Organization of the Educational Process on Natural Science Training in Higher Education Institutions on the Basis of Innovation and Heuristics

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Abstract: The relentless informational variability in the field of natural sciences, today's need for the training of highly competent, versatile, apologetic future specialists, as well as the low motivation of psychology students to teach natural disciplines, was established by us in the process of their questioning, require the search for new, non-standard solutions in the organization of natural science training of future psychologists in institutions of higher education. We believe that one of the effective ways to solve this problem is the organization of the educational process with the natural scientific training of future psychologists in higher education institutions based on innovation and heuristic. To organize the educational process from the natural science training of future psychologists on the basis of innovation and euresticity, there is a need to determine such ultra-innovation pedagogical technologies and teaching methods that will meet the requirements of the time, contribute to the formation of psychology students' motivation to study natural sciences and improve the quality and the effectiveness of natural science training. We have characterized pedagogical technologies, namely: coworking technology, barcamp technology, workshop technology, SMART technology, BYOD technology and such innovative methods as: lecture-visualization, video lecture, debates, round table, electronic brain assault, a laboratory experiment and a design-role-playing game, which, in our opinion, will contribute to the implementation of the educational process with the natural science training of future psychologists in higher education institutions based on innovation and heuristic.

Keywords: *future psychologists, natural sciences, coworking technology, barcamp technology, workshop technology, SMART technology, BYOD technology.*

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Introduction

The constant variability of information in the field of natural sciences, the need of today in the training of highly competent, well-developed future professionals, as well as low motivation of students of psychology to study natural sciences, which we found in the process of their questionnaires, require finding new, non-standard solutions in nature. training of future psychologists in higher education institutions.

We believe that one of the effective ways to solve this problem is to organize the educational process for natural science training of future psychologists in higher education on the basis of innovation and heuristics..

Problems of educational innovations in the organization of the process of training future specialists are covered in the research of L.P. Sushchenko, (2015), V.V. Khymynets, (2009) and other domestic and foreign scientists.

L.P. Sushchenko, (2015) substantiates the importance and expediency of organizing the educational process in higher education institutions on the basis of innovation by the need to meet the challenges posed to humanity in the XXI century, namely: "society's transition to a new development strategy based on knowledge and highly effective information and communication technologies."

In this context, V.V. Khymynets, (2009), insisting on the need to overcome "conservatism in approaches to educational activities and existing stereotypes in the thinking of its participants", rightly, in our opinion, argues that "only innovative education can educate a fully developed, self-sufficient individual who is guided by their own knowledge and beliefs, will be able to live in a modern globalized society".

The scientist notes that the organization of the educational process on the basis of innovation involves: a) changes in the content of the main subjects of the educational process by strengthening the functions, in particular, expanding the control over the formation of knowledge, skills and abilities to monitor the quality of educational activities; b) changes in the organization of the subjects of the educational process, namely: the introduction of so-called "free planning", when the student is allowed to determine the intensity and order of training with the mandatory performance of all necessary tasks for a certain period of time; joint cooperation of students and teachers in the process of forming the content of the discipline, independent and scientific work; c) changes in the means and forms of educational activities, in particular the provision of the educational process with computer and multimedia equipment; d) the transition from frontal forms of activity to individual and group; e) changes

in the socio-psychological climate, ie the reduction of psychological stress in all participants in the educational process V.V. Khymynets, (2009). From the point of view of V.V. Khymynets, (2009) on the importance of innovative approaches to the organization of the educational process agree O.Ya. Mytnyk, (2013), Yu.O. Liannoy, (2017), A.M. Khlopov, (2015); Nerubasska (2020), Melnyk (2019), Sheremet (2019), Gerasymova (2019), Onishchuk (2020), Maksymchuk (2020) and other scientists. O.Ya. Mytnyk, (2013) believes that the organization of the educational process in higher education institutions on the basis of innovation "increases the competitiveness of educational institutions", and Yu.O. Liannoy, (2017), supporting this view, argues that the organization of the educational process on the basis of innovation contributes to the active involvement of students in the organization of the educational process, the formation of sustainable positive motivation to learn, critical thinking, creative potential and creative transformation of knowledge , skills and abilities in the system of competencies ". According to the scientist, such an organization of students' education in higher education institutions provides for the "application of innovative educational technologies" Yu.O. Liannoy, (2017), among which he singles out the following: "technologies of problem-based and project-based learning, interdisciplinary, contextual and modular learning, portfolio development", as well as interactive case-study technologies; game technologies; simulation modeling; "Critical thinking" and "brainstorming"; discussions; "Round Table"; training; health technologies; Computer Technology".

A.M. Khlopov, (2015) also believes that improving the quality of student learning depends on the effectiveness of the introduction of innovative technologies in the educational process, and interprets them in broad and narrow meanings. According to the scientist, innovative technologies in a broad sense are "the process of creating and disseminating new tools (innovations) to explain those pedagogical problems that have been solved differently, and the result of a creative search for ways to solve various pedagogical problems", and in the narrow - "forms and methods of teaching, non-standard approaches to management" A.M. Khlopov, (2015).

Sharing this view, L.M. Krivshenko, (2017) believes that among the leading educational technologies is "the method of heuristic learning and its component - heuristic learning dialogue, which combines heuristic dialogue between teacher and student."

