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ELECTRONICAL EDUCATIONAL AND METHODOLOGICAL COMPLEXES AS A MEANS OF FORMING THE PROFESSIONAL COMPETENCE OF FUTURE DOCTORS WHEN STUDYING DISCIPLINES FROM NATURAL SCIENCES

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Abstract

The article examines the possibilities of electronical educational and methodological complexes for the formation of professional competence of masters of higher medical education institutions and assessment of their academic achievements. It is claimed that obtaining a quality education is inextricably linked to the use of digital information and communication technologies, connected with the ability of students to understand electronic materials presented in the form of texts, graphs and tables, and to independently master theoretical material. Emphasis is placed on the tendency to use professionally oriented materials as a source of knowledge. The article presents the results of research into the forms and methods of effective implementation of electronical educational and methodical complexes on the Moodle platform among students which are studying at the Kharkiv National Medical University on the example of the academic discipline Medical and

Biological Physics. The advantages and disadvantages of using electronic educational and methodological complexes in higher educational institutions are discussed.

Keywords: electronical educational and methodological complex; competence approach; educational discipline; medical education; Moodle.

Relevance of the research

The current state of development of digital learning technologies in the higher education system, including in the system of higher education in medical institutions, and the integration of medical education into the educational and scientific space requires teachers and scientists to use the latest advances in the field of digital information and communication technologies [1, 2]. Digital information technologies allow not only to increase the efficiency of traditional forms of education, but are also aimed at activating and improving the independent work of students in the study of the discipline, the objectivity of the process of monitoring and evaluating students' knowledge, and increasing the efficiency of the level of competence of students in the chosen profession. The computerization of the educational process and the active development of the education system, the result of which is the implementation of educational programs using electronic learning and distance educational technologies, require the modern teacher to be ready to use digital technologies in teaching his subject. In this regard, modern society needs specialists in the field of medicine with a high level of development of intellectual and creative potential, with a scientific culture of thinking, with a responsible attitude to their duties, which implies that they have key professional, digital, communicative and other skills competences for successful professional activity. The main goal of the Ukrainian education system is to create conditions for the development and self-realization of each individual as a citizen of Ukraine, to form generations capable of lifelong learning, to create and develop the values of civil society, as documented in the «National Doctrine of the Development of Education of Ukraine» in the 21st Century [3], which will contribute to the preparation future specialists to creative development and provide the necessary set of competences to realize their potential. According to the provisions of the Bologna Declaration [4], preference is given to the individualization of student learning using new information technologies, the effectiveness of which can be achieved only if students have complete sets of educational and didactic materials, this can be performed under the conditions of the growing role of information,

network technologies and creation and implementation of electronic complexes for educational disciplines in the educational process [5-7].

Education is aimed at realizing the Ukrainian national idea. It is subject to the consolidation of the Ukrainian people into a Ukrainian political nation, which seeks to live in a commonwealth with all nations and states of the world. Nowadays, education is easily obtained from various sources using mobile methods of communication, namely the computer and the Internet. E-learning means the organization of educational activities with the use of information contained in databases and used in the implementation of educational programs, with the use of information technologies, technical means, as well as information and telecommunication networks that ensure the transmission of the specified information over communication lines and the interaction students and teacher.

Nowadays, anyone with a secondary education can create a simple online educational course, but the effectiveness of creating and using a modern online course in the process of teaching students, inextricably linked to the digital and professional competence of future specialists, is a deeper and problematical. Implementation of the creation of an effective training course in the disciplines of the main and variable blocks of the curriculum for students of higher educational institutions requires a lot of time and effort. It is also necessary to take into account the fact that students perceive information, text and images differently, depending on the professional orientation of this information, which they receive during learning the material that is demonstrated when studying visual material for one lesson. One of the innovative directions in the preparation of professionally oriented methodological materials for the training of future doctors in institutions of higher education, taking into account the formation of the future professional competence of medical students, is the creation of electronic educational and methodological complexes (EEMCs).

Analysis of previous research

A modern characteristic of the educational environment is the provision of access for students and teachers to structured educational and methodological materials, electronic educational and methodological complexes and the possibility of their use in any place, at any time and at any pace. Availability of educational material provides students with the opportunity to communicate with the teacher, receive individual consultations online, as well as the opportunity to freely design a personal plan for mastering the discipline. Among modern educational technologies, interactive technologies play a significant role. According to the classification of O. Pometun and L. Pyrozhenko, interactive technologies are divided

into groups depending on the purpose of the lesson and the form of organization of the educational process, namely: technologies of cooperative learning, interactive technologies of collective and group learning, technologies of situational modeling, technologies of discussion issues [8].

