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METHODOLOGICAL TRAINING OF FUTURE TEACHERS BASED ON STEAM EDUCATION TECHNOLOGIES

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Abstract. This article examines the transformations occurring in the education system within the context of the digital transformation of society, highlighting the role and significance of STEAM (Science, Technology, Engineering, Art, and Mathematics) educational technologies, as well as issues related to the development of methodological training for future teachers. Furthermore, the paper discusses effective methods and models for teacher preparation grounded in innovative pedagogical approaches.

Keywords: digital transformation, STEAM education, methodological training, pedagogical competence, innovative technologies, integrative approach.

Introduction. In contemporary society, digital transformation has significantly influenced all sectors, including the education system. The rapid development of information and communication technologies has contributed to the emergence of new pedagogical approaches. In this regard, preparing future teachers in accordance with modern educational requirements has become one of the most pressing tasks. Particularly, STEAM education technologies serve to organize learning through an integrative approach, enabling students to develop creative thinking, problem-solving abilities, and innovative competencies.

Literature Review and Methodology. An analysis of scientific literature indicates that the STEAM educational model is widely implemented in the practices of developed countries. This model facilitates the organization of the educational process based on interdisciplinary integration.

During the research process, methods such as theoretical analysis, comparative analysis, systems approach, and pedagogical modeling were employed.

Digital transformation refers to the process of integrating digital technologies into all spheres of social life. Within the education system, this process includes electronic learning platforms, distance education, the use of artificial intelligence, and digital pedagogy. Consequently, the role of teachers is evolving; they are no longer solely providers of knowledge but are increasingly expected to function as facilitators, mentors, and innovators.

STEAM education technology incorporates the following components:

- **S (Science)** – Natural Sciences;
- **T (Technology)** – Technology;
- **E (Engineering)** – Engineering;

- **A (Art)** – Arts;
- **M (Mathematics)** – Mathematics.

This approach integrates theory with practice, enhances creativity, supports project-based activities, and is oriented toward solving real-life problems.

The methodological training of future teachers refers to their ability to effectively organize the educational process, appropriately select teaching methods and technologies, and apply them in practice.

Methodological training within the STEAM framework consists of several components:

- **Cognitive Component** – a system of knowledge;
- **Operational Component** – practical skills;
- **Motivational Component** – professional interest and needs;
- **Reflective Component** – the ability to analyze one's own pedagogical activity.

Analysis and Results

To improve the methodological training of future teachers through STEAM education, the following approaches are considered effective:

Development Through Project-Based Learning (PBL)

Project-Based Learning is an instructional method that organizes the educational process around solving real-life problems. This approach represents one of the core principles of STEAM education, integrating theoretical knowledge with practical activities.

Through this method, future teachers acquire competencies such as:

- identifying and analyzing problems;
- setting goals and planning activities;
- conducting research;
- presenting outcomes in the form of practical products (models, projects, or programs);
- developing teamwork skills.

The methodological significance of this approach lies in enabling teachers to learn how to organize project-based educational activities, foster independent thinking among learners, and apply alternative assessment forms such as portfolios, presentations, and project defense.

For example, students may work on an "Intelligent Greenhouse" model, integrating knowledge from biology, physics, mathematics, and technology.

Use of Interactive and Digital Tools

In the context of digital transformation, a teacher's methodological preparedness is directly linked to their ability to effectively use modern information and communication technologies.

This approach includes:

- **Virtual Laboratories** – providing opportunities to conduct experiments in a safe and cost-effective environment;
- **Simulations** – modeling complex processes such as physical phenomena or chemical reactions;
- **Educational Platforms** – supporting distance and blended learning;
- **Multimedia Tools** – enhancing visual and interactive teaching.

The methodological value of this approach is that teachers learn to create and utilize digital content, organize differentiated instruction based on students' individual characteristics, and effectively implement distance education.

