

PROBLEMS OF WEB TECHNOLOGY'S INTRODUCTION IN THE INFORMATICS AND MATHEMATICS FUTURE BACHELORS TRAINING

Inna Shyshenko¹, Vladyslav Punko², Volodymyr Shamonia³

¹Ph.D. (Pedagogical Sciences), Associate Professor, Associate Professor of the Department of Mathematics, Physics and Methods of Teaching, Makarenko Sumy State Pedagogical University, Sumy, Ukraine, e-mail: shiinna@ukr.net, ORCID: <https://orcid.org/0000-0002-1026-5315>

²Postgraduate student of the Department of Computer Science, Makarenko Sumy State Pedagogical University, Sumy, Ukraine, e-mail: v.punko@fizmatsspu.sumy.ua, ORCID: <https://orcid.org/0000-0002-3454-7106>

³Ph.D. (Physical and Mathematical Sciences), Associate Professor, Associate Professor of the Department of Computer Science, Makarenko Sumy State Pedagogical University, Sumy, Ukraine, e-mail: vhshamonia@fizmatsspu.sumy.ua, ORCID: <https://orcid.org/0000-0002-3201-4090>

Abstract. *The article highlights the main tasks for the introduction of web technologies in the education sector. The study of the use and implementation of norms and methods of teaching future bachelors in the process of teaching mathematics and computer science courses using web resources requires special study. The introduction of web technology in the higher education system can be carried out in the following areas: support and functioning of the local network of faculties and the university as a whole; organization of the educational web portal or website, where all materials created by teachers and students can be accumulated; transferring library resources to electronic and providing access to them through the local network; involvement of all university teachers in the creation and use of open educational resources; formation of educational web space on the basis of web technologies. Each of these areas requires the availability of highly qualified personnel in the education system, and especially teachers and lecturers who would ensure the study of computer science and mathematics at the appropriate level. It becomes clear that the processes of informatization and mass global communication of society create a new social order in the higher education system for the training of computer scientists who have fundamental knowledge in computer science and mathematics and are able to use modern web technologies in future careers. Mathematical training of future specialists in computer science with the use of web resources should be cross-cutting and carried out both in the process of studying mathematical disciplines and through the introduction of appropriate special courses and workshops. It is this training that allows the future specialist to develop the appropriate skills and abilities. Systematic, purposeful use of web resources in the process of studying computer science disciplines allows students to deepen their understanding of educational material, increase learning motivation, provide creative, research direction, develop practical skills on specific material with a mandatory focus on professional tasks. to be a specialist in computer science.*

Keywords: *higher education; future bachelors; professional training; informatics and mathematics training; introduction of web technologies.*

JEL Classification: A22, I23

Formulas: 0; **fig.:** 0; **tabl.:** 0; **bibl.:** 6

Introduction. Today only the knowledge, skills and abilities acquired by young professionals during their studies are not enough to adapt to the conditions of market relations. Increasing the requirements of the modern labor market to the educational level led to changes in the educational systems of most countries and Ukraine in particular led to the search for ways to reform the educational process. One of the main tasks of the State Program of Higher Education Development for 2005-2007 was to ensure the innovative direction of higher education and its advanced nature, as well as deepening international cooperation, integration of the Ukrainian higher education

system into European and world educational and scientific space, expanding participation of higher education, scientists and students in international research projects. This way of education development emphasizes the importance of the competence approach as a factor in the convergence of educational systems.

In the context of joining the Bologna Process the national higher education system is undergoing significant structural and substantive changes. Today the task of higher education is to form in students a scientific worldview, a system of modern professional knowledge, the development of creative abilities, professional qualifications. The learning process should focus on the gradual creation of students' appropriate system of knowledge, certain skills, key and professional competencies, including information and digital. Competences are the criteria that determine the readiness of the graduate for professional activities.