One of the priority directions of the development of the education system in higher educational institutions is the development and use of a wide range and capabilities of electronic educational resources, which is reflected in the Law of Ukraine «On the Main Principles of the Information Society in Ukraine for 2007-2015» [9], the Decree of the President of Ukraine «On measures to ensure the priority development of education in Ukraine» [10] and other legislative and regulatory documents. Among the variety of electronic educational resources, the indisputable advantage belongs to the electronic educational and methodical complexes, focused on the innovative development of education.

The electronic educational and methodical complex is an automated system that includes informational reference and methodical materials from the educational discipline and allows you to use them comprehensively to acquire knowledge, abilities, skills and exercise control and self-control over this process.

A specific feature of EEMCs is the integration into a single system of electronic learning tools of various natures, due to the fact that its structure is non-linear. Information is presented not only in the form of text, but also in graphs, diagrams, animations, sound and video. With the help of hypertext, the user can switch to another page and receive explanations, flash animation or video fragments in this way. The fundamental difference between the analyzed EEMCs and traditional printed didactic materials is that they provide a qualitatively new level of learning, built on the principles of interactivity, information openness, remoteness, and formalization of knowledge assessment procedures. At the same time, it should be noted that the term “electronic educational and methodical complex” is widely used among specialists who deal with educational technologies, but still does not have a generally accepted definition.

In the scientific and pedagogical literature, there are different interpretations of the concept of EEMC. In the works of M. I. Zhaldak, EEMC is defined as an information resource [11]. R. S. Gurevich and M. Yu. Kademiya consider EEMC as a didactic system in which, in order to create conditions for the pedagogical activity of information interaction between teachers and students, applied software products, databases, as well as other didactic tools and methodical materials that provide and support the educational process are integrated

[12, 13]; some scientists consider EEMC as a software multimedia product, EEMC is a means of implementing computer technologies of learning in any form (full-time, part-time, external, distance), aimed at activating students' independent work in studying the discipline, improving the quality of education, objectivity of the process of monitoring and evaluating students' knowledge. L.E. Koval includes EEMC in the composition of the electronic textbook consisting of a set of complementary and interconnected didactic (programmatic, theoretical, practical, methodical, visual, reference, control measuring and bibliographic) means of learning according to the discipline of the curriculum of the specialty, presented on electronic media, which contribute to the effective assimilation of the educational material of the discipline, necessary for organization and implementation of independent work of students, including in the distance education system [14]; V. Wolf - defines it as a “living” electronic book [15]. EEMC should contain a package of educational and methodical materials, correspond to current programs, should be methodically thought out and vividly designed, it should use materials from current textbooks, electronic textbooks with the completeness of the presented material, etc. Taking into account the rapid development of information technologies, it can be argued that EEMC is a new generation of educational tools that integratively combines an electronic textbook (manual) with educational and practical, methodical materials for meaningful modules and a test control system developed in one of the freely available systems distance learning. However, all authors are united in the fact that that the use of EEMC provides ample opportunities for users to improve the level of knowledge, abilities and skills anywhere, at any time and at any pace, which allows to successfully solve the problems of continuous and distance education. EEMC must ensure all the main stages of the pedagogical process — communication of educational information and its perception, consolidation and improvement of knowledge, abilities and skills, their application and control, and the main functions of the educational process — educational, educational and developing. The analysis of scientific and pedagogical sources shows the diversity of approaches to the interpretation, requirements, structure of the electronic educational and methodological complex. The variety of approaches complicates its development, creation and use in the educational process.

The purpose of the article is to study the structure of the electronic educational and methodological complex and to determine the specifics of the expediency of using the electronic educational and methodological complex as a tool for the formation of professional

competence in the study of disciplines from natural sciences in the process of professional training of students on the example of the discipline Medical and biological physics.

