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IMPROVING BIOTECHNOLOGY EDUCATION THROUGH A CREATIVE APPROACH

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Abstract

This article discusses the scientific foundations, practical methods, and modern pedagogical technologies for developing biotechnology education through a creative approach. The impact of creativity on the educational process and its importance in developing independent thinking and innovative perspectives among students are analyzed. In addition, the content and functions of creative methods used in modern education are examined.

Keywords: teaching methods, educational processes, pedagogy, interactive methods, innovative approach, quality of education, creativity, technology, innovation, professional development, creative pedagogy, STEAM integration.

The need for teaching methods based on a creative approach is steadily increasing, as the modern education system aims to nurture a generation capable of creative thinking, innovation, and finding unconventional solutions to problems. The Decree of the President of the Republic of Uzbekistan, Shavkat Mirziyoyev, dated January 28, 2022 (PF–60) "On the Development Strategy of New Uzbekistan for 2022–2026", as well as the Resolution dated May 12, 2022 (PQ–257) "On Additional Measures for the Development of Science and Innovation", emphasize the importance of a creative approach in improving the quality of education.

Furthermore, the Law "On Education" (new edition, 2020) and the Presidential Resolution dated April 29, 2019 (PQ–4310) define specific tasks aimed at increasing the professional competence of teachers and implementing innovative and creative teaching methods.

In the modern educational process, teaching based on a creative approach plays an important role in developing students' creative potential, independent thinking, and the ability to approach problems in unconventional ways. Innovative, interactive, and creative approaches are gradually replacing traditional teaching methods. Through these methods, students' interest in academic subjects increases and their personal activity becomes more active.

Creativity is the ability to think creatively, approach situations in unconventional ways, and view problems from a new perspective.

Creativity can also be defined as the ability to generate new, original, and effective ideas, find unusual solutions to problems, and look at existing situations from a different perspective.

In modern conditions, biotechnology is not only a field of scientific research but also a strategic area closely connected with the economy, medicine, agriculture, and ecology.

Therefore, limiting its teaching and development to traditional methods alone is insufficient. Improving biotechnology education through a creative approach is an important factor in increasing educational effectiveness, fostering innovative thinking, and developing practice-oriented competencies.

A creative approach primarily involves organizing teaching based on problem situations. For example, students may be presented with real ecological problems, antibiotic-resistant microorganisms, or issues related to food safety, and they are directed to develop biotechnological solutions.

Such methods integrate theoretical knowledge with practical thinking and develop independent decision-making skills.

Another important direction is the implementation of interdisciplinary approaches through **STEAM integration (Science, Technology, Engineering, Art, Mathematics)**. The use of

digital technologies, visual design, and algorithmic thinking in modeling biological processes improves students' level of understanding. Virtual laboratories, 3D modeling, and artificial intelligence tools allow experiments to be conducted in a safe and economically efficient manner.

Another important aspect of the creative approach is the use of the **Project-Based Learning (PBL)** method. Students work in small groups to develop biotechnological startup ideas, create product prototypes, or design scientific research models, transforming theoretical knowledge into real outcomes.

This process develops entrepreneurial thinking, teamwork, and scientific communication skills among students.

Scientific and Methodological Foundations for Improving Biotechnology Education. The following information highlights the scientific foundations, practical methods, and modern pedagogical technologies for developing biotechnology education through a creative approach.

1. Creative Pedagogy and Innovative Methods

Innovative interactive platforms increase the effectiveness of biotechnology education because they stimulate active student participation and help simplify complex biological processes.

The creative pedagogy method develops students' abilities in independent thinking, problem-solving, and generating innovative ideas, which leads to better outcomes than traditional memorization-based learning.

Pedagogical research shows that students who learn through creative approaches demonstrate significantly higher levels of creative thinking.

2. Interactive and Innovative Approaches

Interactive methods such as problem-based learning, project-based learning, argumentation, and web-integrated approaches enhance experiential learning and promote deeper understanding of biotechnological concepts.

When laboratory and practical sessions are conducted using innovative approaches, students simultaneously develop knowledge and technical skills. For example, experiments such as genomic DNA isolation and PCR analysis help students understand theoretical concepts through practical application.

The use of digital tools and virtual laboratories in the educational process facilitates the integration of theoretical knowledge with practical experience.

3. STEAM and Interdisciplinary Integration

STEAM integration in biotechnology education helps students understand complex biological processes from multiple perspectives by combining design and technology.

An interdisciplinary approach equips students with complex skills such as biomimicry, digital analytics, and ecological system analysis.

The concept of transdisciplinarity also integrates bio-scientific knowledge with society, practical activities, and scientific research.

4. Challenge-Based Learning

Within the framework of Challenge-Based Learning, students are given real-world problems and encouraged to search for solutions, conduct research, and evaluate results through an in-depth learning process.

This approach develops 21st-century skills such as collaboration, critical thinking, technology integration, and individual responsibility.

5. Media Pedagogy and Visualization

Media pedagogy, including animations, simulations, and visual resources, helps explain complex biotechnological processes visually and facilitates understanding.

This approach is particularly effective in linking theoretical concepts with practical applications and increasing student motivation.

Conclusion. To improve biotechnology education, it is necessary to implement creative pedagogy, interactive teaching methods, STEAM integration, problem-based learning, and media pedagogy simultaneously.

These approaches allow students to integrate theoretical knowledge with practical skills while developing innovative thinking, problem-solving abilities, and scientific research potential.

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