THE USE OF WEB TECHNOLOGIES TO IMPROVE THE EFFECTIVENESS OF ORGANIZING PHYSICS AND BIOPHYSICS LABORATORY WORK IN HIGHER EDUCATION INSTITUTIONS

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***Abstract**. This article examines the use of web technologies to improve the organization and effectiveness of physics and biophysics laboratory work in higher education institutions, particularly in medical education. It discusses the pedagogical value of laboratory classes as a bridge between theoretical knowledge and practical skills, while also addressing limitations related to equipment, safety conditions, and access to complex experimental devices. The article proposes the use of electronic textbooks, virtual demonstration stands, multimedia tools, local-network systems, and dynamic web pages to support laboratory learning. Such technologies allow students to observe experiments, complete assignments, record results, and generate reports through computer-based systems. The study emphasizes that web-based laboratory organization can enhance students' creative thinking, independence, information competence, and professional readiness. It also highlights the importance of integrating technological, user, evaluative, and professional information skills into the preparation of future medical specialists for modern educational and professional environments in an increasingly digital society.*

***Keywords**: creative thinking, methodology of teaching biophysics, freedom, sensitivity.*

INTRODUCTION

Today, in Uzbekistan and throughout the world, all the conditions necessary for distance-learning technology have been sufficiently developed. Citizens of our republic, situated in any corner of the world, have the opportunity to study at any educational institution of their choice and to keep informed about material relating to the topics of various subjects. This has led to progress in the fields of informatization and communication and to the deepening of integration ties throughout the world.

Laboratory classes in the subjects of physics and biophysics at higher education institutions are a key factor that links theory and practice and ensures their unity. They are of great importance in consolidating students' knowledge, in forming such skills as independence, the ability to work with measuring instruments, and the ability to conduct experiments, as well as in developing practical skills such as the ability to assess absolute and relative errors.

Physics laboratory classes conducted at educational institutions can be organized in three ways: frontal, mixed performance of laboratory work, and cyclical. However, for carrying out certain physics laboratory works — namely, studying the operating principle of the Geiger–Müller counter; determining the amount of radiation in the surrounding environment; studying nuclear interactions with the help of photographs obtained in a bubble chamber; becoming acquainted with and learning to operate devices for detecting charged particles; studying the methods of preparation and the structure of radiation sources; and studying the structure and operation of neutron-detection devices — the laboratory equipment, instruments, radioactive-radiation sources, and technical-safety conditions may be insufficient. Therefore, performing such laboratory work with the help of electronic textbooks, web technologies, virtual demonstration stands, and multimedia not only provides students with deep knowledge but also enables the enhancement of their creative activity, a faster understanding of processes previously unknown to them, and the gradual formation of certain skills related to their own field of study.

Distance learning offers students real advantages and also provides opportunities to obtain a quality education within a short period of time. As is known, distance learning differs from traditional education in its compactness, parallelism, modularity, broad coverage, purposefulness, convenience, modernity, and mass accessibility [1].

METHODS

In practice, the student, seated at the computer, observes the progress of the laboratory work with the help of interactive stands, demonstration animations, and audio and video materials, and takes part in carrying out the assignments. The results, report, and conclusions of the laboratory work performed by each student are recorded on the computer. Likewise, all data and results are accumulated on the teacher’s computer (server) over the course of the academic year. In this case, the web technology is required to be organized mainly in the form of a local-network structure in the computer room where the laboratory work is conducted. To process the results of the laboratory work, data-management software (SQL, MySQL, Apache, Denwer) is installed on the server computer.

Today, as a result of the development of web technologies, plug-in programs are being placed within web pages, and as a result web pages have been given an interactive character. One of the latest outcomes of the development of web technologies is scripting languages (Script Languages, JavaScript, VBScript). The purpose of using them is to ease the work of the web server and to create solutions to various small tasks on the user’s own computer without disturbing the web server. One of the latest achievements of web technologies is dynamic web pages (DHTML, XML, PHP, JSP, ASP), which are directly connected with CGI programs; CGI programs are located on the server and are programs that make use of the server’s capabilities. They process the requests that reach the server, and as a result of this processing a new web page is generated.

