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THE USE OF INNOVATIVE TEACHING METHODS IN THE TEACHING OF BIOLOGICAL SCIENCES IN HIGHER EDUCATION INSTITUTIONS.

Summary

The article notes that at the stage of Ukraine's entry into the market economy, European integration, building an independent state, democratization of society, humanization of higher education, student-centeredness there is a need to rethink the higher education system and abandon the adaptive model of learning in favor of personality-oriented education. The article clarifies the essence of the concept of «innovative teaching methods», substantiates the need for their introduction into the educational process and presents the results of a study on the effectiveness of innovative methods in teaching the educational component «Laboratory Diagnostics». The methodological features of the use of the case method, role-playing games, brainstorming, tag cloud in the teaching of biological sciences in higher education institutions are described.

Keywords: innovative teaching methods, biological sciences, higher education institution, case method, project method, role-playing games, tag clouds.

Introduction

The rapid development of society and the integration of Ukraine into the European political, economic and cultural space are the realities of today. The experts of various specialties with higher education have a cardinal influence on the formation of Ukraine as an independent state, its national revival and the transition to market relations. A special place among belongs to future teachers and lecturers as highly competent and comprehensively educated specialists, whose level of training should provide the socio-pedagogical needs of society in the implementation of the «National Doctrine of Education Development of Ukraine

in the XXI Century» [16]. The content of the educational space is influenced by the democratization of society, the humanization of higher education and student-centeredness. It requires the rethinking of the paradigm of higher education and its reforming. Thereby it is inevitable to find new techniques, teaching methods and forms of organization of educational activities [1]. Restructuring of the educational process in higher education institutions involves the renovation of approaches to learning, focused on the personality of students and formation of their general and special competencies. Therefore, the introduction of effective innovative techniques, teaching methods that would contribute to the achievement of program results provided by educational and professional programs of specialties, is relevant.

The aim of the research is to reveal the essence of innovative teaching methods, to characterize the methodological features of implementing such innovative methods as case method, project method, role-playing games, tag clouds during the preparation of higher education applicants of the specialties 091 Biology and 014.05 Secondary education (Biology and human health).

To achieve the aim, the following tasks are performed:

- to substantiate the need for the introduction of innovative teaching methods;
- to reveal the essence of the concepts «method», «teaching method», «innovative methods», «active and interactive methods» in the context of didactics and pedagogics of higher education;
- to reveal the role and importance of innovative teaching methods in the preparation of higher education applicants;
- to describe the most effective innovative methods and techniques of teaching biological disciplines for future biologists and biology teachers.

Research results

Among the innovative methods that are most in demand in today's educational services are active and interactive teaching methods. As the creative component of education grows significantly, the role of all participants in the educational process becomes more active, the creative and exploratory independence of students is strengthened, and the concepts of problem-based and interactive learning have become especially relevant today. During such training the student enters into a dialogue with the teacher, performs creative, problem tasks, answers the questions that develop analytical and critical thinking, asks the questions to the teacher and

other participants, so creative cooperation of the teacher and students is activated (they solve problems, model situations, evaluate the actions of classmates and their own behavior together).

The integration of Ukrainian higher education into the European educational space is associated with problems, the solution of which involves reforming the training system in accordance with international requirements. With the growth of information from many fields of science and technology, radical changes in the social sphere, high professional requirements for future professionals, it is necessary to intensify the learning process, create conditions for training highly qualified staff using modern technologies and teaching methods [6].

In the higher education institutions innovative methods and techniques contribute to the development of creative activity and research initiative of students, lay the foundation for further understanding and development of knowledge, the successful application of acquired knowledge in practice. The introduction of innovative technologies in the educational process helps to train highly qualified, competitive biologists and biology teachers who are able to perform complex research, professional and creative tasks.

Before moving on to the problem of innovative methods and forms of education, it is necessary to reveal the essence of the concept of «innovation» in relation to higher education.

The concept of «innovation» has existed in the international lexicon for over a hundred years. It existed and developed at first mainly in the economic, banking, technical, organizational and managerial spheres, and only in the last quarter of the XX century it became widespread in education [2].

