

THEORETICAL FOUNDATIONS OF USING WEB TECHNOLOGIES IN THE TRAINING OF FUTURE SPECIALISTS IN THE FIELD OF CHEMISTRY

Viktoriia Davyskyba¹, Vitalii Honcharuk², Vladyslav Parakhnenko³

¹Lecturer at the Department of Chemistry, Ecology and Relevant Teaching Methodologies, Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine, e-mail: vika197031@gmail.com, ORCID: <https://orcid.org/0000-0002-3900-9745>

²Ph.D. (Pedagogy), Associate Professor, Department of Chemistry, Ecology and Methods of its Training, Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine, e-mail: gvitalii1975@gmail.com, ORCID: <https://orcid.org/0000-0002-3977-3612>

³Lecturer-trainee, Department of chemistry, ecology and methods of their teaching, Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine, e-mail: vladparachnenko@ukr.net, ORCID: <https://orcid.org/0000-0002-4312-6194>

Citation:

Davyskyba, V., Honcharuk, V., & Parakhnenko, V. (2023). Theoretical foundations of using web technologies in the training of future specialists in the field of chemistry. *Pedagogy and Education Management Review*, (3), 52–60. <https://doi.org/10.36690/2733-2039-2023-3-52-60>

Received: August 25, 2023

Approved: September 29, 2023

Published: September 30, 2023



This article is an open access article distributed under the terms and conditions of the [Creative Commons Attribution \(CC BY-NC 4.0\) license](https://creativecommons.org/licenses/by-nc/4.0/)



Abstract. The article examines the theoretical foundations of using web technologies in the training of chemistry teachers. The factors of preparation of future chemistry teachers for the use of WEB technologies during distance learning have been determined. The use of educational WEB-resources enables teachers to carry out purposeful and more effective interaction with students, organize individual educational work, introduce and deepen methodical materials from educational subjects. An analysis of the theoretical works of domestic and foreign scientists was carried out, which indicates that in the context of the study of the quality of education, there is no unambiguous methodology for the development of WEB-oriented educational systems. The use of WEB technologies is growing significantly in all spheres of human life, in particular, this applies to the sphere of education. One of the main reasons for teachers' intensive attention to the problem of implementing WEB technologies is the convenience and ease of use of existing tools for finding, creating, and using educational WEB resources. Using educational WEB resources, it is possible to greatly increase the effectiveness of the educational process, to activate the educational and cognitive and independent activities of students. In the process of his activity, the teacher has to solve tasks related to the search for available educational WEB resources, analyzing them for the feasibility of using them in the educational process and creating his own. First of all, this affects the chemistry teacher, since his profession is closely related to the use of WEB technologies. Chemistry teachers can use WEB resources for distance learning, in class and in extracurricular work. The introduction of WEB technologies into the educational process requires the development and practical use of scientific and methodological support, the creation and effective use of tools and systems of computer training and knowledge control, the systematic integration of these technologies into existing educational processes and organizational structures.

Keywords: WEB technologies, training of chemistry teachers, education, informatization of education, pupils, students, computer training, knowledge control.

JEL Classification: I 23, I 29

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

Introduction. The use of web technologies in education is one of the most promising directions for the informatization of education. One of the main reasons for the increased attention of educators to the problem is the convenience and simplicity of using existing tools for searching, creating, and using educational web resources. The development of computer and web technologies inevitably leads to the informatization of all types of educational activities, including the creation of an information and educational space. The priority directions for creating an information and educational space include the implementation and use of the didactic possibilities of the Internet and web technologies (web services, educational web resources, online communities) in higher education. This allows organizing the learning process in a way that engages students actively and with enthusiasm, allows them to see the results of their work, and enables them to assess their progress independently. Combining traditional teaching methods with modern information technologies can help achieve these goals. Today, various possibilities of internet technologies are used in several main areas: as a means of obtaining information, as a means of communication, for entertainment, and for learning. The Internet provides access to an unlimited amount of text, audio, and video materials in different languages, including electronic newspapers and magazines, electronic versions of printed publications, library catalogs, archives, museum websites, educational institution websites, transcripts of some television programs, movie scripts, web pages of famous political and cultural figures, etc. Educational web resources are electronic resources placed on the web locally or globally in various formats (text, graphics, archives, audio, and video formats). They can be classified by their functional purpose into educational, educational-methodical, reference, normative, scientific, pedagogical, and software tools. The development of information technologies is rapidly progressing, with the number of software products constantly increasing. To prepare the younger generation for life in an information society, higher education institutions must educate professionals who can make decisions independently using their knowledge of modern information technologies and means of accessing information resources. It is important for future teachers to possess the skills to independently create informational resources and to master the technologies of creating educational websites, which have become essential components of a unified educational space.

