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DIDACTIC TERMS OF USE OF BIOGRAPH INFINITI SPECIALIZED SOFTWARE IN UKRAINE'S HIGHER EDUCATION INSTITUTIONS

Abstract. The article shows the possibility of using hardware ProComp Infiniti System with BioGraph Infiniti Software in the educational process of higher education institutions in Ukraine in different directions of training, including specific training conditions. The Infiniti system monitors and records a wide range of physiological and mechanical signals, analyzes and provides real-time biofeedback through various auditory and visual aids. The authors analyzed scientific and professional literature on the development and introduction of specialized software products in the educational process of higher education institutions in Ukraine and across the globe. The paper defines the advantages and prospects of carrying out a cycle laboratory work and research with BioGraph Infiniti tools and the principles of work with ProComp Infinity hardware. The didactic conditions of use of BioGraph Infiniti Software in the educational process of higher medical education institutions and universities of internal affairs of Ukraine are defined for formation of informational and subject competence of Ukraine's students. Attention is focused on ensuring the flexibility of the educational process by means of variability, changes in the content and methods of education, forms of organization of educational classes with a direct practical component, a combination of different education methods for students of various types of higher education institutions. The possibilities of development of a series of laboratory works with their further placement in the virtual educational environment "Laboratory works system with specialized software Biograph Infiniti" are considered. Each laboratory work is created according to the principles of scientificity, integrity and professional orientation of education and includes 3 levels: general (basic), psychological and medical-biological.

Keywords: software product; educational process; didactic conditions; Medical University; University of Internal Affairs; IT competence; BioGraph Infiniti.

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1. INTRODUCTION

Statement of the problem. According to the Law of Ukraine "On the Concept of the National Informatization Program" dated 01.01.2022 No. 75/98-BP [1], the informatization of education in Ukraine is aimed at the formation and development of the intellectual potential of the nation, improvement of the forms and content of the educational process, and the introduction of computer-based teaching methods and testing, which should solve the problems of education at the highest level, taking into account global requirements. Informatization of higher education in Ukraine should be aimed at the development of the information culture of students, development of the content, methods and means of education to meet world standards, integration of educational and research activities in the educational environment of the educational institution, improving the personnel through specialization and intensification of training of relevant specialists, including by means of digital technologies. The Law of Ukraine "On Education" [2] recognizes the information and communication competence as one of the key competences needed by every modern person for a successful life. The importance of increasing the level of digital awareness of specialists in various branches of Ukraine's economy is indicated in the State Strategy of Regional Development for 2021-2027, approved by the Resolution of the Cabinet of Ministers of Ukraine dated August 5, 2020 No. 695 [3]. On May 22, 2018, the European Parliament and the Council of the EU adopted the Framework program of updated key competences for lifelong learning, in which digital competence is recognized as one of the eight key competences for the full life and activity of EU citizens [4].

According to the above-mentioned normative-legal documents and on the basis of analysis of specialist literature in the field, it is possible to assert that formation and development of digital skills and digital competence of students of higher education institutions, both classical and with specific conditions of education, are among the current priorities of higher education. The development of students' IT competence in the use and processing of information resources by means of the latest computer technologies and digital educational resources is aimed at increasing the level of their digital skills and ensuring the formation of future specialists with a high level of professional knowledge.

Analysis of recent research and publications. The emergence of new digital technologies, their active development and distribution lead to the emergence of new trends in the formation of highly qualified specialists who are competitive in the global labor market. Current tasks of education include informatization and computerization of the educational process, building up students' computer literacy and information culture, their digital competence. ICT penetrate into all spheres of activity, influence the style, content and methods of work, enrich and improve it, and expand the limits of application. Informatization of higher education affects the professional competence of future specialists through the involvement of technological innovations, the use of Internet space, and the introduction of interactive technologies [5]. Modern tasks of informatization of education are reflected in the works of such Ukrainian scientists as Nychkalo N. G. [6], Muranova N. P. [6], Bykov V. Yu. [7], Krasnoschok V. V. [8], Pyshnohub M. V. [8], Bushuyev S. D. [9], Bushuyeva N. S. [9], Kozyr B. Yu. [9], Vakaliuk T. A. [10], Osova O. O. [10] and others. Research of Abuvatfa S. I. [12], Zadorozhna O. V. [13], Kovalenko P. H. [13], Kovalenko V. V. [14], Marienko M. V. [14], Sukhikh A. S. [14] and others features the use of specialized software products. Didactic and psychological aspects of the use of digital learning technologies are considered by Bassfar Z. [16], Ragan E. [17], Frezza S. [17], Chimalakonda S. [18], Nori K.V. [18] and other researchers.