J. Botkin's scientific work «Innovative Learning» states: «Innovation is a constant desire to reevaluate values, preserve those that are of undeniable importance, and the abolition of those that are outdated» [3]. In the scientific, pedagogical and methodological literature the concept of «innovation» is most often used in the composition of terminological phrases: innovative method, innovative methodology, innovative approach, innovative technologies etc. In a general sense, «a method» is a technique or system of techniques for achieving a goal. As a general didactic concept, «method» is a set of techniques of interdependent activities of the subjects of the educational process, aimed at achieving the educational goal, education and personal development [8]. The essence of innovative methods has been the subject of research by both foreign and Ukrainian scientists. General theoretical, scientific and practical problems of the innovation paradigm in higher education, progressive forms and technologies of education are revealed in the works of A. Aleksiuk, I. Dobroskok, V. Kotsur, S. Nikitchyna, V. Kremen, V. Ilin, S. Proleiev, M. Lysenko, P. Saukh and others [4].

The concept of «innovative teaching methods» is multicomponent, as it combines all the new and effective ways of learning (acquisition, transfer and production of knowledge), which contribute to the intensification and modernization of the educational process, develop creativity and personal potential of its participants [2]. The history of the emergence and formation of innovative pedagogical sphere in education abroad and in Ukraine is given in the monograph by O. Dubaseniuk [6].

Activation of the modern innovation movement in Ukraine contributes to the formation of authorial schools of innovative type (M. Huzyk, O. Zakharenko, A. Solohub, M. Chumarna, etc.), whose activities are aimed at forming qualitatively new, alternative concepts and pedagogical systems [6]. Modern methods of teaching biological disciplines in higher education institutions have a rich arsenal of various methods, techniques and teaching aids. Innovative methods are characterized by novelty, efficiency, effectiveness, expediency of use in modern conditions. Innovative teaching methods combine all new and effective ways of learning, which contribute to the intensification and modernization of the educational process. Due to the strengthening of creative and exploratory independence of students, the concepts of problem-based and interactive learning have become especially relevant today. During their implementation, the student enters into a dialogue with the teacher, performs creative, problem tasks, answers the questions that develop analytical and critical thinking, asks the questions to the teacher and other participants in the learning process; that activates creative cooperation of teachers with students, as a modern specialist must think critically, choose the best solution in different situations.

Research and teaching staff become the creators, modifiers of specific innovations. The innovative position of the teacher is characterized by creative activity, personal readiness to review and restructure the system of their own activities [13].

The methods of teaching biological disciplines should be personality-oriented; their indicators are: students' motivation to study; favorable, comfortable educational environment to achieve the goal; reliance on experience, knowledge, skills and abilities of students; a sense of control over the learning process; achieving success, meeting cognitive needs and the need for self-realization; full immersion in the learning process; sufficiency of time for assimilation of new knowledge and skills; no health risk factors; changing the content of teaching and the position of the teacher [17].

In this article we consider the essence of innovative methods and techniques:

- ✓ «brainstorming»;
- ✓ case method (case-study);
- ✓ role-playing game;
- ✓ project method;
- ✓ tag cloud.

The case method was first used in the educational process of the Harvard School of Business in the early XX century [11]. Initially, the case method was used in business and law schools. In Ukraine it was first introduced in 1992 at the National Academy of Public Administration under the President of Ukraine [18]. Later it began to be used in the training of specialists in various specialties. Currently this method is promoted by specialists of the Center for Innovation and Development (V. Loboda, Y. Surmin, A. Furda, O. Sydorenko, etc.) [18]. Y. Shapran recommends the use of the case method in the training of future biology teachers, as it promotes the development of creative potential and positive motivation for students to learn and is personality-oriented, plays an important role in formation of the professional competence of future teachers [15]. R. Romaniuk substantiates on the examples the effectiveness of the case method in the training of biology teachers of the senior profile school in higher education institutions [14].

When implementing the case method, the educational material is presented to students in the form of microproblems, and knowledge is acquired in solving specific life and professional situations, as a result of active creative and research activities. Case-study is a specific, personality-oriented, practically problematic method of organizing the educational process, which has a clear description of the practical problem and a demonstration of finding ways to solve it [15]. Cases have a certain structure, which includes necessarily:

- 1) case situation (problematic situation from real life, which has a number of contradictions, ambiguous solution, as well as information about the time, place, actions of the participants in the situation)
- 2) tasks for working with the case;
- 3) information material of applications (scientific articles, methodical recommendations, Internet resources, illustrative material, list of additional sources of information, etc.).

Working with the case includes the following four stages: 1) individual independent work of students with case materials (acquaintance with the situation, identification of the problem, formulation of key alternatives, proposal of a solution or recommended action); 2) work in small groups on solving a key problem, analysis of consequences, decision-making; 3)

presentation and examination of the results of small groups at the general discussion, the choice of solutions to the problem 4) reflection and determination of results [6].