Presenting main material

The purpose of teaching the natural science discipline Medical and Biological Physics at the Kharkiv National Medical University is the formation of professional competence, from knowledge, skills and competence, of students of medical faculties who are preparing for the second (master's) level of the field of knowledge 22 “Health Care”, regarding the acquisition of competences:

a) phenomenon of living nature that occurs at all levels of its organization, starting from molecules and cells and ending with the biosphere as a whole;

b) the mechanisms of action of external fields on the human body, which are the basis of the functioning of modern electronic medical equipment and determine the main principles of its operation and use [16].

The lecture course of the academic discipline Medical and Biological Physics is accompanied by a laboratory practicum, which gives students additional competences and practical skills, in particular, when using modern electronic medical equipment, dosimetric radiation control devices, and other physical and biophysical methods in medicine [17]. Teaching the above-mentioned discipline ensures the formation of basic professional competences, including: integral (the ability to integrate knowledge and solve complex issues, formulate judgments; clearly and unambiguously convey one's conclusions and knowledge to a professional and non-professional audience, be able to rationally justify their judgments); general (ability to abstract thinking, analysis and synthesis, the ability to learn and be modernly trained, use information and communication technologies, evaluate and ensure the quality of performed work, conduct research at the appropriate level); special (professional) (ability to ensure the organization of work in structural units, apply modern work methods, use professional knowledge and practical skills).

The electronic educational and methodological complex “Medical and Biological Physics” is an informational educational resource intended for the presentation of structured educational material of the discipline in various forms (text, tables, graphics, multimedia presentations, schematic images, etc.), which reflects the model of the educational process and intended for practical use by teachers and students, regulates all types of educational activities of students and significantly facilitates the work of the teacher due to the active use of methodological support. EEMC “Medical and Biological Physics” allows providing

assistance to students in studying and systematizing theoretical knowledge; to form practical skills and abilities; rationally combine different forms of education; control the learning process (self-control and control by the teacher); effectively manage independent work; implement an individual approach.

The advantage of EEMC "Medical and Biological Physics" is the availability of grouped material, which includes programs of lectures and practical classes, topics of essays, programs of exams and credits, as well as methodological recommendations for students on mastering the academic discipline, lists of recommended literature.

EEMC develops a teacher (a team of teachers) of the department, who ensure the teaching of the content of the academic discipline in accordance with the curriculum for the training of students of the appropriate educational and qualification level by direction (specialty). The teaching and methodical materials included in the EEMC must correspond to the modern level of development of science, technology and technology, provide for a logically consistent presentation of the content of the educational material, the use of modern methods and technical means of the educational process, which allow students to deeply master the educational material and acquire skills.

The development of EEMC is carried out in the following sequence:

— the development and approval of the work program of the educational discipline;

— the development of a synopsis of lectures and compilation of a glossary;

— the development of instructions (recommendations) for conducting practical / seminar / laboratory classes;

— the preparation of instructions (recommendations) for independent work;

— the preparation of instructions (recommendations) for course work (projects);

— the development of diagnostic tools for all types of educational works in the discipline;

— the development of instructions (recommendations) for teachers;

— processing of documentation;

— the approbation of materials in the educational process;

— the correction or update of materials.

All teaching and methodical materials of discipline Medical and Biological Physics are developed in accordance with the approved work program. The deadlines for the development of materials are determined by the head of the department, for which the educational discipline is fixed, are fixed by the protocol of the meeting of the department, the

preparation of the elements of EEMC is included in the individual work plan of the teacher (to the section of educational and methodical work).

The use of EEMC in the practice of studying the discipline Medical and Biological Physics is justified by high productivity, significant intensification of the educational process, visual and auditory visibility of electronic content. EEMC combines text; graphic and video images in digital form; new learning tools are created on this basis. It is obvious that the effectiveness of the process directly depends on the effectiveness of the processes of creating and using the information resource. With the help of EEMC, the student is an active participant and can control the educational process himself. The teacher is given the opportunity to quickly and objectively analyze the students' knowledge, in the assessment of which his subjective attitude towards the student is completely excluded.

Table 1. The components of electronic educational and methodical complex of discipline Medical and Biological Physics.

