



PEDAGOGICAL BASIS OF INTEGRATION OF STEM EDUCATION INTO THE EDUCATIONAL PROCESS

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Abstract: This article discusses the pedagogical foundations of integrating STEM education into the educational process and ways to increase the effectiveness of education, its role in the education system and its practical aspects.

Key concepts: STEM (Science, Technology, Engineering, Mathematics), education, technology, innovative education, interdisciplinary, problem-based learning, critical and creative thinking.

It is directly related to the deep structural changes taking place in the education system today and the sharp renewal of labor market requirements. In the conditions of the modern economy, the need to train competitive, independent-thinking, and practical-skilled specialists is increasing, which requires a transition from traditional theoretically oriented education to competency-based, modularized training.

The modern education system is changing rapidly in connection with rapidly developing technologies and social demands. In this context, STEM (Science, Technology, Engineering, Mathematics) education plays an important role in the formation of students' skills such as critical thinking, problem solving, creative approach, and technological literacy.

The role of integration in the modern education system is increasing, which is reflected in the educational activities of higher education institutions, the results of the personal development of university students, and their creative and scientific abilities. It should be noted that the traditional educational strategy, limited only to the acquisition of the necessary knowledge and skills, does not satisfy the needs of the individual in the perception of universal and cultural values, does not adequately respond to his development as a cultured and competent person. The introduction of integrative approaches to the practical processes of the education system provides an opportunity to know, observe, analyze the historical development of integration in conducting applied research and select the most relevant approaches related to its implementation in accordance with the education system.

According to the analysis of the literature, the types of integration are classified as follows:

1. By development direction: horizontal, vertical, diagonal integration.
2. By the degree of integration: mutual cooperation, cooperation and full integration.
3. By areas of activity: production, scientific, educational marketing, investment and innovation integration.
4. By legal basis: shared and joint integration.

STEM education combines the fields of science, technology, engineering and mathematics, developing critical thinking, creative approaches and practical skills in students. Its integration into the educational process allows students to combine theoretical knowledge

with practice. A learner-centered approach and problem-based teaching methods play an important role in STEM integration. Interdisciplinary project work develops systematic thinking in students and provides skills for solving real problems by combining different disciplines. The effective use of technologies, such as robotics, programming and 3D modeling, further enriches STEM integration. Integrating STEM education into the educational process increases students' interest in science and technology and prepares them for future professions. Thus, STEM integration directs modern education in a practical, interactive and motivational direction.

For the successful implementation of STEM education, it is necessary to determine the pedagogical foundations of its integration into the traditional educational process.

STEM education allows students to combine science and technology knowledge and apply it to solve real-life problems. This approach:

1. Develops an interdisciplinary approach - creates connections between different disciplines.
2. Uses problem-based learning - students gain deeper knowledge through practical projects.
3. Develops critical and creative thinking - students learn to apply theoretical knowledge in practice.

The integration of STEM education into the educational process is based on the following pedagogical principles:

1. Learner-centered approach

The educational process adapts to the interests, abilities and experience of the student. For example, project-based learning encourages independent thinking of students.

2. Active teaching methods

Laboratory work, interactive activities, problem-solving exercises play an important role in STEM integration.

3. Problem-Based Learning (PBL)

Students analyze real-life problems, test ideas, and find solutions. In this process, theoretical knowledge is reinforced by practice.

4. Interdisciplinary project work.

Projects that combine different disciplines develop students' systematic thinking and the ability to see problems from multiple perspectives.

5. Effective use of technology.

STEM education enriches the learning process using digital tools and software. For example, robotics and 3D modeling projects.

Advantages of integrating STEM education:

Students' interest in science and technology increases;

Practical skills are developed, theoretical knowledge is strengthened;

Critical and creative thinking is developed;

The opportunity is created to prepare students for future professions.

Aspect	STEM education	Traditional teaching
Lecture assignment	Providing theoretical knowledge in the field	Providing fundamental concepts

Aspect	STEM education	Traditional teaching
Orientation to practice	Very high	Less, more general thinking
Nazorat shakli	Projects, laboratory, portfolio	Essays, tests, speeches
O'qitish metodlari	Task-based, project-based learning, internship	Discussion, problem-based method, interactive lessons

Integrating STEM education into the traditional educational process requires modern pedagogical approaches. This process develops skills such as critical thinking, creativity, problem solving, and technological literacy in students. Therefore, educators need to use active learning methods, interdisciplinary projects, and problem-based learning approaches to successfully integrate STEM into the classroom.

References:

- 1.Otojanova Nilufar. Boshlang'ich maktabda STEM ta'limi – pedagogik innovatsiyalar, fanlararo o'rganish va muammoga asoslangan yondashuvlar bo'yicha ilmiy tahlil.
- 2.Portillo Blanco, A., Deprez, H., De Cock, M., Guisasola, J., & Zuza, K. A Systematic Literature Review of Integrated STEM Education: Uncovering Consensus and Diversity in Principles and Characteristics.
- 3.L. D. STEM education K 12: perspectives on integration.
- 4.Larkin, K., & Lowrie, T. Teaching Approaches for STEM Integration in Pre and Primary School: a Systematic Qualitative Literature Review.
- 5.L. D., & Guzey, S. S. K 12 STEM Education: An Overview of Perspectives and Considerations.