Educational web resources provide information and presentation, advisory, informational-methodical, enlightening, and educational support for the activities of interaction subjects. They open up new opportunities for interaction with the public and allow:

1. Interactively deliver information to the audience regardless of their geographical location.
2. Provide up-to-date coverage of the activities of the web resource through the publication of news, reviews, catalogs of publications, as well as scientific, methodological, and practical materials.
3. Utilize modern means of communication (email, interactive conferences, forums) and effectively organize the portal's support service.

4. Activate the participation of educational staff, students, and teachers in Internet competitions, contests, and conferences.

Educational web resources can be classified by their purpose of use:

1. For independent work by students or pupils.
2. For the preparation of teachers for classes.
3. For self-education of educators.
4. For organizing practical work during classes.
5. For organizing extracurricular activities in a discipline.

Literature review. The use of web technologies in the preparation of chemistry teachers has been explored in the works of various scholars, including S. Arkhangelsky, V. Bykov, N. Voropai, O. Goryachev, M. Zheldak, A. Kolomiets, N. Morze, L. Petukhova, Y. Rivkind, O. Spirin, N. Tverezovska, and others. These studies have addressed the challenges in preparing future chemistry teachers and the integration of web technologies.

The preparation of future information technology specialists has been researched by scholars like A. Verlan, O. Goncharova, Y. Goroshko, A. Yershov, V. Klochko, E. Kuznetsov, O. Kuznetsov, Y. Mashbitsa, V. Monakhov, N. Morze, S. Rakov, Y. Ramsky, I. Robert, Z. Seydametova, S. Semerikov, E. Smirnova-Tribulska, Y. Tryus, and others. These studies have focused on the psychological and pedagogical aspects of using modern information resources in the educational process.

Aims. The article's aim is to clarify the theoretical foundations of using web technologies in the preparation of chemistry teachers.

Methodology. The problems of modern school education can be solved at a qualitatively different level through the application of computer technology and advanced ICT (Information and Communication Technologies). The use of telecommunications and Internet information resources not only complements the informational content of educational subjects in general education but also significantly changes the methods of their teaching, updates the content of education, and enhances the professionalism of teachers. Modern ICT has fundamentally changed our perception of traditional forms of education. Since the most accessible environment for implementing educational programs today is the Internet, the combination and creation of an educational space in this network provide enormous opportunities for educational institutions of various levels to realize their educational potential at a higher and more qualitative level.

Information technologies (IT) represent a set of methods and software and hardware tools integrated for effective data processing. Based on this concept, web technologies can be defined as a set of methods and software and hardware tools integrated for effective processing of web resources located in the web space (local or global, such as the Internet). Therefore, the concept of web technology is associated with the use of web space - the World Wide Web (WWW) - a global information space based on the physical infrastructure of the Internet and the HTTP data transfer protocol. Web technologies provide answers to the questions:

If this question were related to information on a user's computer (which is not connected to the network), you can use text, graphic, and sound editors. However, to

perform these operations on the network, you only need a web browser and a set of relevant web technologies that function on different servers. For example, to enter text in an email, you don't need to use a text editor installed on your computer because most email interfaces have a built-in editor that allows you to type text directly in the browser. This technology is called web technology.