Lecture	The “Lecture” element contains the necessary theoretical material for reading, hyperlinks, videos, Power Point presentations, and info-graphics. Providing the material in a presentation form makes it possible to stimulate students' visual memory, their cognitive and creative activity, allowing increasing the rate of assimilation of the educational material, increasing the students' interest in the taught subject.
Seminar/Practice	“Seminar/Practice” elements develop students' creative abilities and teamwork skills; reading, listening, understanding and processing of information resources, adaptation, and reconstruction of the content of the lecture material using key words is carried out. Note-taking, use of reading, listening and writing strategies, as well as speaking, presentation and teamwork strategies.
Test	Intermediate and final testing is conducted in the “Test” element.
Electronic assignment	The element “Electronic task” is intended for posting homework completed by students.
Glossary	The “Glossary” element organizes work with definitions, terms, and thematic vocabulary, is used for students to create their own dictionary, select keywords, and compile thematic groups.
Methodical support	The “Methodical support” element briefly describes the course program, competences, rating plan, topics and tasks for the current, intermediate and final certification, a list of basic and additional literature.
Feedback	The element “Feedback” is built into every e-course, students answer questions in the questionnaire, suggest improvements and changes to make the course even more useful and interesting.
Forum	In the “Forum” element, masters have the opportunity to share their conclusions and discuss the obtained results.
Editing	In the “Editing” element, the teacher has the opportunity to place recordings of lectures and seminars on the course, to include new

	elements in the form of hypertext links, separate files or additional modules.
Video conference	The “Video conference” element is used for conducting seminars, colloquiums, conferences, etc.
Navigation	The “Navigation” element searches for the necessary information on the electronic course.
Portfolio	In the “Portfolio” element, students can save history and records of completed tasks, grades, ratings, and webinars.

Working with electronic texts within the framework of the educational course (educational module) fully corresponds to the didactic principles of visually, consciousness, activity and interactivity in the assimilation of material and in the study of the theory and practice (Table. 1.). The educational resource is created for the purpose of providing teachers and students with informational and methodical materials necessary for the organization of the educational process.

The electronic educational and methodical complex of discipline Medical and Biological Physics also includes:

a) the basic and additional educational resources;

b) the tests and simulators;

c) the ways of accessing virtual classrooms where classes, recordings of lectures, audio and video presentations take place;

d) the electronic library fund;

e) the individual online consultations;

e) the electronic ratings, reports and other elements.

In EEMC of educational discipline of Medical and biological physics are the structuring of lectures, the organization of practical classes, which are accompanied by multimedia means, is carried out, which allows to significantly expand the field of knowledge, comparison of facts, observations.

Lectures can be presented not only in electronic (printed) form, but also in audiovisual form - with a demonstration of slides, video clips. Tasks for students can be aimed at independent search, creative activity that requires solving a problem, creating one's own knowledge.

The advantages of using EEMC are:

1) the differentiation of training, which consists in dividing tasks according to levels of complexity, taking into account the variety of forms in the presentation of information;

2) the timely and objective evaluation of the results of students' activities;

3) the teacher consultations and report on the studied material;

4) the increasing the motivation and interest of students, increasing cognitive activity due to various forms of work, the possibility of including a game moment and using various approaches in presenting information;

5) the intensification of independent work, which consists in strengthening the activity of self-learning, self-control, self-assessment of the student;

6) the possibility of distance learning, having access to the Internet.

Structured electronic educational and methodical complexes can be placed in the local university network, on the Internet, on electronic media, which allows to fully providing students with the necessary information on the discipline. The information bank of the discipline (electronic textbooks and manuals, demonstrations, test and other tasks, examples of already completed projects, topics of course and diploma theses, tasks for independent and individual work), which is part of the electronic educational and methodical manual, must be constantly updated [19, 20].

The model of the electronic educational and methodological complex for use in the professional training of future doctors based on the example of the discipline Medical and biological physics contains theoretical material from the discipline, presented in the form of a manual provided by the curriculum. In addition to the text, the manual contains significant illustrative material as known as tables, photos, drawings, for examples: Fig. 1, Fig. 2 and Fig. 3 [17].