The Law of Ukraine «On the Concept of the National Informatization Program» outlined the main ways to modernize national education through the introduction of information and communication technologies. Thus a modern school, both higher and secondary, needs teachers who respond quickly to changes in the social environment, effectively apply scientific and technological progress in learning, competently guide the personal development of students, creatively work to improve the learning process, use and demonstrate use of modern information technologies, in particular web technologies.

Analysis of the state of teaching mathematics and computer science in higher education shows that the level of formation of professional competencies of future specialists in computer science after graduation from these courses does not sufficiently meet the requirements of today; in terms of credit-module system, due attention is not paid to the study of the formation of information and digital competencies in the teaching of mathematics and computer science.

A significant role is played by web technologies, which are rapidly penetrating all spheres of society, including education, which aims to ensure the transition from industrial to information society through innovation in teaching, education and scientific and methodological work. The introduction of web technologies in the higher education system will accelerate Ukraine's transition to the information society and ensure that it receives a worthy place in the global educational space.

Literature review. The importance and necessity of introducing web technologies in the field of education is mentioned in a number of normative documents. The Decree of the President of Ukraine «On Urgent Measures to Ensure the Functioning and Development of Education in Ukraine» of July 4, 2005 states that it is necessary to ensure effective use of information, including multimedia and electronic learning tools, create a network of information support in education. On December 7, 2005, the Cabinet of Ministers of Ukraine adopted a resolution approving the State Program «Information and Communication Technologies in Education and Science» for 2006-2010, which directly indicates the need to introduce information and communication technologies, including web technologies, in education.

Analysis of the main aspects of informatization of the educational process, which is based on the works of V. Bykov, E. Vinnychenko, M. Zhaldak, V. Zabolotny,

V. Klochko, M. Lapchyk, Y. Mashbits, V. Monakhov, N. Morse, S. Rakov, Yu. Ramsky, S. Semerikov, O. Spivakovsky, O. Spirin, Y. Trius, S. Yashanov and others, made it possible to determine the strategy of IT implementation in the learning process, according to which educational and cognitive activities could provide productive development of each pupil and student. Leading domestic and foreign scholars have devoted research to the psychological and pedagogical features of the organization of higher education, didactic foundations of development and introduction of innovative pedagogical technologies.

Analyzing these studies, it can be argued that a number of aspects require further study. In particular, it is emphasized that the change and improvement of the content of education and training is in different directions, the importance of which changes with the development of the process of informatization of society. In this regard, the tasks of reforming the system of information and mathematical training and advanced reform of the system of training specialists in informatics are becoming especially important.

Aims. To identify problems related to the reform of the system of information and mathematical training of future specialists in informatics, and on this basis to outline the overall strategy for the introduction of web technologies in the field of their training.

Methods. Theoretical methods: systematic analysis of scientific, psychological and pedagogical, methodological literature; generalization and systematization of theoretical information on the introduction of innovative changes in the higher education system of Ukraine.

Results. The introduction of modern web technologies in the field of education for its development requires large financial costs, so the spread of these technologies is somewhat slow. This explains the relatively small number of information resources devoted to education. In order to better understand the problem of implementing modern web technologies in the field of education, it is necessary to clearly present the existing obstacles to this process. This will determine the direction of concentration of efforts and the necessary conditions for the successful solution of the problem itself.

In our opinion the introduction of web technologies in higher education institutions is hampered by psychological, pedagogical and logistical factors. Among the psychological and pedagogical factors include the following.

1. Lack of a complete theoretical basis for building learning systems based on the use of web technologies.

2. Insufficient development of methodological and organizational aspects of the use of web technologies in the educational process, the use in their construction mainly empirical approach.

3. Weak psychological readiness of most teachers to use web technologies as a means of learning, due to a number of reasons, including the natural resistance of man to innovation, lack of computer skills and knowledge of its use in the educational process.

4. Lack of understanding and a certain level of knowledge among some educators about the use of web technologies on the Internet.

5. Insufficient motivation for the introduction of web technologies in pedagogical activities and their use in the educational process.

Among the material and technical factors include the following.

1. Unavailability (due to high cost and other reasons) of quality software.
2. High tariffs for communication services and, as a result, high tariffs for Internet users.