Most scientists note that the pace of the development of digital technologies is ahead of the adaptation of the educational environment to their implementation in the educational process. There is a contradiction between the potential opportunities, prospects of digital technologies and the degree and quality of their use in the educational process of higher

education institutions. This requires the intensification of scientific research in the process of searching for content, forms, pedagogical methods and means of introduction of general and specialized software in higher education institutions of Ukraine. Now it is necessary to proceed from the fact that the use of professional software in higher education is not only possible, but also necessary.

Thus, based on the analysis of specialized literature, the authors argue that the creation and implementation of specialized software products in the educational process is important for the development of digital skills and digital competence of students of higher educational institutions. Therefore, the **aim of the article is** to investigate the capabilities of the BioGraph Infiniti specialized software and to determine the didactic conditions for its use in the educational process of higher education institutions, including those with specific learning conditions.

2. RESERCH METHODS

The following methods of research were used to achieve the set goal:

theoretical – analysis of psychological-pedagogical and other specialist literature on the problem of informatization of educational process and development and use of specialized software in higher education institutions; analysis of educational literature, educational standards and programs of professional training of students in institutions of higher education, including those with specific training conditions; study of literature on the practical use of specialized software BioGraph Infiniti;

empirical – observations, interviews with students of Donetsk National Medical University, cadets of Donetsk State University of Internal Affairs, medical workers and psychologists of the Center of Medical and Psychological Rehabilitation "KOM-PAS" and communal non-commercial enterprise "Regional Clinical Hospital of War Veterans of the Kirovohrad Regional Council" concerning physical principles of ProComp Infiniti hardware functioning, specifics of work with BioGraph Infiniti software and didactic conditions of use of the specialized software in the educational process.

3. RESULTS OF THE RESEARCH

In the research process, we used ProComp Infiniti hardware based in the Center for Medical and Psychological Rehabilitation "KOM-PAS" of the Communal Non-Profit Enterprise "Regional Clinical Hospital of War Veterans of the Kirovohrad Regional Council". The ProComp Infiniti comes with the 360 or Rehab Suites packages. The ProComp Infiniti system includes: ProComp Infiniti Encoder, BioGraph Infiniti Software Platform, 360 Suite or Rehab Suite, BioGraph Infiniti Feature Set, Developer Tools Software, Fiber Optic cables, Built in Compact Flash Recorder, TT-USB Receiver, USB Cable, Sample Electrodes [15].

Recommended computer configuration for ProComp Infiniti System must include the following features:

- Central processing unit (CPU): Quad-core CPU, Intel i5;
- Operating systems (supported 32 and 64 bit versions): Microsoft® Windows® 8, Pro, Enterprise – Microsoft® Windows® 7 Home Premium, Business, Ultimate, or Enterprise; Microsoft® Windows Vista® Home Basic, Home Premium, Business, Ultimate, or Enterprise with Service Pack 2; Microsoft® Windows® XP Professional or Home Edition with Service Pack 3;
- Memory (Random Access Memory): 2 GB (Windows® XP) or 3 GB (Vista® or Windows® 7/8);

- Hard Drive space: not less than 50 GB to save video and sessions data;
- Video / Graphics card: at least 1 GB of dedicated memory.
- Monitor: 2 monitors which support resolution of 1280x1024 and higher.
- DVD-ROM drive;
- 32-bit compatible sound card & speakers;
- High-speed Internet access (for updating software and receiving technical support).

The Infiniti system is designed for bioelectronic feedback and physiological monitoring. ProComp Infiniti is an important technical component of the Infiniti system and is a data collection and psychophysiological monitoring device. It contains 10 high-speed channels and can receive data from any sensor in the Thought Technology set. The unit can be used for research of up to four coders at the same time. ProComp Infiniti uses real-time fiber optic cable to write to the computer memory and display the results of medical and biological data on the user's screen. The Infiniti system combines specialized equipment with modern software that meets the requirements of safety, versatility and ease of technical use. All the sensors we use in the research and training process are completely non-invasive and do not require special practical preparation for their use. We work with sensors: Electromyography (EMG), Electrocardiography (EKG), Electroencephalography (EEG), Schicin conductivity, skin temperature, Insulation of voltage, blood volume, pulse wave shape, heart rate and amplitude (BVP). Also, we have had experience of work with Goniometer and Torsiometer.