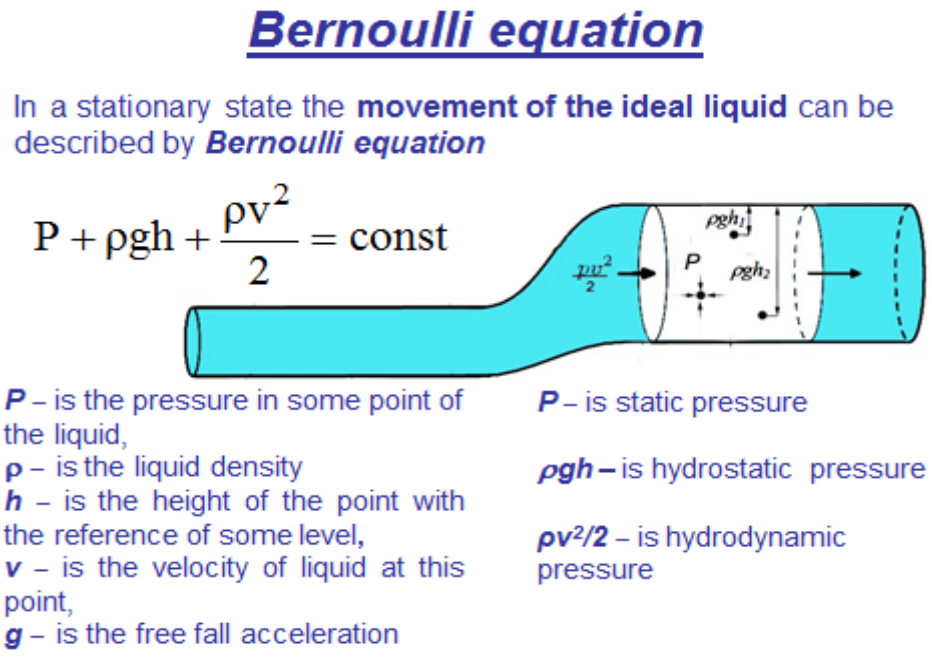

Fig. 1. Basic concepts and formulae of hydrodynamics. The Bernoulli equation.

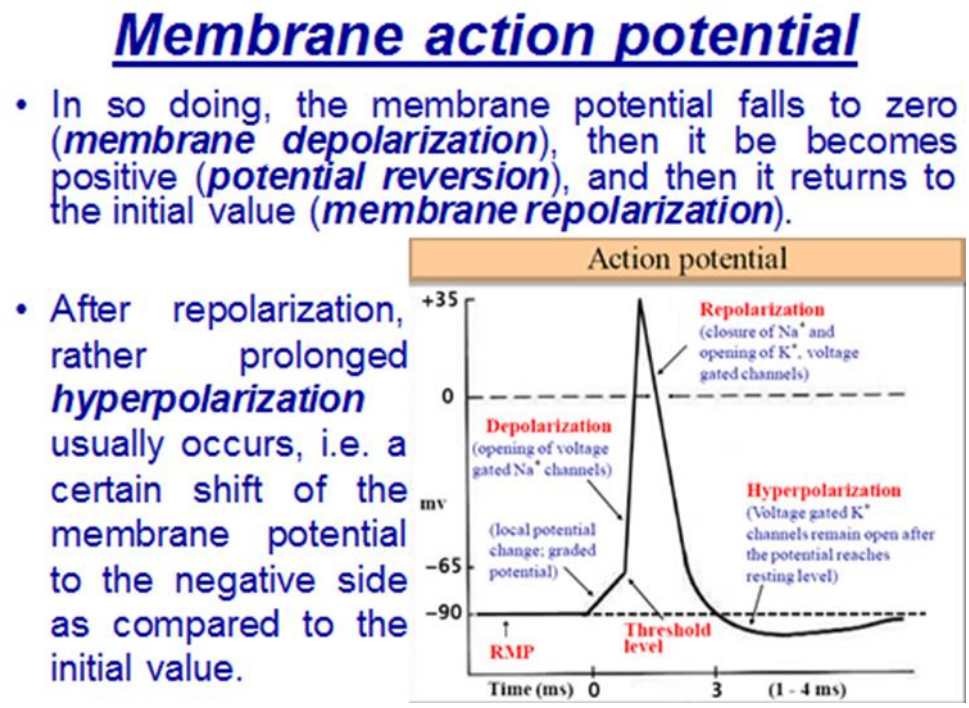

Fig. 2. Biopotentials. Membrane potential. Action potential generation.