3. Insufficient computer equipment of most institutions.

4. Insufficient number of specialists for technical support of the web technology implementation process.

5. Lack of domestic providers a sufficient number of direct channels of access to global educational networks.

6. Lack of legal framework for the use of educational web space on the Internet.

To address these issues, it is necessary to determine the overall strategy for the introduction of web technologies in education. The main directions of this process include the following.

1. More widely implement web technologies in all types of educational institutions. This will contribute to the creation of information and educational space, development of software and pedagogical software and, as a consequence, improving the quality of knowledge of pupils and students and the implementation of one of the main tasks of education - the transition from industrial to information society.

2. To train teachers to use local and global networks.

3. To create open educational resources and fill the Ukrainian part of the educational web space of the Internet with them. A powerful impetus to this process could be provided by the creation of a center where information on the location of these resources could be accumulated.

4. Identify typical web technologies that should be used in the educational process and the feasibility of their use. Based on such data, predict possible ways of developing web technologies for certain categories of users.

5. Facilitate the creation of educational information search engines and web directories.

6. Stimulate the creation of public servers in the field of education, useful for teachers.

These are the main tasks for the introduction of web technologies in the field of education.

The introduction of web technology in the higher education system can be carried out in the following areas:

- support and functioning of the local network of faculties and the university as a whole;

- organization of the educational web portal or website, where all materials created by teachers and students can be accumulated;

- transferring library resources to electronic and providing access to them through the local network;

- involvement of all university teachers in the creation and use of open educational resources;

- formation of educational web space on the basis of web technologies.

Each of these areas requires the availability of highly qualified personnel in the education system, and especially teachers and lecturers who would ensure the study of computer science and mathematics at the appropriate level. It becomes clear that the processes of informatization and mass global communication of society create a new social order in the higher education system for the training of computer scientists who have fundamental knowledge in computer science and mathematics and are able to use modern web technologies in future careers.

The rapid development of information technology, programming paradigms, improvements in computer technology, increasing the flow of data and the need for its processing have prompted leading educators to reconsider approaches to teaching computer science and mathematics in general.

The future specialist in computer science must have a basic level of mathematical training, regardless of theoretical knowledge of computer science, have scientific methods, implement numerical methods in practice and more. Mathematical methods and formal considerations are part of most branches of computer science. Computer science depends on mathematics and its fundamental definitions, axioms, theorems and methods of proof. Mathematics provides tools for working on concepts related to computer science, real tools of analysis and verification, as well as a theoretical basis for understanding different types of computer science ideas. Functional programming and solving problems using a computer is based on mathematical theories and analysis of functions; knowledge of combinatorics and probability theory, graph theory is necessary for analysis of algorithms; verification of algorithms is based on formal logic and deduction. Thus, to understand the theoretical foundations of computer science, the curriculum of the future teacher of computer science should include a sufficient list of disciplines of the mathematical cycle.

Students must acquire certain knowledge, skills and abilities in mathematical analysis, geometry, linear algebra, statistics, numerical methods, number theory, probability theory and logic. Students should also be familiar with the techniques of discrete mathematics.

The use of modern web development environments in the classroom significantly increases the motivation of computer science students to study mathematics. Practical testing of such tools provides an opportunity to form a clear idea of the current process of design and development of software products. It is not enough for a modern computer specialist to have skills in the use of traditional technologies, but it is necessary to know and study the educational segment of the Internet, have the skills to implement digital technologies in the educational process and so on.

For example, when studying mathematical disciplines, it is advisable in the process of studying graphic data to give students the task to search for graphic images on the Internet or create your own image using a graphic editor. In the future, such tasks can be combined into a project on a specific topic in mathematical disciplines and completed by creating a page in the system of wiki-encyclopedia.

Discussion. Web technologies have become widespread in the field of education. Web technologies will be considered information technologies, the use of which allows

the processing of web resources hosted in the web space of computer networks (local or global). Web space should be understood as an information component of local or global networks, through which the use of web resources (text, graphics, audio, video resources), which are interconnected by hypertext links.