S. Genkal, (2016) according to L.M. Krivshenko, (2017) argues that in the methodology of teaching biology, innovative technologies, in particular heuristics, are not widely used by teachers of higher education

institutions. According to the scientist, heuristic learning in biological education should be represented in all components of the educational process, among which it distinguishes the following: "a) targeted, which, provided the organization of the educational process on the basis of heuristics, involves the ability to formulate goals and to problems; choose a goal from several, establish their interaction and carry out specification taking into account the power of means to achieve it; to substantiate the choice of the purpose of activity and to rank the purposes on term of their achievement; b) semantic, the features of which in these conditions are: compliance with the curriculum for the development of biological science; increasing the volume of the conceptual apparatus and the depth of mastering the concepts; increasing the number and complexity of training and special skills; providing opportunities for self-determination; increasing attention to interdisciplinary links; actualization, deepening, expansion and generalization of knowledge, improvement of skills and abilities of research activity; c) activity, which, in the context of heuristic learning, embodied in the system of heuristic methods ("brainstorming", heuristic observation, semantic, figurative and symbolic vision, method of heuristic questions, method of comparison, method of specific situations, method of facts and construction of concepts, theories , rules or hypotheses, error method, research method, discussion method, role play) and forms (heuristic conversation, heuristic lectures, "Socratic lecture" or lecture-dialogue; lecture of theoretical construction; lectures with the use of cultural-historical analogies; generalizing and review lectures), heuristic seminars (search seminars, project seminars, problem-solving seminars, round tables, business games seminars, educational project defense seminars, analytical seminars), d) effective - application of the heuristic system and pedagogical support of heuristic activities (correction of students' work and teacher's assistance in determining the results of their activities) S. Genkal, (2016) .

Summing up the results of his research S. Genkal, (2016) argues that the didactic possibilities of the educational process in higher education, based on the principles of heuristics, are "improving the efficiency of learning, the ability to form cognitive motives, strong knowledge and competence of students, creative activity during the study of biology and in the course of self-education, the application of acquired knowledge in practice, promoting the development of creative thinking and skills of productive activity, reflective skills and creative abilities.

O. Khutorsky, (2020) shares the opinion of S. Genkal, (2016), but emphasizes the need to separate heuristic forms and methods of learning from forms and methods heuristic learning. Heuristic forms and methods of

learning, according to the scientist involve the discovery by schoolchildren / students of new for them (in the studied subjects or educational areas) learning outcomes, which they represent in the form of ideas, projects, etc., and forms and methods of heuristic learning are aimed at independent discovery by pupils / students of learning outcomes and creative preparatory and accompanying work, namely: planning, control and reflection on mastering the basic content of education, its evaluation, i.e. is a broader concept.

Considering the above, we believe that for the organization of the educational process with the natural scientific training of future psychologists on the basis of innovation and euresticity, there is a need to determine such ultra-innovative pedagogical technologies and teaching methods that will meet the requirements of the time, contribute to the formation of psychology students' motivation for learning naturally - scientific disciplines and improving the quality and effectiveness of natural science training.

Effective pedagogical technologies in higher education institutions on the basis of innovation and heuristics

In this context, we would like to note the fact that in the reality of the application of a large number of pedagogical technologies and teaching methods in higher education institutions, there is no common and unambiguous opinion of scientists on the criteria influencing their choice.

Therefore, taking into account the above conclusions of scientists on the research problem, and the experience of their own pedagogical activities, we believe that for the organization of the educational process of natural science training of future psychologists in higher education on the basis of innovation and heuristic pedagogical technologies will be effective. organization of educational activities and tactics of educational implementation.

Such pedagogical technologies include: coworking technology, barcamp technology, workshop technology, which in the world educational space are treated as co-working technology, BarCamp technology, Workshop technology, respectively, as well as SMART and BYOD technologies.

Let's analyze them in more detail.

A theoretical analysis of scientific sources showed that coworking (from the English Co-working - joint work or work together) is a relatively new concept of organizing activities, for each area has its own specific features. It is important for us to find out the reasons that contributed to the

introduction of coworking technology into the educational environment, its capabilities, advantages and disadvantages, principles of creation and functioning. In this context, following the results of scientific research T.V. Mayasova, (2018), who emphasize that the introduction of coworking technology into the educational environment is due to the need to expand proposals for the growing demand for research and project training technologies; popularization of such areas of education as natural science and technical; improving the quality of education.

Such scientific views are shared by E.B. Khalmurzaeva, (2018), who interpreting coworking technology as a way of organizing the educational process, which aims to create an informal genetically open to innovation and experimentation interdisciplinary environment, argues that this technology can become a leader in innovation development higher education institution, as it provides participants in the educational process with more space, opportunities and time. Thorough analysis of the scientific work of E.B. Khalmurzaeva, (2018) on ways to apply coworking technology provided an opportunity to find out that the scientist describes several options, namely the creation of: a) external research and educational coworking, among which distinguishes: cooperation of research institutions or other organizations with scientists and students higher education on the basis of a scientific institution, organization, which provides for the implementation of various educational and scientific activities on the basis of informal cooperation of scientists, practitioners, university staff, students, as well as the association of innovation, science, education and business; and coworking spaces "free space": "training club", "platform for education", "training center" - which are interpreted by the scientist as an alternative to a traditional educational institution (higher education institution) and aim to increase the level of education of coworking participants through informal cooperation ; b) hybrid coworking - involves the cooperation of public organizations, research institutions, enterprises and educational institutions in the process of which coworking participants to achieve a common goal have the opportunity to use the material, technical, methodological base and the results of joint work of each of them; c) internal educational coworking, the creation of which provides free access of coworking participants to all educational buildings of the educational institution, their funds, library areas, conference halls, etc. Introduction of this type of coworking, believes E.B. Khalmurzaeva, (2018), should be carried out on a permanent basis as long-term, for example, to ensure the educational process: conducting lectures, seminars, practical and laboratory classes, and short-term - to conduct workshops, courses, trainings.