As a result, students demonstrate increased engagement in lessons, improved comprehension of complex concepts, and enhanced independent learning skills.

Teaching Based on Interdisciplinary Integration. One of the most important aspects of STEAM education is interdisciplinary integration. In traditional education, subjects are taught separately; however, within the STEAM approach, they are interconnected and studied in relation to one another.

The essence of this approach includes:

- applying knowledge from multiple disciplines to address a single problem;
- connecting theoretical knowledge with real-life contexts;
- fostering complex and systemic thinking.

The methodological dimensions of interdisciplinary teaching involve:

- designing integrated lesson plans;
- organizing interdisciplinary projects;
- promoting collaboration among teachers from different subject areas.

For instance, in an "Energy-Efficient House" project:

- Physics addresses energy sources;
- Mathematics focuses on calculations;
- Technology contributes to model development;
- Art supports design elements.

As a result, students acquire knowledge systematically rather than fragmentarily and become better prepared to solve real-world problems.

Development Through a Competency-Based Approach

The competency-based approach represents one of the leading concepts in modern education, emphasizing the practical application of knowledge rather than theoretical understanding alone.

Within the framework of STEAM education, the following competencies are considered essential:

a) Digital Competence

- searching, analyzing, and processing information;
- effective use of digital tools;
- understanding cybersecurity fundamentals.

b) Creative Thinking

- generating new ideas;
- finding unconventional solutions;
- applying innovative approaches.

c) Communication Skills

- teamwork and collaboration;
- clear and coherent expression of ideas;
- presentation skills.

d) Problem-Solving Skills

- identifying problems;
- generating alternative solutions;
- selecting the most effective option.

The methodological significance of competency-based development lies in enabling teachers to organize the educational process around competencies, develop competency-based assessment criteria, and align educational outcomes with real-life applications.

The approaches described above are closely interconnected, and their integrated implementation contributes to a qualitative improvement in the methodological preparedness of future teachers. In particular, educational processes organized on the basis of STEAM contribute not only to knowledge acquisition but also to the formation of practical skills and modern competencies

Conclusion. Within the context of society's digital transformation, the use of STEAM educational technologies serves as a crucial factor in enhancing the methodological preparedness of future teachers. This approach contributes to the development of modern competencies among educators and prepares them for effective professional activity in innovative educational environments.

References:

1. Atenov, J.D. Problems and the Current State of Methodological Preparedness of Future Teachers. International Journal of Artificial Intelligence, Vol. 6, Issue 03, 2026, pp. 489–493. American Academic Publishers. ISSN: 2692-515-X. Impact Factor: 9.23. Available at: https://www.academicpublishers.org/journals/index.php/ijai/article/view/11719
2. Atenov, J.D. The Concept of Methodological Preparedness of Future Teachers. International Multidisciplinary Journal for Research & Development, Vol. 13, Issue 03, 2026, pp. 393–397. eISSN: 2394-6334. Impact Factor: 8.854. Available at: https://www.ijmrd.in/index.php/imjrd/article/view/5318
3. Atenov, J.D. The Role of the STEAM Approach in Preparing Future Teachers. Preschool and School Education Journal, No. (3)2, March 16, 2026, pp. 170–173.
4. Bovanova, U., Alimova, D., & Atenov, J. STEAM in Primary Education. Tashkent: Firdavs Shoh Publishing House, 2026. 122 pages.
5. Preschool and School Education Journal. (2022). STEAM Pedagogy and Issues of Pedagogical Preparedness. Retrieved March 15, 2026, from: https://maktabgacha-va-maktab-talimi-jurnal.uz/index.php/jurnal/article/view/345
6. The Times of India. (2023, May 15). Trainee Teachers Lack Practical Skills, Reveals Study. Retrieved March 15, 2026, from: https://timesofindia.indiatimes.com/city/hyderabad/trainee-teachers-lack-practical-skills-reveals-study/articleshow/123738900.cms