crucial factor not only for teaching subjects together but also for the personal and social development of the student.

Relevance of the study: Ensuring the intellectual, social, and aesthetic development of students through the application of the STEAM approach in primary education, and equipping them with real-life applicable skills, is one of the central aspects of modern education strategy. This requires an update in both the content and form of education. Therefore, the effective implementation of the STEAM approach in the primary education system is considered one of the urgent scientific and practical issues.

Purpose of the study: To identify the theoretical foundations of modernizing the educational process in primary education based on the STEAM approach and to propose effective ways of its practical implementation.

Objectives of the study:

I. To study the scientific and theoretical foundations of the STEAM approach;
II. To determine the role and importance of interdisciplinary integration in primary education;
III. To analyze the application of the STEAM methodology in foreign and local experiences;
IV. To develop appropriate pedagogical methods and techniques for primary school students;
V. To develop practical recommendations for organizing the lesson process based on the STEAM approach.

Object of the study: The content and methodology of the educational process in the primary education system.

Subject of the study: The processes, methods, and pedagogical opportunities of modernizing primary education based on the STEAM approach.

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Scientific research on this approach is widely reflected, especially in the experiences of developed countries such as the USA, the United Kingdom, South Korea, Finland, and Singapore. Literature analysis shows that the STEAM concept is based on integrating five core subjects — Science, Technology, Engineering, Arts, and Mathematics — into a unified teaching methodology. Through this integration, high-level cognitive skills such as problem identification, analysis, and creative solution finding are developed in students.

The STEAM model, initially proposed by J. Sanders (2009), existed originally as STEM (without the Arts component). However, it was later recognized that including the arts is necessary to foster students' personal expression, aesthetic taste, and cultural awareness. Based on this, Yakman (2010) justified in his conceptual model that the STEAM approach is a student-centered, systematic, and integrated methodology. Beers (2011) notes that the STEAM approach encourages students not to look for the "correct answer," but to strive for a "creative solution." According to him, this method motivates students to learn not through ready-made knowledge but through discovery. Henriksen et al. (2014) in their research emphasize the importance of the interaction between aesthetic and engineering thinking in creating an innovative educational environment through the STEAM approach.

Among local scholars, pedagogues such as S. To'xtasinov (2018), B. Usmonxo'jayev (2019), and Z. Normurodova (2021) have acknowledged in their scientific works that integrated approaches in education positively affect students' socio-cultural development. For instance, To'xtasinov highlighted that integrated lessons in primary education develop students' interest in science, independent thinking, and teamwork skills. The "New Uzbekistan Education Program" for 2022–2026 also emphasizes the development of interdisciplinary integration and the practical application of the STEAM approach to unlock students' creative potential. This, in turn, confirms the relevance of the STEAM methodology in the national education system.

In conclusion, the literature review indicates that the STEAM approach holds significant importance not only theoretically but also practically in modernizing the pedagogical process. It not only ensures interdisciplinary connections but also

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directs education toward solving real-life problems, shaping students into independent and creative thinkers.

The study was conducted during the 2024–2025 academic year at Secondary School No. 5 in Qarshi city, Qashqadaryo region. The participants were fourth-grade students, with the experimental group consisting of class 4-"B" (26 students) and the control group consisting of class 4-"A" (25 students).

Research methods:

- **Experimental method** – New methodologies based on the STEAM approach were implemented in the experimental class to organize lessons and determine their impact on students.
- **Observation method** – Students' participation, interest, expression of their opinions, and creative approaches were regularly observed during the lessons.
- **Survey method** – Special questionnaires were distributed to assess students' learning motivation and their attitude toward the STEAM approach.
- **Interview method** – Practical aspects of the new approach were analyzed through discussions with teachers and parents.
- **Diagnostic tests** – Tests were administered at the beginning and end of the study to evaluate students' knowledge levels.

The experiment was conducted in three stages:

1. **Preparatory stage** – Control and experimental groups were identified, and initial knowledge levels were assessed.
2. **Main stage** – Integrated lessons based on the STEAM approach were conducted in the experimental group (for example, projects combining mathematics and technology, natural sciences, and arts).
3. **Final stage** – Data obtained from tests, surveys, and observations at the end of the lessons were analyzed and compared with the control group.