Scientists G.O. Ignatieva, (2016), interpreting coworking as a plot-activity pedagogical technology, which can be used to implement a new format of the educational process, believe that this technology involves an informal exchange of knowledge, information and free communication.

According to E.M. Akhmedova, (2017), the organization of the educational process in higher education institutions with the use of coworking technologies opens up to teachers and developers of educational programs prospects for cooperation with students and potential employers; will promote the rapid updating of training modules taking into account the needs of students, the development of science and the demands of the labor market.

S. Babych, (2014) agrees with the above views, but still, emphasizing the benefits of coworking such as: the formation of a community of interests, the opportunity for its participants to constantly exchange ideas and experiences, professional growth, mutual assistance in projects, emphasize and its shortcomings, namely: the cost of time and money on the way to the coworking center and back, minor events that may arise and divert attention from solving the main tasks of cooperation in the absence of control "from above".

An indicator of the effectiveness of the use of coworking technology in the educational process of higher education, according to T.V. Gromushkina, (2016), should be: a high level of formation of subject and communicative competencies of students; their adaptation to professional activity; ability to objectively self-assess one's own capabilities; developed corporate culture.

T.M. Smagina, (2019) interpreting coworking technology as a new set of interconnected actions and procedures aimed at transforming the educational space, where the formation of theoretical knowledge into a territory for the formation of competencies and providing quality educational services, identifies the basic principles according to which it is created and operates educational coworking, namely: openness, accessibility, infrastructural support of activities, the presence of a community of like-minded people, their independence and free communication, the opportunity to exchange ideas and help each other in professional growth.

So, within the framework of our study, coworking technology will be interpreted as a modern pedagogical technology, the result of which is the creation of an open, naturally directed scientific and educational coworking space based on informal cooperation of research institutions, higher educational institutions, departments (faculties, institutes) in within one institution of higher education, institutions of professional practice, informal

real and virtual cooperation of scientists, including foreign ones, - natural, medical, pedagogical and other industries, - teaching practitioners, practicing psychologists, psychology students, the coordination center of which is located on department, the teachers of which carry out the natural science training of future psychologists in a specific institution of higher education.

At the National Pedagogical University named after M.P. Drahomanov's natural science training of future psychologists is already carried out today with the use of coworking technology, which is manifested in informal cooperation of the Department of Medical-Biological and Valeological Fundamentals of Life and Health of the Faculty of Pedagogy and Psychology with research institutions (Ecological and Naturalistic Center, O.O. Bogomolets Institute of Physiology of the National Academy of Sciences of Ukraine, Krakow Pedagogical University named after the Commission of Public Education (Krakow, Poland) - educational and scientific cooperation, D.F. Chebotaryov Institute of Gerontology, National Academy of Medical Sciences of Ukraine - educational cooperation, National Museum of Medicine Ukraine - cultural and educational cooperation) and institutions of potential employers, namely, organizations where students of psychology carry out educational and introductory practice (G.S. Kostyuk Institute of Psychology of the National Academy of Pedagogical Sciences of Ukraine, National Academy of Pedagogical Sciences of Ukraine "Academy of Psychological Science and Practice", Public organization "Ukrainian Association of Specialists in Overcoming consequences of traumatic events", Kyiv Gestalt University, Scientific and Methodological Center for Practical Psychology and Social Work, LLC" OS Ukraine ", Commercial Medical and Consulting Center" Kardeya ", Charitable Foundation" SOS Children's Town ", etc.) - educational and practical cooperation), during which coworking participants to achieve a jointly defined goal have the opportunity to use the material, technical and methodological base of each of the participants, jointly hold conferences, seminars, workshops, etc.

In our opinion, the organization of the educational process of natural science training of future psychologists, its theoretical or practical component in particular, with the use of coworking technology allows to unite in a single plane educational services provided in higher education institutions of Ukraine and the world, modern scientific achievements in natural sciences and future practical activity of students-psychologists that will promote overcoming of their negative attitude to natural-scientific preparation, increase of motivation in the course of training of natural-

scientific disciplines and formation of a high level of natural-scientific competence.

According to K. Fopel, (2010), the modern labor market wants to get not only competent but also creative, analytically thinking professionals who are ready to take responsibility for decisions..

Such modern requirements motivate us to supplement the usual format of the organization of the educational process of natural science training of future psychologists, which is carried out in higher education institutions in original ways of interaction of its participants..

We believe that barcamp technology and workshop technology can be useful here. We justify our choice. During the analysis of scientific sources, we found that the feasibility of using barcamp technology (from the English. BarCamp - open interactive meetings of people whose goal is to exchange ideas and experiences in the organization of the educational process in higher education institutions of Ukraine and the world focused their attention on both domestic and foreign scientists, namely: L.Yu. Sultanova, (2018), K.L. Trushnikova, (2015), D. Topps, (2017), and others. K.L. Trushnikova, (2015), in particular, interpreting barcamp technology as a new format of educational activities, organizational issues of which participants decide independently, notes that it is appropriate to use it for conferences, debates, discussions, training seminars. The success of the introduction of barcamp technology, according to the scientist, depends on the degree of activity of all participants in the educational process, namely: the desire to communicate and work together, express their views on the problem and formulate conclusions based on facts proposed by other participants. The use of barcamp technology in the educational environment, argues K.L. Trushnikova, (2015), will be able to solve several problems, in particular, it develops students' ability to work independently with scientific sources and master practical knowledge; ability to think analytically and substantiate generalizations and conclusions; communication skills and teamwork.

L.Yu. Sultanova, (2018), referring to the fact that barcamp technology is spreading around the world and involves the active exchange of knowledge on the basis of open interaction of all participants, also supports the feasibility of its use in organizing seminars, educational trainings, speeches, presentations, workshops.