For instance, well-known social networks like VKontakte or Odnoklassniki utilize various web technologies that allow users to upload and view photos, music files, videos, and more. Google offers the Google Docs service, which includes a web-based text editor for creating .doc documents, a web-based presentation editor, and spreadsheets. Therefore, you don't need to use software installed on your computer; it's sufficient to open a web browser, enter the Google system's address, and create the required document.

Any web technology can be implemented using network resources, either globally or locally, within a single audience or an entire building. Let's take a look at the basic principles of how the Internet functions. In summary, the World Wide Web (WWW) is built on a variety of technologies that serve different functions within the Internet. For instance, to create dynamic web pages, PHP is used, while CSS technology is used to enhance the visual perception of web content by allowing for unified styling across multiple web pages. JavaScript is used to create dynamic elements on web pages, making them more attractive and functional.

Web pages can either be simple static sets of files or be created by a specialized computer program on a server known as a "website engine." This program can be custom-built for a specific website or be a ready-made product designed for a certain type of website. Some of these programs allow website owners to flexibly structure and present information on their websites and are known as content management systems (CMS). The process of creating websites as functional information resources is a complex task that requires a combination of various professional skills. The general term used to describe this process is "web development."

Web services are technologies that allow applications to exchange data regardless of the platform and programming language. A web service must have a programmatic interface, which it uses to receive commands and data in a pre-agreed format, perform operations, and send responses over the network. Data transferred over the network is typically in a standardized format, often some variant of XML. The TCP/IP protocol, usually HTTP or HTTPS, is almost always used. A group of web services that interact in this manner forms a web application. The corresponding application architecture is known as service-oriented architecture (SOA).

Today, there is a large number of web services operating on the internet that are based on web technology. In chemistry lessons, a computer is used as a means of learning and as a tool for automating educational activities. It can be applied throughout the entire lesson for learning new material, reviewing and consolidating it, assessing knowledge, and preparing for lessons.

However, it is necessary to use various ways of applying ICT in lessons because their monotonous use hinders holistic and creative perception of educational material. The introduction of information and communication technologies is an educational

strategy for teaching and learning. The peculiarity of this technology is that it does not necessarily have to be used at all stages of the lesson because it requires a certain foundation, additional efforts, time, and is relevant in solving a range of problems in modern chemistry teaching methodology.

The intensity of computerization of chemistry lessons is determined by their focus: some lessons incorporate multimedia elements, while others are entirely computerized. The former involve episodic use of computer resources to address specific lesson tasks, such as checking knowledge from the previous topic, demonstrating experiments, acquiring new skills and knowledge, completing exercises, and conducting assessments. Fully computerized lessons (multimedia lessons/lectures) are used to achieve educational objectives when studying new material.

Methodological issues of implementing digital technologies and innovative teaching methods include the use of multimedia presentations during seminars, which emphasizes a high degree of student independence in acquiring and applying knowledge. The use of web technologies, on the one hand, opens up a wide space for creativity for teachers and students, expands opportunities for solving professional and research tasks, and, on the other hand, places higher demands on the preparation of future teachers in terms of their readiness to use Internet technologies in their professional activities.

The problems of preparing future chemistry teachers to use web technologies during distance learning in their professional activities are determined by factors such as:

- Increased requirements for the quality of chemical education for future chemistry teachers as a necessary condition for accelerating scientific and technological progress in all sectors of Ukraine's economy.

- Requirements for the formation of computer literacy skills and the application of Internet technologies in the process of studying the chemistry course.

- The need to increase the quality of educational and research activities of teachers based on the use of modern Internet technologies.

In summary, the use of information and communication technologies (ICT) in teaching chemistry can enhance the learning experience and offer various benefits. However, it's essential to vary the ways ICT is applied in lessons to prevent monotony and ensure effective learning. The level of computerization in chemistry lessons can range from episodic use of multimedia elements to fully computerized lessons, depending on the specific educational objectives and needs. Additionally, the preparation of future chemistry teachers to use web technologies and digital tools is crucial for enhancing the quality of chemical education and keeping up with the demands of the modern world.