The cases used by research and teaching staff of the Faculty of Natural Sciences of Zhytomyr Ivan Franko State University during the teaching of methodological disciplines aimed at training future teachers of natural sciences, as well as in mastering higher biological disciplines (biochemistry, histology, animal and human physiology, parasitology, microbiology with the basics of virology, laboratory diagnostics, etc.) can be divided into practical, educational and research cases. In the evaluating the results of case studies of students their activity when discussing the described situation, the search for original constructive solutions to the problem; application of theoretical knowledge in various fields of biology and / or methods of its teaching; use of facts, reference material for reasoned speeches; the ability to clearly express their position are taken into account. The advantages of case-study are: constant interest of higher education students in the learning process, active acquisition of knowledge and skills, development of creativity and critical thinking, designing future professional activities, the formation of professional competence.

The application of the case method requires from the teacher a careful selection of theoretical and practical material. The teacher first asks students to pre-work the necessary theoretical material on a particular problem, then specific examples of situations that should be discussed with students in the class. The practical professional experience of the teacher in this work acquires special importance. This method deserves an honorable place in the modern methodology of teaching professional disciplines in higher education [2].

Here is an example of a case that can be used in classes on «Laboratory Diagnostics»: «A sick man aged 65 complains of malaise, general weakness, bone pain. Blood test results: protein – 110 g/l, hypercalcemia, ESR (erythrocyte sedimentation rate) 82 mm/h, anemia, thrombocytopenia. Plasma cell infiltration was found in the sternal punctate. Make a probable diagnosis».

Role-playing is one of the most popular types of educational work among students of specialties 091 Biology and 014.05 Secondary Education (Biology and Human Health), as it is based on creativity and collective cooperation. The effectiveness of this method is determined by the quality of prior training of teachers and students. The main purpose of any role-playing game is to create a situation as close as possible to the real one, in which the student must perform the necessary professional actions, correctly apply the acquired knowledge, identify

the competencies [2]. The teacher prepares a game script, in which students can help him. The main components of the preparation and conduct of the game: the creation of the plot (a specific life or close to such a situation); plot processing; work with literary sources; distribution of roles; actions of game participants; analysis and summarizing. As for possible roles in the business game, the list of its participants is determined depending on its nature, content and purpose. The key point of role-playing games is the reincarnation of applicants in accordance with the roles played, which creates opportunities for improvisation, the development of reconstructive and creative thinking. The actions of the participants of the role-playing game are not strictly regulated, accordingly their course may deviate from the previously planned one. Such games convey simulations of life situations in which applicants take on the role of specialists in certain specialties (laboratory assistant, biology teacher, biology teacher, etc.) and make certain decisions. An example of such a game is «One hour of clinical diagnostic laboratory» or modeling and conducting a biology lesson in secondary school.

Another method used by scientific and pedagogical staff of the faculty is the project method, which originated in the United States in the 20s of the XX century. The ability to use it is an indicator of high qualification of the teacher [10]. J. Dewey, W. Kilpatrick and E. Collings started the method of projects in educational activity [5]. P. Blonskyi, V. Vakhterov, A. Makarenko, V. Sukhomlynskyi, S. Shatskyi and others noted the effectiveness of this method [8]. This method is attributed to the «technologies of the XXI century, which provide, above all, the ability to adapt to rapidly changing human living conditions in post-industrial society» [10].

The main features of the project method are: the presence of a significant research problem in terms of research, which requires integrated knowledge, research search to solve it; practical, theoretical, cognitive significance of the obtained results; independent activity; structuring the content of the project; use of experimental methods [10]. The advantage of this method is a strong connection between theory and practice, that teaches to plan the activities, develops the ability to observe, verify, analyze and summarize [9]. In addition, using this method the participants learn to work in a team, self-organize, express opinions, listen to others, learn to seek consent, develop a common opinion about what and how to do [12].

The main stages of project activities are preparatory, training and final. During the first there is the formation of groups of participants, the choice of topics, definition of the purpose, structure of the project and the form of its final product. At this stage it is necessary to determine what the project will be: individual, pair or group. If the project is pair or group, then it is

necessary to distribute responsibilities among the members of the group. As part of the training phase there is research, collection of information by applicants, its analysis, processing. At the final stage applicants prepare for the presentation of the final product, presentation of the final product, evaluation of project implementation [9].