Foreign scholars D. Topps, (2017) interpret barcamp technology as an innovative educational technology that provides free exchange of knowledge, formation of skills to work in a team to achieve a common goal and skills on the basis of open, voluntary and motivated, informal and

democratic way of communication between participants. non-standard and creative approach to solving problems and decision-making and outlining tasks for further research.

Given the above, we believe that barcamp technology is of great didactic importance for the organization of scientific training of students of psychology as a component of natural science training, which is carried out in higher education institutions. The introduction of this technology, in our opinion, will increase the motivation of students-psychologists to carry out scientific activities and natural science self-education, internal organization and responsibility, the formation of interest and need for scientific creativity and independence, deepening and strengthening the scientific sciences. knowledge, development of creative thinking and creativity.

Scientific training of future psychologists involves the participation of student psychologists in the activities of scientific circles and problem groups that have a natural science orientation. Traditionally, the initiators of the creation of student research groups and problem groups were teachers of specialized departments.

In this context, we consider it appropriate to emphasize that the methodology of meetings of important student scientific communities is also based on the principles of barcamp technology, in particular, the main speakers at the meetings are always students, and the teacher acts as co-speaker, while, traditionally, the teacher was the main actor, and the student - the secondary, he was given the role of co-speaker. Discussion of problematic topics takes place in the format "What? Where? When? ", according to the script of which, students also play leading roles.

In conditions when a significant amount of educational material students have to master independently the organization of the educational process with the use of workshop technology (from the English - workshop) in higher education is gaining popularity.

Analysis of scientific sources makes it possible to identify the main approaches of scientists to the interpretation of the concept of "workshop".

Thus, in pedagogical practice, "workshop" is interpreted as a technology aimed at developing communicative and leadership qualities of students O. Minina, (2012); as an educational event, the participants of which gain knowledge due to the high intensity of group interaction, activity and independence of everyone, available experience and personal experience K. Rechka, (2020); as an intensive educational event, during which participants learn independently through their own activity Ya.L. Katyuk, (2020). The given examples of interpretation of the concept of "workshop"

give grounds to conclude that most scientists associate it with active independent learning of pupils / students.

In the framework of our research, we will use the interpretation of the concept of “workshop”, which is proposed by K. Fopel, (2010). So, according to the scientist, the workshop is a modern technology of organizing the educational process, the focus of which is focused on the independent learning of students, is built on the basis of intensive group interaction and is aimed at obtaining dynamic knowledge K. Fopel, (2010).

We believe that the use of the workshop technology for organizing classroom and extracurricular independent work of psychology students, which is carried out by them within the natural science training in higher education institutions, will allow teachers to form their understanding of the importance of natural science self-education and the need to carry it out now and throughout their lives.

Note that at the Department of Biomedical and Valeological Foundations of Life and Health Protection of the Faculty of Pedagogy and Psychology, National Pedagogical University named after M.P. Drahomanova workshop technology is used in the creation and presentation of copyright natural science projects by psychology students, to be treated, according to the decision of the department teachers, as their independent work in all disciplines of the natural science cycle.

The impetus for the study of the possibilities of using SMART-technologies in the organization of the educational process of natural science training of future psychologists in higher education, as a factor that will enable such training on the basis of innovation and heuristics, were the results of our previous analysis of natural science training future psychologists in the world's leading higher education institutions, which are covered in detail in the third chapter of this work, and point out that SMART-technologies are an integral part of the organization of the educational process of natural science training in foreign higher education institutions.

Note that the analysis of reference sources did not give a positive result on the linguistic interpretation of the concept of "SMART". We managed to find out that it is an abbreviation of qualities, namely: specific - specificity, measurability - measurability, achievement - reachability, relevance - relevance, temporary limited - time constraints that characterize the relevant type of technology.

The results of the analysis of the scientific literature give grounds to claim that scientists N. Gubriy, (2014), N. Dobrovolska, (2014), etc., studied

various aspects of SMART-technologies. We will briefly highlight those of them that, in our opinion, will be useful for our study.

Thus, N. Gubriy, (2014), interpreting SMART-technologies as informational and highlighting such positive aspects of their implementation in the educational process of higher education institutions as: "the ability to apply in the teaching of various disciplines; promoting interest in learning and the effectiveness of students' acquisition of knowledge, as well as the development of creative potential; ", convincingly and arguably prove that in today's conditions for the introduction of SMART-technologies in higher education, along with the traditional application package: Microsoft Office , Word, Excel, Power Point, which are already actively used in the process of teaching students, other logistics is needed. Scientists-educators emphasize the expediency of using an interactive whiteboard and software for it, namely: "Smart Notebook". They are convinced that the Smart Notebook's interactive whiteboard, which helps the teacher to write, select, pin and move objects, add images, pictures and photos, is the multimedia tool that will help him modernize the educational process and to create an atmosphere of interactivity in which students will not only study the material, but also cooperate, receiving positive impressions from the lesson, which will motivate them to learn and improve performance "N. Gubriy, (2014).

N. Dobrovolska, (2014) generally agrees with this opinion, however, believes that the effectiveness of the interactive whiteboard will increase if you expand its software. She argues that in combination with the program "Smart Notebook", the teacher should use the learning opportunities of the programs "Bridgit" and "SynhronEyes". The same point of view is held by I.S. Yevsyukov, (2018), who notes that each program has its own resources and functionality, so, "Smart Notebook", according to I.S. Yevsyukov, (2018), allows you to perform any operations with text and data, "Bridgit" - remote presentations with the ability to receive comments, and "SynhronEyes" - to diagnose scientific and educational achievements of students and present their results on the board or send from the general board to all computers.