Research tools:

- Questionnaires: Consisting of 10 closed and open-ended questions prepared for students and parents.

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- Observation sheets: Forms used to record student activity and participation during each lesson.
- Diagnostic tests: Interdisciplinary tests consisting of 20 questions to evaluate students' knowledge.
- Lesson plans and projects: Interactive assignments, project works, and group activity scenarios adapted to the STEAM approach.
- Analytical tools in the form of graphs and tables: Used to visually represent the obtained results.

The study achieved the following results:

1. Initial Knowledge Level.

At the beginning of the study, the knowledge levels of students in both the experimental and control groups were almost equal. Both groups showed an average result of around 58%. This indicates that there was no initial knowledge gap between the groups, providing a stable basis for the experiment.

2. Final Knowledge Results.

After the learning process based on the STEAM approach, the knowledge level of the experimental group significantly increased, reaching an average of 86%. Meanwhile, the control group showed an average result of 65%. These figures demonstrate the effectiveness of the STEAM approach in improving students' knowledge.

3. Student Participation.

The participation rate of the experimental group students in lessons was high, with 91% actively involved. Most of them also actively participated in group work and showed great interest in creative tasks.

4. Motivation and Interest.

According to the survey results, 89% of the students in the experimental group considered the lessons conducted with the STEAM approach to be interesting and useful. This indicates an increase in both interest in the lessons and motivation to learn.

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5. Parents' and Teachers' Opinions.

In interviews conducted at the end of the experiment, parents noted that their children's independent thinking and interest in technology had increased. Similarly, teachers emphasized that the STEAM approach greatly helped to enliven the lessons and engage students in active participation.

The results of this study confirmed that modernizing primary education based on the STEAM approach has a positive impact on students' knowledge levels, activity, and motivation. Scientific research conducted in Uzbekistan also supports this conclusion. For example, Mamatqulov and Hamroyev (2021) emphasize in their work that the STEAM methodology is effective in enhancing students' creativity and independent thinking skills. Their research also shows that interactive and project-based approaches in lessons improve the learning process. However, some Uzbek studies have noted challenges in fully implementing the STEAM methodology. In particular, Reshiddinov (2022) highlighted problems such as insufficient understanding of the STEAM approach by teachers and a lack of necessary equipment. These issues were also observed in my experiment but can be resolved through stable and effective practice.

Foreign studies, especially those conducted in the United States and European countries, demonstrate that STEAM education, by integrating science, technology, art, and mathematics, allows for the multifaceted development of students (Beers, 2011; Quigley & Herro, 2016). These studies show that the STEAM approach teaches students to solve complex problems through practical tasks and enhances their cooperative work and creative thinking skills. The results of my research align with these international scientific works, particularly regarding the increase in students' interest and engagement in lessons. Additionally, the opinions of parents and teachers in the Uzbek context were also positive, showing that the practical application of STEAM education contributes to the development of children's knowledge and skills.

In conclusion, the results of my study correspond not only with Uzbek but also with global scientific experiences. It is evident that the STEAM approach is an effective tool for improving the quality of primary education and ensuring the multifaceted development of students.

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Conclusion

The conducted study proved that implementing the STEAM approach in the primary education process is an effective method for improving the quality of education. During the experiment, lessons organized based on this approach increased students' engagement and helped develop their independent thinking, problem-solving skills, logical and creative approaches. Practical activities, project work, and interdisciplinary integration not only enhanced students' knowledge but also shaped their skills and competencies. STEAM-based lessons were more effective compared to traditional methods, increasing students' interest in lessons and fostering strong motivation to acquire practical knowledge. Therefore, the STEAM approach should be recognized as one of the priority directions of modern pedagogy in the modernization of primary education.

Recommendations

1. Gradual implementation of the STEAM approach: STEAM components should be consistently integrated into primary education curricula.

2. Teacher training and retraining: Special training sessions should be organized to improve teachers' knowledge and skills related to the STEAM approach.

3. Establishment of necessary material and technical resources: It is important to provide laboratories, technological tools, and resources needed for project work.

4. Encouragement of innovative methods: Systems should be developed to motivate teachers to apply creative approaches.

5. Expansion of scientific and practical research: Scientific studies should continue to analyze the effectiveness of STEAM-based teaching methods in the Uzbek context more extensively.

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