Research and teaching staff of the department use research projects most often. Their implementation, first of all, takes place within the student scientific work. The results of group project activities can be presented in laboratory and practical classes, meetings of problem groups, research groups or in the form of qualifying work in the case of individual work.

The researchers note that when starting a project activity and moving from one stage to another, the teacher acts as a coordinator for independent search for knowledge, creative processing of information results. Since the project is planned and implemented by a student individually or in a group of students, this method provides favorable conditions for enhancing their responsibility, the formation of partnerships between project executors and the teacher.

In order to increase the mental activity of participants in the educational process an innovative method of «brainstorming», which involves joint group and creative work in the audience to solve complex problems or unusual situations, is used. It is advisable to use it at the very beginning of solving the problem. The problem is formulated as a question. At the first stage participants generate their ideas and suggestions. At the second stage there is an active discussion, classification and selection of the most promising proposals.

Recently the introduction of infographics in the educational process has become an important issue. It should be taken into account when teaching academic disciplines, that infographics fully reflect the content of educational material and correspond to the cognitive processes of higher education students during the assimilation of educational information. Research and teaching staff increasingly use modern methods, the purpose of which is to optimize and intensify the educational process. One of these is the «tag cloud» or «word cloud». It is an information technology created by marketers, and infographics in general were conceived as a tool of marketing communication.

«Tag cloud» is a list of shortcuts, categories or keywords of textual content that is a means of visualizing information (Fig. 1).

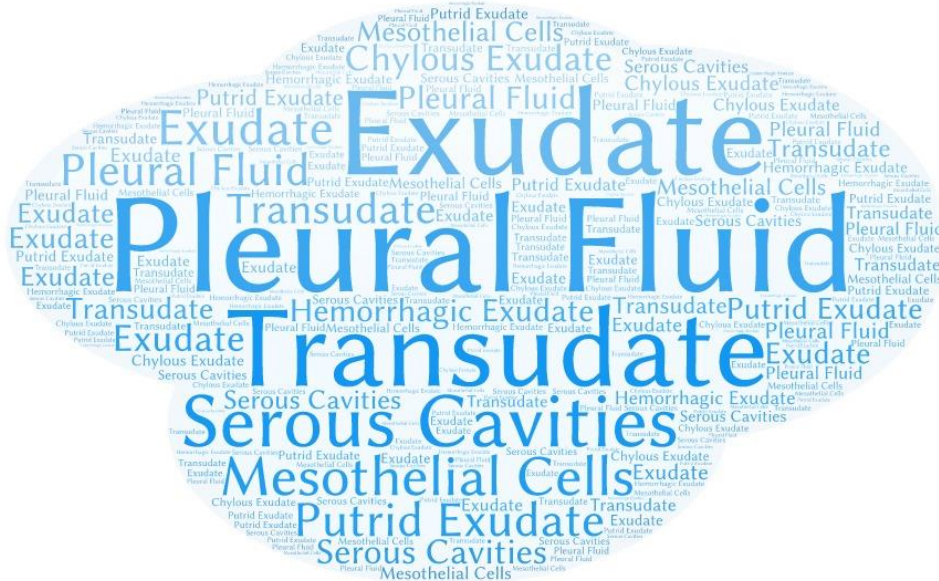


Figure 1. «Tag cloud» on the topic «Investigation of fluids from serous cavities» (scientific discipline «Laboratory diagnostics»)

Each word is a hyperlink and occupies a position in the cloud depending on the frequency of its use in the resource that is visualized. In addition, the «tag cloud» can be supplemented with new terms. Word clouds» due to its external attractiveness, ease of use and availability of resources to create are widely implemented in the educational process in not only secondary institutions, but also higher. This didactic resource is effective in teaching a number of educational components, including «Laboratory Diagnostics».

«Word clouds» in the class can be used as:

1. list of mandatory terms and concepts;
2. a resource for building associative series;
3. a way of generalizing the content of the text or other material for study;
4. a list of terms that should be followed during the oral interview.

Let's consider the example of the use of «word cloud» in the learning process. At the lecture after the announcement of the topic and purpose, the teacher can present a «tag cloud» on this topic. Students analyze it and during the discussion determine the range of concepts they will work with during the class. The «word cloud» can be used when presenting the lecture material, or when summarizing the lecture. «Tag Cloud» can be used as a tool to outline the purpose and main lessons of the classroom. This resource can be considered as a tool for memorizing terms. Sometimes it is difficult for applicants to remember terms. As a lot of people

have a visual type of memory and a bright visual perception of information, a cloud of words helps to memorize textual information.