The sensors are connected to ProComp Infinity decoder – an 8 channel, multi-modality device for real-time, computerized bioelite feedback and instant data acquisition and processing. The sensors transmit the signal to the computer via the ProComp Infinity decoder unit with microprocessor control. The decoder samples the input signals, digitizes them, decodes them and transmits data to the TT-USB interface. The special features of the fiber optic cable used for signal transmission are maximum freedom of movement, signal reliability and electrical isolation. At that, the manufacturers have established that the up to 7,5-meter long fiber-optical cable between the computer and the decoder does not distort the signal. The TT-USB interface unit has four connectors: a fiber-optic connector (connects a fiber-optical cable to a decoder), a mini USB connector (connects a fiber-optical cable to a computer), a connector switch (used as a PC-controlled switch), a synchronization connector (connects a fiber-optical cable to a computer), and more than two USB synchronization interfaces (connects a USB cable to a USB data connection).

The unique design of the system allows the use and replacement of sensors on all 8 inputs. This feature gives the possibility to create a wide range of configurations by simply changing the type of sensors. The TT-USB interface unit is connected to one of the USB ports of the computer with the BioGraph Infiniti software installed (Fig. 1.).

Drivers for TT-USB are installed with the BioGraph Infiniti software. The Windows operating system recognizes when the TT-USB interface unit is connected to one of the USB ports. For TT-USB interface unit drivers, Microsoft uses digital signatures that inform the user about the compatibility of the drivers with the Windows version. If the Microsoft driver certification is pending or not completed at the time of using the TT-USB interface unit, the user should set the system to "Warn" or "Ignore" mode.

The ProComp Infinity decoder unit has switches. Depending on the software used with the decoder unit, the position of the switches changes. In our case, using the BioGraph Infiniti software and the TT-USB interface unit, channels A and B should be set to 2048 samples per second, channels C and D to 256 samples per second. The decoder can also be used with BioGraph software and Multitrace or Pro-SB interface; BioReserch software and Pro-SB interface; Neurocybernetics or NeuroCarePro software with Pro-SB interface.

Fig. 1. Connecting the ProComp Infinity decoder via the TT-USB interface unit to the computer

A compact flash card is used as an alternative data carrier recorded by the decoder. The ProCompInfinity decoder includes a protective compartment for placing a flash card.

The decoder has an internal clock that automatically dates the session execution time on the flash card. The decoder runs on batteries, but retains the date and time in the device memory for 30 seconds when the batteries are replaced. If the time value is lost, it can be set in the "Setting the decoder time" section.

The developers of the ProComp Infinity decoder use specially designed connectors in accordance with the provisions of the safety rules of foreign regulatory bodies regarding physiological monitoring. The metal surfaces of the sensors are covered with a plastic shell, which ensures their safe use in the educational process and during scientific research.

To ensure the correct data is obtained, during a bioelectronic feedback session, the ProCompInfinity decoder should be placed at a convenient distance, but away from a computer, monitor display or other digital device that can create electromagnetic fields and affect the result of the experiment. That is, the decoder must be located within the electromagnetic field of only the subject of the study.

The principle of operation with the ProComp Infinity hardware consists in the fact that, according to the assigned task, the appropriate sensors are connected to the ProComp Infiniti Encoder, which transmit the signal through the TT-USB interface unit to the computer. Sensors are fixed on the body of the research subject according to the algorithm of their use. Signals from the sensors are processed by the BioGraph Infiniti software, and the user receives graphic results of the conducted research (Fig. 2, 3.).