In addition, N. Dobrovolska, (2014) made attempts to justify the benefits of classes based on SMART-technologies. Thus, the researcher considers the advantages of SMART-lecture to be the opportunity for students to "fully focus on the essence of the lecture material", explaining that "students no longer need to take notes in detail, because after the lesson you can get an electronic version." The advantages of SMART-laboratory and practical classes, according to the researcher, are even more

pronounced. In this context, N. Dobrovolska, (2014) notes that the organization of laboratory and practical classes based on SMART-technologies allows the teacher "not to spend time writing tasks, creating drawings and diagrams on the board, and use the capabilities of software included in the interactive boards, namely: to move and modify objects, to record sequence of actions of users of a board, to establish hyperlinks, etc. "that will make such occupations productive and creative".

Thus, we believe that the use of SMART-technologies in the organization of the educational process of natural science training of future psychologists in higher education will allow teachers to creatively design the educational process and implement it in the form most acceptable to the current generation of students. All this together, will increase the interest of students of psychology in scientific knowledge and motivation to master them, will form in them creative thinking and the ability to find different ways to solve one problem, if necessary, using the obtained during natural science training in institutions of higher education with knowledge, skills and abilities.

Taking into account the statement of UNESCO, (2020) that mobile devices can contribute to the efficient use of time in the classroom and improve the quality of education, we consider it necessary to investigate this problem and determine the feasibility of using mobile devices. in the process of organizing the educational process of natural science training of future psychologists in higher education institutions.

We find that BYOD technology, derived from the acronym "Bring Your Own Device", is especially popular with both teachers and students today.

Analysis of scientific works of Yu. Bilyavska, (2018), V.P. Wember, (2019) and others. indicates the interest of researchers in the field of education in this technology. Yu. Bilyavska, (2018), in particular, interpreting BYOD-technology as one that involves the use of a mobile phone as an additional source of information when students perform various classroom and independent extracurricular tasks, emphasizes the factors that should be taken into account when planning, organizing and teaching such technology, namely: the teacher must: take into account the ability of students to learn BYOD-technology, as mobile applications can usually be accessed only on one of the operating systems of a mobile phone: Android, iOS or Windows; to get acquainted with the appendix in advance in order to make a conclusion about its compliance with the topic of the lesson and its usefulness for students; check its availability each time before use, as the possibilities for use may be limited (demo version).

Exploring the functionality of BYOD-technology, V.P. Wember, (2019) argues that it is appropriate to use it to diagnose the effectiveness of educational activities at different stages of the lesson: for initial assessment before work, for formative assessment in the process, as well as at the end of the lesson. In this context, the scientist notes that virtual boards, such as padlet.com, trello.com, www.twiddla.com, can be used to assess the initial level of students' knowledge, on which students can place answers to the teacher's questions. If the survey involves diagnosing the level of students' mastery of educational material or identifying students' interests, it is advisable to use such services as: kahoot.com, mentimeter.com, triventy.com, socrative.com. In this case, convinces V.P. Wember, (2019), students can provide their answers from their own smartphones or tablets. In addition, V.P. Wember, (2019) also focuses on the possibility of using BYOD-technologies by teachers of higher education institutions when creating interactive exercises for students. In this case, the scientist recommends to contact the online service learningapps.org and use its templates.

We agree with the above conclusions of scientists on the prospects of implementation and application of BYOD-technology in the educational process, which takes place in higher education, and consider it appropriate to express their views on the prospects of using its capabilities to organize the educational process for future psychologists. In our opinion, the use of BYOD-technology to teach students of psychology disciplines of the natural science cycle, namely such mobile applications as: "NeuroSlice" and "iSurf BrainView", which involve the study of human brain structures based on MRI images; "Neuroanatomy - Digital Atlas" (allows to study the anatomical structures of the human brain in layers and to substantiate the clinical manifestations of its various pathological conditions); "Brain - classification of departments with a description" - a program in which the main emphasis is on the study of human brain functions; "Cerebrum ID" - an application that contains information about the normal structure of the human brain and is accompanied by interactive 3D models of its structures; "Neuro Anatomy Next" (allows you to study the topography of the cranial nerves using 3D models of the human skull); "My Brain Anatomy", which allows students to work with a 3D model of the human brain on a smartphone screen and study its structure; as well as mobile applications that allow students to assess the level of formation of subject competencies, namely: "Daily Anatomy: Flashcard Quizzes to Learn Anatomy" - flashcards on anatomy, which allow you to check the initial level of knowledge of students about the structure of the human body and its organs and systems; "Quiz:

Anatomy" and "Easy anatomy - atlas & quizzes" (programs for intermediate control of the effectiveness of the educational process in the discipline "Anatomy and physiology of the nervous system"); "Anatomy. Tests "- a program for reflection on the relevant discipline and other programs, will help not only the formation of future psychologists interest and motivation to carry out scientific training, but also increase the level of activity in the process of such training and satisfaction with the results.

Listening to lectures by students

We consider it expedient to emphasize that despite the conclusions of the American educator E. Dale, (1969) (Fig. 1), that the usual listening to lectures by students is one of the most inefficient ways to master something, which the scientist came to in 1969, in In higher education institutions, verbal methods still occupy a leading place among teaching methods.

Fig. 1. Edgar Dale Learning Cone Scheme (current interpretation)

Modern scientists T. Derkach, (2016), A.B. Kovalenko, (2009), Yu.A. Rudenko, (2019) and others, sharing Edgar Dale's point of view, also claim that during traditional lectures, which provide a monologue way of teaching material by the teacher, students memorize only 15% of the information.