To establish the effectiveness of the implementation of innovative methods and techniques, a research was conducted. To do this, the level of success of applicants for higher education was studied. Two groups of 15 students of the Faculty of Natural Sciences of Zhytomyr Ivan Franko State University, specialty 091 Biology of the first (bachelor's) level of higher education were selected for the experiment; the level of students' knowledge was approximately the same. It was established by the results of the previous examination session: the absolute indicator of the level of knowledge in both groups was 93.3%, and the qualitative indicator of the level of knowledge was 60%.

We analyzed the results of students' success in two groups: control and experimental during the study of the discipline «Laboratory Diagnostics». In the first group learning took place using traditional methods, in the second – using innovative methods («brainstorming», «tag cloud», role-playing games, project-based learning, case method). After studying five topics, students' knowledge was assessed, and the results are presented in Figures 2-6.

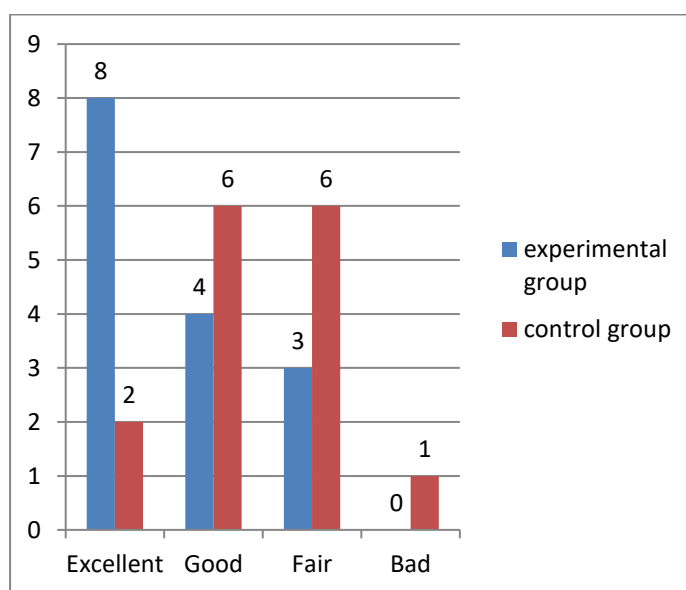


Figure 2. The results of student success on the topic: «Basic techniques and operations in laboratory research»



Figure 3. The results of student success on the topic: «Preparation, fixation and staining of blood smears»

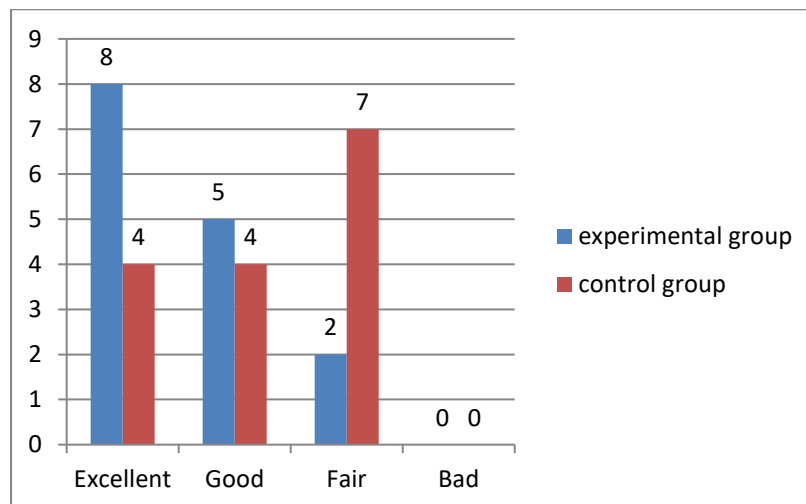


Figure 4. The results of student success on the topic: «General clinical blood test»