Results. There are four approaches to defining the purpose of such training:

1. Formation of a certain level of information literacy.
2. Formation of information culture.
3. Formation of information competence.
4. Formation of readiness to use Internet resources.

The use of computers in chemical education, which began almost simultaneously with their use for scientific research, for a long time occupied a minor place in the development of educational technologies. Teaching technology is understood as a system of three interconnected aspects: a set of necessary theoretical and methodological foundations for addressing issues related to the organization of the educational process, the educational process itself, and its technical equipment. Undoubtedly, computers are an effective means of assessing students' knowledge, which, firstly, helps diversify forms of assessment, making them more attractive to students, secondly, allows for a more objective assessment of knowledge, and thirdly, simplifies administration by collecting and analyzing a large amount of information in a single database. In China, a fully computerized state exam in chemistry has been introduced into the structure of final school exams. The development of distance education systems allows students to deepen their knowledge, fill gaps in specific topics or school program courses, and prepare for standardized tests. At the same time, the peculiarities of chemistry as a subject impose serious limitations on the use of distance learning. For example, in distance learning, students lose the opportunity to conduct chemical experiments, and they do not have continuous feedback with the teacher. The solution to these difficulties was found in combining traditional and distance learning methods. This approach not only allows for real experiments but also provides the opportunity to watch videos over the Internet or from CD-ROMs. Interactive interaction between the teacher and the student is carried out through email. Currently, the educational process is undergoing informatization. Modern information and communication technologies are entering all areas of human life, including education. The present requires new approaches to the educational process, new methods, and forms of presenting educational information. These new approaches are needed in teaching chemistry and natural sciences in general. One of these approaches is the use of web technologies during the educational process. The use of ICT in teaching chemistry allows intensifying the educational process, accelerating the transfer of knowledge and experience, and improving the quality of education. Modern information technologies and innovative teaching methods in the training of specialists: methodology, theory, experience, problems. In addition, the implementation of web technologies in the educational process requires the development and practical use of scientific and methodological support, the creation and effective use of software and computer-based learning and knowledge assessment systems, systematic integration of these technologies into existing educational processes and organizational structures. Chemistry teachers can use web resources for distance learning, in regular classes, and extracurricular activities. This serves several purposes: obtaining up-to-date information, instant communication with colleagues or students (optimizing the learning process), sharing personal experiences, professional development, and learning from the best practices of other teachers. Successful integration of traditional teaching methods with computers allows teachers to significantly increase the effectiveness of their pedagogical influence, making the learning process more interesting, diverse, and intensive. In particular, the use of multimedia presentations created using Internet technologies

promotes a faster understanding of the main aspects of the educational material and frees the teacher from repetitive explanations. The use of computer technologies allows teachers to create high-quality visual aids with minimal time and store such images for future use on lessons and in the development of their own methodological support."

Internet technologies play an important role in assessing students' educational achievements. Computer-based online tests and diagnostic systems facilitate rapid differentiated assessment of knowledge and timely corrections. Internet technologies can serve as the basis for organizing independent work for students. For instance, on specialized music educational websites, students can not only read about specific musical instruments but also listen to their sounds. The Internet offers unlimited possibilities for organizing extracurricular activities for students. Specialized creative Internet centers allow anyone interested to showcase their talents and gain recognition.

Internet technologies are of paramount importance in the professional self-development of teachers. Their application allows for swift exchange of professional information among experts. Sharing new ideas, lesson plans, and educational event scenarios, as well as the results of pedagogical research, significantly enhances teachers' professional development.

Internet technologies reduce the time required and prevent duplication of work. Electronic information transfer is faster compared to traditional methods and ensures the exchange of materials among a much wider group of professionals. Internet technologies serve as an effective means of communication among all participants in the educational process, facilitated through various chats and teleconferences.