A student performing physics laboratory work launches a browser available in the operating system (Internet Explorer, Opera, Mozilla Firefox, Safari) and accesses the server on the local network (for example: http://fizika/laborator.php). Once the dynamic web page has fully loaded, the student enters his or her own information into the appropriate fields in order to register on the server and selects the required topic from the list of laboratory works on the screen. The student performs the laboratory work step by step and records the obtained results in the designated fields. Through the dynamic web pages, the results are processed on the server and are output in the form of a report on a new web page (http://fizika/result.php).

RESULTS AND DISCUSSION

Under the conditions of the informatization of education, the state educational standards ensure the training of personnel for professional activity only in the area of the technological and user components of information skills, which is not yet sufficient. In our opinion, the list of requirements imposed on a graduate of a medical university should be supplemented with a block of information skills that includes technological, user, evaluative, and professional components. A brief description of each component of this block is given in Table 1.

Table 1. The student's information abilities for working with a computer.

Technological	Special	Evaluative	Medical
Knowledge of the principles of computer operation, the basic concepts of informatics, and the basic methods of information processing.	The ability to work with a computer as a user of basic software.	The ability to critically evaluate information obtained from various sources of the information environment.	The correct use of information technologies in the profession of the future physician.

One of the reasons for the incompetence of specialists is the alienation of the knowledge being studied from the specific individual, their indifference to the subject, and the failure of any understanding to form in the minds of the learners. The accumulation of scientific knowledge and the rapid growth of the flow of information have led to modern higher education being oriented, as far as possible, toward "cramming in" knowledge that students hardly assimilate at a reproductive level. This cause can be eliminated on the basis of fundamentalizing the content of education, for which the following are necessary:

– first, to direct the attention of university faculty members and students to the problems of developing general culture, comprehending the best achievements of civilization, and forming the scientific forms of systematic thinking;
– second, to change the content and methodology of the educational process so as to focus attention on the development of modern scientific ideas and to acquaint students with the prospects for their development — that is, its orientation should be redirected toward studying, in modern terms, the most fundamental laws of nature and society [4].

As proponents of the concept of fundamentalization point out, the modern content of university education does not meet the requirements stated above. For example, the traditional construction of the biophysics course in essence follows the biological law that "ontogeny recapitulates phylogeny" [5]. The content of the biophysics course forms in students' minds mainly the elements of a mechanical and electromagnetic conception of the world — a conception in which the scientific achievements of the twentieth century are present merely as foreign additions [5].

In addition, the reduction in the number of hours allotted to the study of preclinical-cycle subjects must be taken into account. There is a need to overcome the barrier between the natural sciences and the humanitarian components of culture, and the solution of this problem is often associated with the humanization of education. In practice, in order to solve the problem of humanization, "two approaches" are often proposed:

a) increasing the set of humanitarian subjects in the curricula of higher education institutions when training specialists in various fields;
b) changing the content and methods of teaching traditional subjects with the aim of giving them a general cultural tone.

Unfortunately, educational practice often takes the path of reducing the teaching hours allotted to the study of subjects in the natural-science cycle. This is a general tendency of modern university education, and it is characteristic not only of medical-pedagogical but also of technical specialties. The requirement of fundamental education applies not only to the subjects of the science block.

V.V. Kraevsky [6], in characterizing the teacher's creative activity, includes among the special skills such abilities as seeing the problem and correlating factual material with it:

– formulating the problem in specific cognitive tasks;
– putting forward a hypothesis and carrying out mental anticipation;
– using analogy and transfer, and searching for alternative solutions.

These skills are formed in the process of research activity. If a specialist's thinking is distinguished by the ability to make predictions and by the ability to combine theoretical analysis with empiricism, then only a physician who became devoted to scientific research during the student period can possess such abilities. Such skills constitute a "methodological culture," the content of which includes: methodological reflection (analysis of one's own scientific activity), as well as the ability to provide a scientific basis for particular methods of cognition, management, and design, and to think critically and apply them creatively. The main components of this type of culture are the designing and construction of one's medical activity, awareness, formation, and the creative solution of professional problems.

The technology examined in this study is intended to form an expanded system of competencies for the future physician, and the educational standard is regarded as an invariant basis that can be supplemented depending on the strategy and tactics of planning the educational process at the university. This educational standard was presented for the preclinical section.

In physics and biophysics classes, this enables the teacher to monitor students' knowledge in a programmed manner and also to eliminate, to a certain extent, the absolute and relative errors encountered in performing laboratory work. This form of class allows the teacher to organize the teaching process in a prompt, effective, parallel, modular, broadly inclusive, purposeful, and modern manner.

CONCLUSION

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