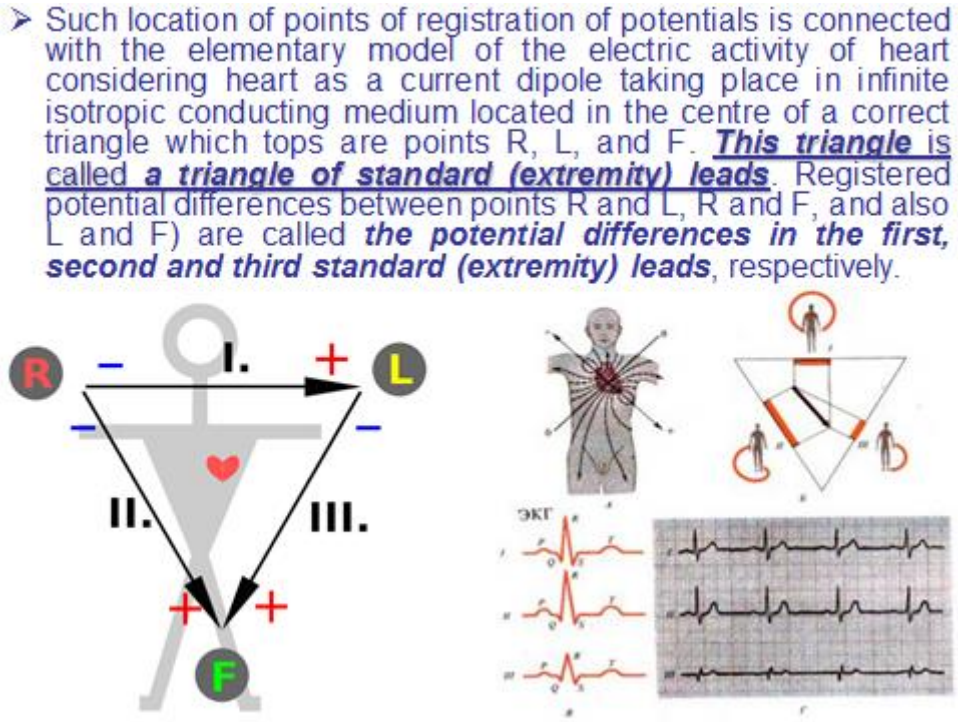

Fig. 3. Einthoven's electrocardiac field theory.

The discipline is divided into modules, which in turn are divided into separate sections and separate topics [18].

Section 1. **Mathematical methods in biology and medicine.**

Topic 1. Elements of probability theory.

Topic 2. Random variables.

Topic 3. Elements of mathematical statistics.

Topic 4. Control work according to Section 1.

Section 2. **Biomechanics.**

Topic 1. Fluid mechanics. Some applied issues of hemodynamics.

Topic 2. Mechanical oscillations and waves. Bioacoustics.

Topic 3. Control work according to Section 2.

Section 3. **Electromagnetic phenomena in biology and medicine.**

Topic 1. Transport of substances through cell membranes. Biopotentials

Topic 2. Physical foundations of electrography. Electrical properties of biological tissues.

Topic 3. Effect of electromagnetic fields on biological objects

Topic 4. Medical electronics

Topic 5. Control work according to Section 3.

Section 4. **Optical devices. Physics of visual perception.**

Topic 1. Geometrical optics. Lenses. The optical system of the human eye

Topic 2. Optical microscopy.

Topic 3. Polarization of light

Topic 4. Control work according to Section 4.

Section 5. **Biomedical aspects of atomic and nuclear physics.**

Topic 1. Thermal radiation. Basic concepts of quantum physics. Luminescence

Topic 2. X-ray radiation and its use in medicine

Topic 3. Dosimetry of ionizing radiation. Radiation diagnostics and radiation therapy

Topic 4. Control work according to Section 5.

Each section has a lecture course in which there is a link to the main terms.

Lecture 1. Elements of probability theory.

Lecture 2. Random variables.

Lecture 3. Fluid mechanics. Some applied issues of hemodynamics.

Lecture 4. Bioacoustics.

Lecture 5. Physical foundations of electrography.

Lecture 6. Effect of electromagnetic fields on biological objects.

Lecture 7. Geometric optics. Lenses. The optical system of the human eye.

Lecture 8. X-ray radiation and its use in medicine.

Lecture 9. Dosimetry of ionizing radiation.

Lecture 10. Radiation diagnostics and radiation therapy.

Independent and individual work with methodical recommendations for their implementation is allocated to each topic. The practical part of EEMC contains electronic development of practical classes on the main topics, tests for self-checking, which at the end of the work display the test results on the screen.

So, working with the complex involves:

1) the development of theoretical material;

2) consolidating the knowledge and skills acquired by students through the study of educational ones programs and performance of tasks of the practical part;

3) the knowledge control based on test tasks and completed exercises from the workbook.

