PRINCIPLES UNDERLYING THE USE OF MODERN DIGITAL LEARNING TOOLS IN PREPARING FUTURE BIOLOGY TEACHERS FOR PROFESSIONAL ACTIVITY

Bakhodirova Umida Bakhodirovna, Associate Professor, Navoi State University

Abstract. This article highlights the pedagogical potential of the effective use of modern digital learning tools in preparing future biology teachers for professional activity, as well as the main principles on which the organization of this process is based.

Keywords: digital learning tools, principle, 3D model, animation, virtual laboratory, simulation.

In today's context of digitalization, new requirements are being placed on the content and technologies of preparing future biology teachers for professional activity. This is because, in the biology disciplines taught at higher education institutions, the possibility of fully demonstrating many objects and processes – such as cell structure, physiological processes, genetic laws, evolutionary changes and ecological systems – by means of traditional tools is limited. To address such problems, modern digital learning tools make it possible to study these processes visually and dynamically through 3D models, animations, virtual laboratories, simulations, digital microscopic images and interactive tasks [1]. Therefore, it is advisable that the use of digital tools in preparing future biology teachers for professional activity be organized not randomly, but systematically, on the basis of specific pedagogical principles. Accordingly, within the framework of the study, the principles underlying the use of digital learning tools in preparing future biology teachers for professional activity were developed (see Table 1). In developing the principles, the studies of U.M. Mirsanov [2], A.O. Norbekov [3] and H.B. Nikadambayeva [4] were drawn upon.

Table 1

Principles underlying the use of modern digital learning tools in preparing future biology teachers for professional activity

№	Principle	Content of the principle	Manifestation in biology education
1	**Principle of scientific rigor**	Information provided through digital tools must be scientifically reliable, accurate and up to date	Digital materials on the cell, genetics, evolution, anatomy and ecology are based on scientific sources
2	**Principle of systematicity and consistency**	Digital tools must be consistently linked to the content of education and the stages of learning	Step-by-step progression from simple biological concepts to virtual modeling of complex processes
3	**Principle of visual clarity and visualization**	Creating opportunities to perceive complex biological objects and processes in visual form	Studying the 3D cell, human anatomy, DNA structure, photosynthesis and mitosis through animations
4	**Principle of interactivity**	The student should become an active participant in the digital resource	Virtual experiments, interactive tasks, tests, observing results by changing the parameters of biological objects
5	**Principle of professional orientation**	The use of digital tools should be oriented toward the tasks of future pedagogical activity	The student creates digital materials, a virtual laboratory or interactive tasks for a biology lesson
6	**Principle of activity orientation**	Knowledge should not be given in ready-made form but acquired through	Conducting an experiment in a virtual laboratory, recording the results and

		practical activity	drawing biological conclusions
7	**Principle of integrativeness**	Integration of biological, pedagogical, methodological and digital knowledge is ensured	Developing a digital lesson project on the basis of biology + ICT + teaching methodology
8	**Principle of individualization and differentiation**	Students' level of knowledge, abilities and pace of learning are taken into account	Offering interactive tasks of varying complexity and individual e-learning pathways
9	**Principle of adaptivity**	The digital learning environment should adapt to the student's individual needs	Providing additional tasks, recommendations or learning materials depending on test results
10	**Principle of reflexivity and feedback**	The student should evaluate and analyze their own activity and results	Electronic tests, digital portfolio, self-assessment and automatic feedback
11	**Principle of digital safety and ethical responsibility**	Safe use of the digital environment in accordance with legal and ethical norms is ensured	Copyright, personal data protection, academic integrity and responsible use of artificial intelligence

In conclusion, the use of modern digital learning tools in preparing future biology teachers for professional activity is one of the important factors in increasing the effectiveness and practical orientation of the educational process. However, the mere availability of a digital tool does not in itself ensure high pedagogical outcomes.

Its effectiveness depends on its application on the basis of appropriate didactic and methodological principles.

Therefore, it is recommended that the training of future biology teachers be based on the principles proposed above. An educational process organized on the basis of these principles serves to develop not only the digital literacy of the future biology teacher, but also their professional digital competence in effectively teaching biological knowledge in a modern educational environment, selecting and creating digital educational resources in line with pedagogical goals, organizing virtual experiments and managing learners' activities.

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