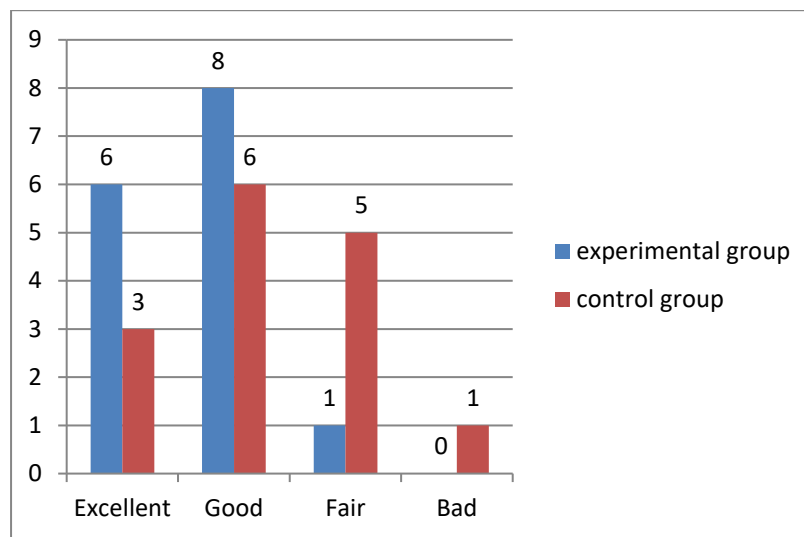


Figure 5. The results of student success on the topic: «Study of fluids from serous cavities»

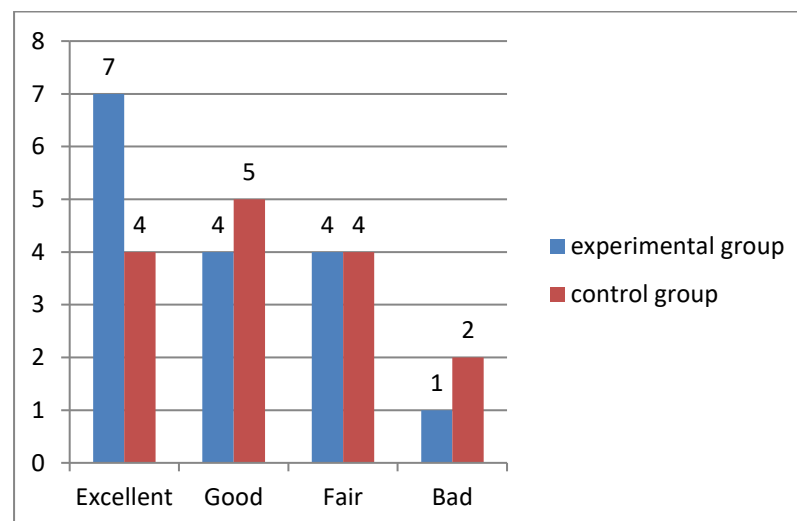


Figure 6. The results of student success on the topic: «Microscopic examination of urine sediment»

The qualitative indicator of the level of knowledge on five topics is presented in the chart.

The chart “Qualitative indicator of the level of students’ knowledge on the topics of the discipline «Laboratory Diagnostics»”

№	Name of the topic	The qualitative indicator, %	
		Experimental group	Control group
1.	Basic techniques and operations in laboratory research	80	53
2.	Preparation, fixation and staining of blood smears	80	67
3.	General clinical blood test	87	53
4.	Study of fluids from serous cavities	93	60
5.	Microscopic examination of urine sediment	73	60

According to the results of the study of the effectiveness of innovative teaching methods in relating to the discipline «Laboratory Diagnostics», the quality of knowledge of students who were trained using innovative methods was better by 13-34%.

In addition, the experimental group noted a constant interest of higher education students in the learning process, active acquisition of knowledge and skills, development of creativity, creative and critical thinking, designing future professional activities, the formation of professional competence.

Conclusions

The need to rethink the system of higher education in Ukraine in connection with Ukraine’s entry into a market economy, European integration, building an independent state, democratization of society, humanization of higher education, student-centeredness is substantiated. The essence of the concepts «method», «teaching method», «innovative teaching methods» is established. It has been found that, unlike traditional methods, which are mostly focused on the reproduction and consolidation of knowledge, innovative methods require students not just to reproduce information, but to create, because they contain an element of the unknown in their conditions. They involve the formation of new knowledge, skills, competencies and program results from students. Innovative teaching methods combine all

those new and effective ways of learning (acquisition, transfer and production of knowledge) that contribute to the intensification and modernization of the educational process, develop a creative approach and personal potential of its participants.

The introduction of innovative technologies in the educational process helps to train highly qualified, competitive biologists and biology teachers who are able to perform complex research, professional and creative tasks. Innovative methods help to train professionals who can think critically and choose the best solution in different situations.

The effectiveness of the use of innovative teaching methods in the preparation of higher education students in the specialty 091 Biology has been experimentally proved. The qualitative indicator of knowledge of students, whose education was conducted using innovative methods, was better by 13-34%.

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