Today, web technologies are best implemented on the Internet, which covers more than 150 countries. According to research firm Netcraft [3], which studies the global Internet, as of January 1, 2009, there were more than 185 million sites on the Internet. As for Ukraine, the beginning of the use of web technologies can be considered 1992, when the official registration of the UA domain took place. As of February 2009, the total number of registered domains in the UA territorial domain was about 390197.

At the end of 2005, the term Web 2.0 (second-generation web technologies) appeared, which was proposed to be used for the whole set of progressive trends in the development of web technologies [4; 6]. The use of this term quickly became widespread in all areas of information relations, and derivatives of this term began to appear: Business 2.0, Education 2.0, News 2.0, Advertising 2.0, and so on. In many aspects of the introduction of web technologies, Ukraine lags far behind the world's leading countries. According to the latest data [2], 14.6% of the population in Ukraine use the Internet, on average in Europe – 48.5%, in the world – 23.5%. Regarding thematic content, there are about 60 thematic catalogs in the Ukrainian web space of the Internet.

Analysis of web resources of other categories of the thematic catalog gives grounds to claim that most of them are commercial, which means that the Internet in Ukraine is developing largely due to commercial structures that already operate under market economy laws and can finance those technologies, which have a positive effect on their development [5].

The use of web technologies in the process of professional training of future specialists in computer science allows to form information retrieval skills. Such activities aim at the student's conscious acquisition of knowledge in the process of solving professional problems, increases the effectiveness of training future professionals, as well as contributes to the formation of skills of independent work in the process of solving the problem. Methods of using these resources in the training of future computer scientists should be focused not so much on studying the use of specific web resources, but on forming an approach to their selection and use in professional activities to achieve pedagogically significant results [1].

Conclusions. The study of the use and implementation of norms and methods of teaching future bachelors in the process of teaching mathematics and computer science courses using web resources requires special study. It is necessary to create conditions in educational institutions of Ukraine for the formation of information and digital competencies of students of mathematics and information specialties, who in the future will use web technologies as a means to solve not only professional problems.

Mathematical training of future specialists in computer science with the use of web resources should be cross-cutting and carried out both in the process of studying mathematical disciplines and through the introduction of appropriate special courses and workshops. It is this training that allows the future specialist to develop the

appropriate skills and abilities. Systematic, purposeful use of web resources in the process of studying computer science disciplines allows students to deepen their understanding of educational material, increase learning motivation, provide creative, research direction, develop practical skills on specific material with a mandatory focus on professional tasks. to be a specialist in computer science.

Author contributions. The authors contributed equally.

Disclosure statement. The authors do not have any conflict of interest.

References:

1. Barber M., Donnelly K., Rizvi S. (2012) Oceans of Innovation. The Atlantic, the Pacific, Global Leadership and the Future of Education. London: Institute for Public Policy Research.
2. Miniwatts Marketing Group. Internet World Stats: Usage and Population Statistics, (2007), Access Mode: <http://www.internetworldstats.com/>.
3. Netcraft. Internet nachinayet umen'shat'sya [The internet starts to shrink], (2009), URL : <http://e-commerce.com.ua/9492>. [in Russian].
4. O'Reilly, T. (2005), What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software, Access Mode: <http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-0.html>.
5. Obrazovaniye: onlayn-vyzovy traditsionnoy sisteme (2017), [Education: Online Challenges to the Traditional System], *Prosvetitel'skiy media proyekt ob obrazovanii Newtonew* [Newtonew Educational Media Project on Education], URL: <https://newtonew.com/analytics/issledovanie-kak-onlajn-obrazovanie-menjaet-obrazovatelnuju-sistemu>. [in Russian].
6. Shih, R.C. (2011), Can Web 2.0 technology assist college students in learning English writing? Integrating Facebook and peer assessment with blended learning, *Australasian Journal of Educational Technology*, 27, 5, 829–845.

Received: February 19, 2022

Approved: March 29, 2022