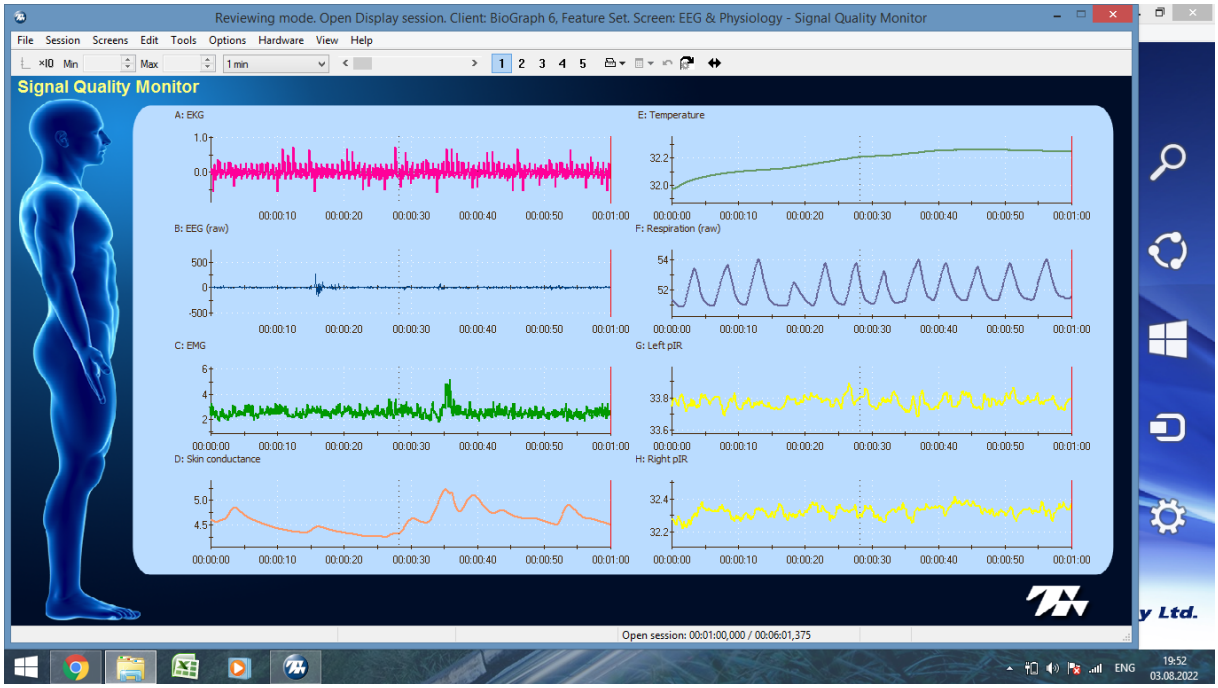

Fig. 2. Graphical results of the research processed by the BioGraph Infiniti software