The implementation of the disciplines of the basic and variable blocks of the curriculum is carried out at the Kharkiv National Medical University with electronic support of the educational process in a modular object-oriented dynamic learning environment (Moodle); includes the development and complex application of information resources, server software necessary for the operation of the server and communication with the electronic learning system via the Internet. Work on the course platform requires mandatory authorization (as a rule, the role of the participants is indicated: student, teacher or administrator); educational materials in the university domain are protected by copyright and are open only to students who are registered in the system and have a personal account. Authorization on the course platforms is possible from any computer, with the exception of programs designed to work only from IP addresses of the university.

The electronic platform Moodle (Modular Object Oriented Distance Learning Environment) is a free open source electronic learning system. A module of the Moodle platform is a ZIP archive that, when installed on the platform adds new features or changes the design. Today, Moodle is translated into more than 100 languages and supports more than 1500 plugins. Moodle is suitable both for the organization of training in universities and

training centers, and for corporate training. One of the features of the Moodle platform is the configuration of the platform through plugins. The functionality and design of Moodle is changed with the help of plugins, which can be downloaded for free from the Internet or created by yourself. Open source provides the ability to develop plug-ins by users themselves, who then publish the developed developments on the Internet for public access and use. Moodle is easy to integrate with other platforms, such as WordPress or Zoom webinars. Moodle supports the most popular standards in e-learning: IMS, AICC and SCORM. In addition, you can upload presentations, images, videos, audio and text files to Moodle. You can create text lectures and quizzes in Moodle. If you connect the H5P Interactive Content plugin, you can add educational content from H5P: a web service for creating interactive student materials. By default, users on the Moodle platform can be assigned roles and grouped. All other functions, such as mass assignment of courses and setting of registration conditions, are added using plugins.

The convenient reporting system of Moodle allows you to customize the reporting system for yourself - to select only those data that are necessary for analyzing the performance of students. For example, you can see how much time they spend studying the course, how often they access the platform, what mistakes they make in the tests. For example, you can configure statistics on the success of users and their activity, the popularity of courses, the operation of the platform (collection of errors, number of activities, etc.).

Today, Ukraine, unfortunately, does not have state-approved requirements for electronic educational complexes, which would regulate the content, structure, didactic conditions of their use in the educational process. Some researchers believe that electronic educational complexes can eventually replace traditional printed textbooks and, even, the teacher, which indicates the existence of the problem of creating and using the latest educational tools, taking into account their advantages and disadvantages compared to paper materials. Remote interaction of teachers and students with the help of EEMC is an area that is actively developing, promising and tested at the university. Implementation in the educational process of EEMC emphasizes a comprehensive approach to education as a whole, it is designed not only for students, but also for the training of teachers and other interested parties participating in the educational process (distance teachers, lecturers, administration, parents, external users of methodical materials , developers of EEMC), which indicates the use of the principle of stakeholder analysis, that is, not only the subject, but also the object of learning. The digital environment helps overcome space and time, involves all participants in

the educational process in the field of the subject of study, forms a holistic worldview and culture of thinking, helps to realize the creative potential of students, and manages the process of discovering new knowledge and experimentation.

Conclusions

After analyzing literary sources, it can be determined that EEMC can be used both in network and case versions, depending on the needs and capabilities of students. The application of EEMC in the teaching process allows to use to a great extent the great opportunities provided by modern telecommunication technologies. The expediency of using EEMC is that before starting the course, the student does not have competences in a certain subject area, but after its completion, he receives competences, the formation of which took place with the direct use of information technologies and knowledge assessment tools. The implementation of EEMC activates the development of students' internal motives and skills to acquire and update knowledge, enrich experience with innovative technologies, use computer technology to search for and use information, master the skills of independent work in the process of studying disciplines, which indicates the need for its use in the process of preparing future specialists.

The use of EEMC in the professional training of students of higher medical education institutions as a means of forming the professional competence of future doctors when they have studied disciplines from the natural sciences on the example of the discipline Medical and Biological Physics allows to improve the quality of education, to develop the creative abilities of students with the help of special programs included in the structure EEMC, to obtain expanded information on disciplines, increases the creative potential of future specialists in the field of medicine, as well as to teach them to think independently and work with educational material, which contributes to their further continuous improvement throughout their personal and professional life.

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