The above, as well as our own experience of pedagogical activity, encourages us, when organizing the educational process from the natural scientific training of future psychologists in higher education institutions,

along with traditional teaching methods, to apply such modern and innovative methods as: lecture-visualization, video lecture, debates, "round table", "electronic brainstorming", laboratory experiment and design-role play.

Lecture-visualization, according to T. Derkach, (2016), is "one of the most promising teaching methods in higher education institutions." Treating it as a "lecture of an innovative type" by T. Derkach, (2016), the researcher claims that it "allows the teacher to turn oral and written information into a visual form, creates a better basis for theoretical knowledge in the minds of students, forms imaginative thinking and helps to increase assimilation information up to 65%".

A.B. Kovalenko, (2009) supporting the views of T. Derkach, (2016) on the effectiveness of lecture-visualization and noting that it "deepens understanding of the problem, topic, teaches students to use different sign systems", emphasizes its negative features such as: complexity of perception and annotation of educational material".

The main advantages of the lecture-visualization Yu.A. Rudenko, (2019) include the following: high quality of psychological-pedagogical, methodical, linguo-didactic potential of teaching the material and visual perception of information; creation of a positive emotional and intellectual educational environment for effective mastering, analysis and synthesis of educational material and dialogic communication in the systems "student-teacher", "student-student" and "teacher-technical device-student"; increase motivation to master the educational material".

Taking into account the positive aspects of the lecture-visualization, as well as in order to avoid the manifestation of their identified negative factors that may arise in the process of its implementation, we consider it appropriate to visualize lectures on science training of future psychologists in higher education through interactive program mozaBook.

Using the possibilities of this program in the process of our own pedagogical activity, we are convinced that the mozaBook software helps: to provide the teacher with illustrative, presentation and animated lectures for future psychologists in the disciplines of natural sciences; interactively perform experiments and demonstrate their results on the screen. Interestingly, a teacher who uses the mozaBook program has the opportunity to visualize not only lectures, seminars or practical classes, but also tools for diagnosing the academic achievements of student psychologists. A variety of images, videos, audio files and 3D models can be used for this purpose, which allows to analyze the results of not only theoretical but also practical preparation.

So, the lecture-visualization within the framework of our research is interpreted as an interactive explanatory and illustrative method of teaching natural science disciplines, increases the interest of future psychologists in natural science training, helps them to master the educational material with ease and contributes to an increase in the percentage of its availability, activates the cognitive activity of students and forms their imaginative thinking.

Another method of teaching, which we interpret as explanatory and illustrative and consider appropriate in the process of organizing the scientific training of future psychologists, which is carried out in higher education institutions, is a video lecture. Let's analyze the opinions of scientists on the effectiveness of video lectures in the educational process in higher education institutions.

Thus, G. Bushchak, (2016) interpreting video lecture as an innovative method of learning in the information society and a well-prepared and well-thought-out audio-video presentation of educational material, which is recorded on physical media, believes that it activates students' cognitive activity, promotes in-depth understanding of the topic and problems, the development of spatial thinking, increasing the level of memorization of information to 55-65%, the formation of their skills to use different technical means of learning.

O.B. Moskalenko, (2016) interpreting a video lecture as a visual method of presenting lecture material, which allows you to briefly or comprehensively comment on the video clips, videos or videos presented at the lecture and distinguishing five types, namely: introductory (used when the teacher introduces students to field of knowledge); motivating (can be used in the advertising aspect); information (contains certain information about any areas of knowledge); educational (solves educational problems of any educational course or discipline); popularization (popularization of the university, specialty, discipline, etc.), generally shares the above scientific provisions, but warns that improperly organized video lectures can lead to the formation of student infantilism and the development of cognitive and creative passivity, loss of feedback between teacher and student; inability of the teacher to timely control the quality of students' mastery of educational material and adjust the educational process.

V.P. Wember, (2016) interpreting the video lecture as a method of teaching that helps to diversify the types of educational activities, demonstrate the advanced nature of education and meet the needs of the Net-generation, agreeing with the reservations of O.V. Moskalenko, (2016) and believe that in order to avoid undesirable consequences from the use of

video lectures, it is necessary to use quality media resources, media tools and multimedia products.

Note that within the framework of our research, the video lecture will be interpreted as an explanatory and illustrative teaching method, which requires the teacher's creativity and ability to use modern technical means and Internet resources and allows him to quickly change the content of natural science disciplines, modules or individual topics, complementing its results with modern natural scientific achievements, and, taking into account the needs of psychology students, to facilitate their perception and mastering of educational material and increase their motivation to study natural sciences and natural science training.

Problem-discussion methods of teaching

Another group of methods that, in our opinion, will contribute to the implementation of natural science training of future psychologists on the basis of innovation and heuristics in our model of natural science training of future psychologists in higher education is interpreted as problem-based teaching methods. Let's analyze them in more detail.

The experience of own pedagogical activity gives grounds to assert that debate (from the French word "debate" - discussion) is now a fairly common method of teaching, which involves the coverage of each participant's views on the chosen topic and reasoned persuasion of each other in the importance and correctness of their position.

We consider it appropriate to emphasize that the peculiarity of the debate as a form of discussion is that there is no controversy between opponents. Questions in the debate are asked only in order to determine the strengths and weaknesses of the opinion.

The organization of classes on natural science training of future psychologists using the method of debate provides: preliminary definition of the topic and formulation of its main discussion issues; formation of two opposing teams, the leading speakers of which will announce and present their arguments and try to provoke the reaction of the opposition team to hear controversial evidence, and the team of observers is formed of students who will not be speakers during the debate, but can ask questions to speakers after their completion, to express opinions about what was happening; determination of the rules of speeches, forms of analysis and criteria for evaluating the debate.