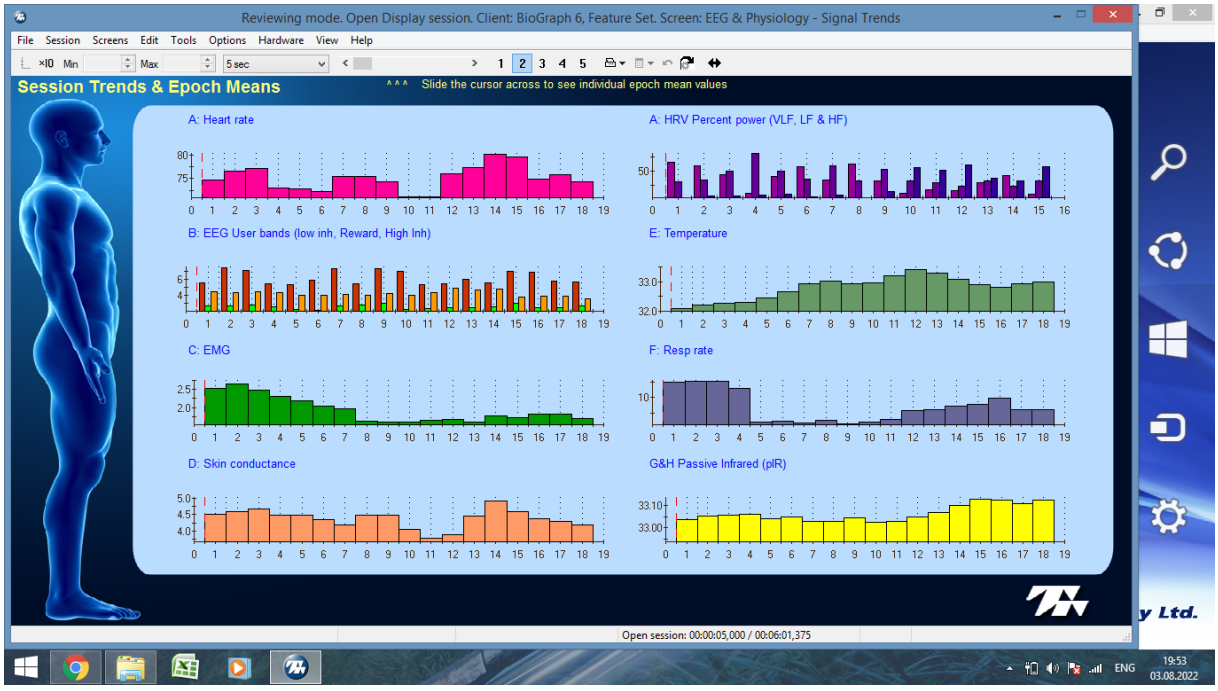

Fig. 3. Variations of graphical display of research results

The developer's tools allowed us to create our own screens, scenarios and sets of channels, which gave us the opportunity to adjust the sets of sensors and the results obtained in one system depending on the professional orientation of the learners with whom we conducted classes and scientific investigations.

The pedagogical expediency of using specialized software in the educational process requires the creation of instructional materials that outline the didactic conditions for using this software in the educational process of a higher education institution and ensure the process of

its effective implementation. For students of medical institutions of higher education, in the process of forming informational and subject competences by means of Biograph Infiniti, emphasis should be placed on the medical and biological justification of the processes under investigation, physical principles of the structure and operation of sensors, algorithms for working with databases, which are structurally similar to Medcard24 and eHealth and are actively used by health care institutions of Ukraine, research-experimental activity in the medical field etc.

The implementation of laboratory work using ProComp Infiniti hardware in institutions of higher medical education should meet didactic requirements, namely, the consistency of the content of laboratory work with the syllabi of academic disciplines, and comply with the didactic principles of systematic education, scientific and professional orientation of training, etc.

We consider it expedient to use ProComp Infiniti in the process of teaching the discipline "Medical and Biological Physics" in the specialty 222 "Medicine", in particular, for the topics:

- "Mathematical processing of medical and biological data" (15 academic hours) – analysis of graphical displays of research results (see Fig. 3);
- "Fundamentals of Biomechanics" (24 academic hours) – work with skin temperature sensors; frequency and amplitude of breathing; blood pulse volume signal, pulse frequency and amplitude; strength sensor; torsiometer; goniometer.
- "Fundamentals of Electrodynamics" (20 academic hours) – work with sensors specialized for electromyography, electroencelography, electrocardiography, electrical skin communication.

The use of ProComp Infiniti in the process of teaching the discipline "Medical and Biological Physics" is focused on the research nature of the formation of competencies in physics. The predicted results of using ProComp Infiniti by students include quick memorization of the educational material; development of independence and motivation for self-improvement through the use of information technology; development of higher mental functions (thinking, memory, attention); manifestation of increased interest in the subject, etc.

We also consider it appropriate to use ProComp Infiniti in the process of learning the discipline "Medical Informatics" in the specialty 221 "Dentistry", in particular, for the following topics:

- "Fundamentals of information technologies in the Healthcare system. Processing and analysis of biomedical data" in order to develop skills for working with a personal computer and specialized medical equipment for collecting and analyzing biomedical data using information technologies, working with databases (filling them, searching for the necessary information according to the specified criteria, etc.), statistical processing of the received biomedical data, etc.
- "Medical knowledge and decision-making in Medicine and Dentistry" to study the basics of algorithmization of medical problems, the application of formal logic in solving problems of diagnosis, treatment and prevention of diseases, students' work with expert systems; teaching students to work with various medical information systems.

In addition, we consider it expedient to use Biograph Infinity tools in elective medical IT courses for the field of knowledge 22 "Health Care", such as "Modern information technologies in medicine", "IT in Health Care", "Information technologies in scientific activity", "Information technologies in professional activities", etc., to provide students with a sufficient amount of IT knowledge.

The use of Biograph Infinity tools in institutions of higher medical education contributes to students' acquisition of integral competence, i.e. develops the ability to solve complex tasks and problems in the field of Health Care in professional activity or in the learning process

through conducting research, implementing innovations and is characterized by the uncertainty of conditions and requirements.