The use of computer technologies provides the opportunity for continuous consultation with methodologists and instructors from the postgraduate teacher training institute, enhancing the effectiveness of the self-improvement process. Internet technologies also play a vital role in checking students' educational achievements. Computer-based online tests and diagnostic systems contribute to rapid differentiated assessment of knowledge and timely corrections.

Internet technologies can serve as the basis for organizing independent work for students. For example, on specialized music educational websites, students can not only read about specific musical instruments but also listen to their sounds.

An important condition to consider in the professional preparation of future chemistry teachers is the recognition of differences in applied software. There is a wide variety of computer tools that teachers used during their higher education and will have to work with in schools. New software tools continually emerge with more educational capabilities and specific usage features. Having basic knowledge of Internet technologies allows teachers to adapt more quickly to changes in applied software.

Significant emphasis in enhancing the professional development of future teachers is placed on acquiring skills for independent knowledge acquisition and using specific software. The ability of future teachers to search for necessary

information in reference systems and formulate inquiries correctly plays a crucial role.

An important aspect of the professional preparation of future primary school teachers is mastering pedagogical software tools for various subjects, which have gained widespread use in recent times. Future teachers should have skills in working with diverse educational software complexes and websites containing a vast collection of various materials like fairy tales, riddles, proverbs, tongue twisters, counting rhymes, educational online games, examples of crafts from various materials, and parenting advice.

The application of different technology usage methods in the process of teacher professional preparation contributes to increasing the level of their professional competence.

Conclusions. In the context of the technical changes in modern education, it is essential to achieve a new quality of education that ensures the holistic development of each individual. This involves teaching every student how to acquire, process, evaluate, and use a vast amount of information in practical activities. To address this need, a promising direction for the development of modern education is the creation of comfortable conditions to organize educational activities through the establishment of an information and communication educational environment.

The key components of this environment are the attainment of educational quality, driven by new standards of education for the new generation, and the didactic potential of information and communication technologies (ICT) and web technologies. The use of educational web resources in the training of chemistry teachers enables purposeful and more effective interaction with students, organization of individualized learning, enrichment of methodological materials for educational subjects, familiarity with new ideas, and mastery of contemporary teaching methodologies. It also facilitates communication with colleagues, participation in scientific-practical conferences, and attendance at methodological webinars and discussions on pressing issues in education in Ukraine.

The use of web technologies empowers chemistry teachers to independently shape the content of education, realize creative ideas, and employ unconventional approaches to problem-solving in the process of preparing future educators. Prospects for further research lie in enhancing the professional training of chemistry teachers through the use of web resources.

Author contributions. The authors contributed equally.

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

References:

1. Computer technologies in teaching natural sciences in school URL: https://chemeducation.pnu.edu.ua/wpcontent/uploads/sites/14/2019/11/%D0%9B%D0%B5%D0%BA%D1%86%D1%96%D1%8F_9.pdf
2. Kochubei O. Preparation of future chemistry teachers for distance learning. Modern research in world science. Materials of the 1st International Scientific and Practical Conference. NPC "Sci-conf.com.ua". Lviv. 2022. 656-663.
3. Potsyapun N. V. Cloud technologies and their use in the process of teaching chemistry. XIII Mendeleev readings: Collection of scientific papers of the Regional Student Scientific and Practical Conference, (Poltava, March 25, 2020) / Ministry of Education and Science of Ukraine, Poltava. national ped. University named after V. G. Korolenko [and others]. Poltava: Editorial and publishing department of V.G. Korolenko PNP. 2020. 149-152.
4. Shpeko O. S. Educational web technologies in the training of future teachers. Bulletin of the Chernihiv National Pedagogical University. Series: Pedagogical sciences. 2018. 151(2). 79-83.

5. Shustova N.Yu. The place and role of Internet technologies in the system professional self-improvement of primary school teachers. *Ukrainian Journal of Educational Studies and Information Technology*. 2016. 4 (1). 72-77.
6. Yatsyuk S. Peculiarities of teaching web technologies for the development of educational systems for future computer science teachers and the method of creating their own educational resources based on them. *Youth and the market*. 2021. 7 (193). 118-122