For example, in a seminar on "Ecology" with our participation, a debate was held on the topic "The impact of environmental factors on the mental health of children and adolescents." During the debate, the keynote

speakers of the opposing teams presented and presented pre-prepared arguments proving their fairness, as well as provisions that contradicted the position of the opposing team.

At the end of his speech, a speaker from one opposing team answered the questions of the lead speaker from the other team or members of his team or the team of observers.

During the debate, all speeches and answers to questions took place in accordance with certain regulations, which were monitored by a time manager chosen by students of psychology.

At the end of the debate (8-10 minutes before the end) a reflexive analysis of their results was conducted by discussion and open voting of the members of the observer team.

In our opinion, the debate that in the framework of this study we interpret as a modern problem-discussion method of teaching, contribute to the development of students-psychologists analytical-dialectical thinking; ability to use the knowledge obtained in the process of natural science training to substantiate their own position; formulation of design and creative skills; skills of friendly and tolerant attitude to the opponent and diplomatic consensus.

Another problem-discussion method of teaching, which, in our opinion, will be effective in the process of natural science training of future psychologists in higher education is the method of "round table".

We believe that this method, like the previous one, should be used in the course of seminars. We emphasize that the effectiveness of the method of "round table" depends on compliance with certain rules, namely: a) the choice of topic: it must be relevant, interesting and specific; b) formulation of questions for discussion: they should not be many, they should be precise, clearly formulated and not beyond the topic; c) forecast of the scenario implementation: anticipate possible discussions, interest, activity or passivity of the participants; d) venue: it is not necessary to have a round table, but the participants of the discussion should be able to see each other in person; e) training of participants: there should be no more than 15 of them and it is necessary to provide them with certain responsibilities in advance; c) training of the moderator: must be able to organize activities on the principle: "all participants of the round table are equal to each other."

For example, in the process of teaching the discipline "Fundamentals of Modern Neurobiology", which in the working curriculum for future psychologists at the National Pedagogical University named after M.P. Drahomanov is singled out as a selective discipline of the natural science

cycle, we organized a seminar in the form of a round table on "Creating individual health programs for people with drug addiction."

In order to get closer to the real conditions at the round table, students of psychology played the role of invited representatives of various medical and psychological rehabilitation centers, NGOs, educational institutions, research institutions, which in small personal reports covered the following issues: brain mechanisms of drug addiction; changes in brain structures: basal ganglia, enlarged tonsils and prefrontal cortex, leading to the formation of drug addiction; genetic drug addiction; general organizational and methodological aspects of rehabilitation of drug addicts; features of rehabilitation of drug-addicted children and adolescents; restorative possibilities of various methods of rehabilitation of drug addicts.

During the meeting, the participants of the "round table" exchanged views on the effectiveness of various methods of drug prevention, discussed proposals for the rehabilitation of people of this nosological group, discussed the advantages and disadvantages of various health programs currently used to rehabilitate people with drug addiction and formulated a common strategy on the creation of individual health programs for drug-addicted children and adolescents.

We believe that the use of "round table" as a method of teaching in the process of natural science training of future psychologists in higher education contributes to the deepening of theoretical knowledge acquired by student psychologists, the development of their creative thinking, the formation of skills to prove their own scientific positions and persuade others, strengthening the research activities of future psychologists in the field of nature.

An equally effective problem-discussion method of teaching students-psychologists of natural sciences in higher education institutions, as practice shows, is the method of "brainstorming".

We consider it expedient to emphasize that in scientific and methodological literature sources we do not observe an unambiguous definition of the term "brainstorming method". Domestic and foreign scientists interpret it as: a method of solving urgent problems in a limited time Y.M. Savka, (2012), etc., a method of finding solutions in the process of joint expression of opinion O.A. Sorochnytska, (2016); creative problem solving A.F. Osborn, (1963).

In the sphere of our study, "brainstorming" will be interpreted as a modern problem-discussion method, in particular as "electronic brainstorming" (in the world educational space, this method is interpreted as Computer Supported Brainstorming), carried out using innovative

technologies and helps students-psychologists to better comprehend the educational material on the disciplines of the natural science cycle, improve their skills to apply theoretical scientific knowledge, develop skills to creatively solve problems, strengthen cognitive interest and activity in the process of natural science training in higher education.

Note that the method of "electronic brainstorming" is actively used by teachers of the Department of Medical-Biological and Valeological Fundamentals of Life and Health of the National Pedagogical University named after M.P. Drahomanov in the process of teaching all disciplines of the cycle of natural science training, but, for example, we will demonstrate its application in the study of "The current state of health of the population of Ukraine" in the discipline "Fundamentals of Medical Knowledge and Children's Health". To update the knowledge on the outlined topic, we offer students a problem to discuss "Stressful diseases of the XXI century."

We emphasize that the method of "electronic brainstorming" involves the use of the above SMART and BYOD technologies.

Thus, the teacher from his computer with the help of a multimedia projector highlights the problem for discussion on an interactive whiteboard (SMART technology is used). Students, using their own mobile phones or tablets (BYOD-technology) using the WI-FI network, send to the teacher's computer their assumptions and suggestions for its solution. The teacher, without analyzing or commenting, translates them to an interactive whiteboard (SMART-technology).

When the teacher has finished covering on the interactive whiteboard all the assumptions made about solving the problem, all participants in the educational process participate in their discussion, systematization and grouping by similarity, analysis of critical remarks on each idea and, finally, choose those that do not were rejected.

We see the advantages of electronic brainstorming over verbal assault in saving time (no need to spend time writing ideas on the board) and reducing anxiety, students' fears about evaluating their assumptions (the author of the idea is not mentioned on the interactive whiteboard).

The disadvantages of the "electronic brainstorming" method include the inability to avoid duplication of proposed solutions, but this issue is easy to solve when analyzing and grouping them by similarity.