The use of Biograph Infiniti tools in institutions of higher education with specific study conditions is also relevant. The operation of the ProComp Infiniti hardware is similar in principle to the operation of a polygraph – a medical-biological device that records psychophysiological reactions that occur in response to certain stimuli, for example, questions. Therefore, it is useful to carry out laboratory work in which students will understand the medical-biological, psychological and physical basics of recording the psychophysiological reaction of the research subject with the sensors of the ProComp Infiniti device. The study of bioelectronic feedback using ProComp Infiniti tools is carried out by the authors of the article on the basis of the Center for Medical and Psychological Rehabilitation "KOM-PAS" of the Communal Non-Profit Enterprise "Regional Clinical Hospital of War Veterans of the Kirovohrad Regional Council".

The authors implement ProComp Infiniti in the process of teaching the disciplines "Information and Communication Technologies" and "Psychology of Operative and Investigative Activity" for students in the specialty 262 "Law enforcement activities".

In the process of teaching the discipline "Psychology of Operative and Investigative Activity", the apparatus can be used to develop skills for managing one's body, namely: stress resistance, attention disorders, fears, obsessive thoughts, nervous reactions, etc. For example, the use of the Biograph Infinity software and the electroencelography kit gives the possibility to: perform 4 types of basic assessment (psychological diagnostics with open or closed eyes, auditory perception and cognitive tasks), conduct neural communication sessions using standard or individually configured EEG protocols, supplement data indicators of neural connection by relaxation exercises, etc.

Using the device, it is possible to develop and practice methods of psychological impact on a person, observing the change in medical and biological indicators measured by sensors of: skin temperature; frequency and amplitude of breathing; blood pulse volume signal, pulse frequency and amplitude; strength; torsiometer; goniometer; sensors for electromyography, electroencelography, electrocardiography.

Specialists in the field of law and law enforcement also actively use various databases in their professional activities. Among them, the Automated System of Executive Proceedings, the Unified Register of Debtors, the "Tsunami" Police Order Management Center, the "Search" web resource of the Ministry of Internal Affairs of Ukraine, etc. The Biograph Infiniti software includes a database that gives the possibility to add a new research subject and information about him/her, save the results of the research and the description of the sensors used, view session data and place event markers, normalize the obtained data by performing artifact deviations, form statistical and trending reports etc. In the process of studying the discipline "Information and communication technologies" in the specialty 262 "Law enforcement activities", students improve their skills in working with office programs, including databases. By conducting scientific research with ProComp Infiniti, students work with databases, filling them and forming reports on sessions, acquire skills in computer visualization and analysis of research results.

We are developing a cycle of laboratory works based on ProComp Infinity hardware with BioGraph Infiniti software. Each laboratory work includes 3 levels: general (basic), psychological and medical-biological.

The general (basic) level is aimed at the development of basic or general educational IT competence and includes materials that form a unified set of knowledge and skills in the field of basic technical and software tools of computing for all categories of users. That is, they form the so-called "computer minimum" of a specialist with a higher education, which is necessary for successful mastering and practical use of arbitrary application software.

Psychological and medico-biological levels are developed with the aim of forming professionally oriented knowledge and skills by means of digital technologies. The materials and tasks of these levels contain a set of universal (interprofessional) and specialized (specific) knowledge and skills for different professional categories of users, which corresponds to the computerization of a specific professional environment.

Summarizing the results of our research, we have fomulated the following didactic conditions of using the BioGraph Infiniti specialized software in the educational process of higher education institutions of Ukraine:

- ensuring the flexibility of the educational process with the help of variability, changes in the content and methods of education, forms of organization of educational classes with a direct practical component, a combination of different methods of education for students of various types of higher education institutions;
- varying the complexity of tasks, the scope and pace of their execution;
- intensification of students' educational and cognitive activities due to the visualization of research results;
- strengthening students' motivation and cognitive interest due to the novelty of the pedagogical methods used and experimental work, the possibility of analyzing the results of the bioelectronic feedback of one's organism;
- the possibility of individualization of training, implementation of the technical capabilities of the computer, provision of a positive emotional background of training;
- organization of flexible management of the educational process based on pedagogical correction and continuous feedback;
- qualitative changes in the control of educational activities through the analysis of the results of the obtained studies;
- interactive visualization of educational material, which optimizes the perception of educational information by students and improves memorization of the sequence of stages of practical implementation of the experiment;
- development of a logical and algorithmic type of thinking thanks to the interactivity of the software and the ability for the user to independently manage the research process;
- students' acquiring knowledge of information-related concepts, as well as the specifics of information-related processes and information and communication means of its processing;
- acquisition of skills in the use of digital technologies during educational and professional activities;
- mastering techniques and methods that allow searching, collecting, evaluating, transforming, processing, analyzing, presenting, storing, distributing information, as well as increasing the quality of implementation of these actions due to the acquired experience;
- effective and responsible implementation of information activities.

4. CONCLUSIONS AND PROSPECTS OF FURTHER STUDIES

The educational process of higher education institutions of Ukraine should correspond to modern trends of existing technical capabilities and active development of digital technologies.

In accordance with the legal documents mentioned in the article, higher education institutions of Ukraine are expected to provide future specialists with a high level of knowledge and ensure a high-quality level of training in fundamental disciplines, in particular by means of

digital technologies. A significant part of the educational environment is laboratory practice and experimental work. Taking into account the active computerization of all spheres of our life, the authors suggested the use of specialized BioGraph Infiniti software in higher education institutions of Ukraine. For this purpose, the capabilities of the BioGraph Infiniti specialized software were investigated and the didactic conditions for its use in the educational process of higher education institutions, including those with specific learning conditions, were determined.

The authors are developing a cycle of laboratory works based on ProComp Infinity hardware with BioGraph Infiniti software. Each laboratory work is created according to the principles of scientificity, integrity and professional orientation of education and includes 3 levels: general (basic), psychological and medical-biological.

We see the prospects for further research in conducting a pedagogical experiment to check the effectiveness of using a cycle of laboratory works based on ProComp Infinity hardware with BioGraph Infiniti software in the educational process of higher education institutions of Ukraine.

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ДИДАКТИЧНІ УМОВИ ВИКОРИСТАННЯ СПЕЦІАЛІЗОВАНОГО ПРОГРАМНОГО ЗАБЕЗПЕЧЕННЯ BIOGRAPH INFINITI У ЗАКЛАДАХ ВИЩОЇ ОСВІТИ УКРАЇНИ

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Анотація. У статті обґрунтована доцільність і показана можливість використання апаратного забезпечення ProComp Infiniti System з програмним забезпеченням BioGraph Infiniti Software в освітньому процесі закладів вищої освіти України за різними напрямками підготовки фахівців, зокрема й зі специфічними умовами навчання. Система Infiniti дозволяє вимірювати та записувати широкий спектр фізіологічних і механічних сигналів, аналізувати та забезпечувати біологічний зворотний зв'язок у режимі реального часу за допомогою різних звукових і візуальних засобів. Авторами проаналізована науково-методична та фахова література щодо розробки та впровадження спеціалізованих програмних продуктів в освітній процес закладів вищої освіти України. В роботі описані переваги та перспективи проведення циклу лабораторних робіт та досліджень засобами BioGraph Infiniti, зазначені принципи роботи з апаратним забезпеченням ProComp Infinity. Визначені дидактичні умови використання BioGraph Infiniti Software в освітньому процесі закладів вищої медичної освіти та університетах внутрішніх справ України задля формування інформаційних та предметних компетентностей здобувачів вищої освіти України. Акцентовано увагу на забезпеченні гнучкості освітнього процесу за допомогою варіативності, зміни змісту і методів навчання, формах організації навчальних занять з практичною складовою, поєднанні різних методик навчання для здобувачів різного типу закладів вищої освіти. Розглянуто можливості та особливості розробки серії лабораторних робіт з подальшим їх розміщенням у віртуальному навчальному середовищі «Система лабораторних робіт зі спеціалізованим програмним забезпеченням BioGraph Infiniti». Кожна лабораторна робота створюється згідно з принципами науковості, цілісності та професійної спрямованості навчання та має 3 рівні: загальний (базовий), психологічний та медико-біологічний.

Ключові слова: програмний продукт; освітній процес; дидактичні умови; медичний університет; університет внутрішніх справ; IT компетентність; BioGraph Infiniti.

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