The expediency of using laboratory experiment and project-role play in the process of natural science training as methods that will facilitate such training on the basis of innovation and heuristics is justified by using the above research by E. Dale, which convincingly and arguably proved that most information (90%) people remember, performing actions or imitating

role activities, as well as guided by their own experience of teaching and beliefs that these methods will help future psychologists in consolidating and storing in long-term memory of theoretical knowledge from the disciplines of science, formation they have skills in a particular discipline and research skills.

The same point of view is held by V.V. Petrenko, (2008) and M.V. Kryvoruchko, (2013). So, V.V. Petrenko, (2008) argues that the use of laboratory-experimental methods of teaching biology contributes to "the formation of students' scientific worldview, better knowledge of the nature of phenomena and their conviction that scientific theories that form theoretical knowledge reflect objective reality, and practice is criterion of truth.

M.V. Kryvoruchko, (2013), focusing on the fact that the laboratory method in biology is used for the firm mastering by students of theoretical knowledge, acquired skills and abilities, believes that, despite the results of a laboratory experiment are known to students in advance, this method involves a creative activity that stimulates the activity of students both at the stage of preparation for research, and in the process of its implementation and gives them the opportunity to feel like creators of experience, to form dialectical ideas about the phenomena being studied, to approach their analysis from different points of view, to identify other, possibly unconventional ways of doing research ".

Own experience in applying the method of laboratory experiment in teaching students of psychology in "Fundamentals of Modern Neurobiology", in particular, in the study of unconditional spinal reflex reactions, unconditional reflex reactions of the human brain, determining the time of sensorimotor reactions, volume and speed of visual information processing, the study of the mobility of nervous processes, etc., suggests that the introduction of this method increases the motivation and activity of students of psychology in the study of natural sciences, provides conditions for the formation of practical skills, forms in their minds understanding of the need for natural scientific training for future professional activity.

The analysis of scientific and methodical literature gives grounds to conclude that the problems of application of the project method of teaching natural sciences are covered in the research of such scientists as: T. Voronenko, (2015), N. Hrytsai, (2012), etc., and the method "role play" - in the scientific works of V.Yu. Tregub, (2005), R.A. Fedorchenko, (2016) and others. For the organization and implementation of the educational process of natural science training of future psychologists in higher education, we

consider it appropriate to combine these two methods into one integrated method of teaching, and interpret it as a method of project-role play.

There have already been attempts at such integration in scientific and methodological practice. O. Kozlenko, (2018), in particular, argues that project-role play is an innovative method of learning that combines the advantages of the project method of learning, namely: the possibility of in-depth study of individual topics; research and exploratory nature of pupils '(students') activity; independence of pupils (students) in the choice of forms and types of activity; active interaction between all project participants; the ability to organize cognitive activities based on intrinsic motivation to learn, with the advantages of the method of learning "role play", as: the ability to gain additional knowledge on issues not covered in the course and develop the ability to apply theoretical knowledge to perform the outlined tasks; development of skills of participation in discussion and cooperation in achievement of the certain purpose; development of creative abilities; the ability to form a tolerant attitude to other opinions and the ability to reasonably defend their beliefs; the opportunity to direct the excessive activity of pupils (students) in a useful direction and create conditions for self-expression and expression of emotions.

L.M. Mikhailova, (2020) agrees with this opinion and explains that the method of project-role play involves students , individual or in groups, project tasks, creating presentations of own projects and their defense in the form of a role play.

We emphasize that the above theses have become leading in the process of implementing the method of project-role play in the organization and implementation of educational activities for natural science training of future psychologists in higher education institutions.

Conclusions

We have characterized pedagogical technologies, namely: coworking technology, barcamp technology, workshop technology, SMART technology, BYOD technology and such innovative methods as: lecture-visualization, video lecture, debate, "round table", "electronic brain" assault ", laboratory experiment and project-role play, which, in our opinion, will contribute to the educational process of natural science training of future psychologists in higher education institutions on the basis of innovation and heuristics.

Pedagogical technologies are described, namely: coworking technology, barcamp technology, workshop technology, as well as SMART and BYOD technologies, which make it possible to organize and implement

in higher education institutions the educational process of natural science training of future psychologists on the basis of innovation and heuristics, and substantiated such innovative methods of teaching natural sciences of future psychologists as: lecture-visualization, video lecture, debate, "round table", "electronic brainstorming", laboratory experiment and project-role play.

In-depth interpretation of the concepts: "coworking technology", "lecture-visualization" and "video lecture".

Coworking technology is interpreted as a modern pedagogical technology which results in the creation of an open natural research and educational coworking space based on informal cooperation of research institutions, institutions of higher education, departments (faculties, institutes) within one institution of higher education, institutions of professional practice, informal real and virtual cooperation of scientists, including foreign, - natural, medical, pedagogical and other branches, - teachers-practitioners, practicing psychologists, students-psychologists, the coordination center of which is located at the department, whose teachers carry out natural -scientific training of future psychologists in a specific institution of higher education.

Lecture-visualization is interpreted as an interactive explanatory-illustrative method of teaching natural sciences, which increases the interest of future psychologists in science training, helps them to easily master the material and increases the percentage of its mastery, activates their cognitive activity in students and forms thinking.

A video lecture is interpreted as an explanatory and illustrative teaching method, which requires the teacher's creative activity and ability to use modern technical means and Internet resources and allows him to quickly change the content of natural science disciplines, modules or individual topics, complementing its results with modern scientific achievements, and taking into account the needs of students - psychologists, to facilitate their perception and mastering of educational material and increase their motivation to study natural science disciplines and natural science training.

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