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DIGITAL EDUCATIONAL ENVIRONMENT FOR METHODICAL TRAINING OF THE FUTURE COMPUTER SCIENCE TEACHERS

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ЦИФРОВЕ ОСВІТНЄ СЕРЕДОВИЩЕ МЕТОДИЧНОЇ ПІДГОТОВКИ МАЙБУТНІХ УЧИТЕЛІВ ІНФОРМАТИКИ

The study deals with digital educational transformation through the development of a digital educational environment for teachers' methodical training. The author has analyzed the concept of "digital educational environment", presented the own interpretation of its content and characteristics. It has been justified the relevance of implementing a digital educational environment into the educational process of higher education institutions. The author has singled out and described the environment structure which concerns with the educational process subjects, technical and technological and didactic components.

Key words: digitization, higher education, educational environment, digital technologies, the future Computer Science teacher.

Анотація. Досліджено цифрову трансформацію освіти шляхом розробки цифрового освітнього середовища методичної підготовки вчителів. Проведено аналіз поняття "цифрове освітнє середовище", сформульовано власне розуміння його змісту, характеристик. Обґрунтовано актуальність впровадження в освітній процес закладів вищої освіти цифрового освітнього середовища. Виокремлено й описано структуру середовища - суб'єкти освітнього процесу, техніко-технологічний і дидактичний складники.

Ключові слова: цифровізація, вища освіта, освітнє середовище, цифрові технології, майбутній учитель інформатики.

The aim of the study is to research and analyze the digital transformation of teachers' professional training at higher education institutions through the implementation of a digital educational environment for the methodical training of the future Computer Science teachers.

Problem statement. A modern society is characterized with digitization, which is reflected in the multifaceted computer networks use, digital technologies, and a wide range of mobile communication. Education does not stand aside from this process and, providing educational services, is based on the digital society requirements. In particular, it concernds with properly implemented learning management systems, innovative pedagogical technologies that involve the use of cloud applications, the Internet, digital content, as well as electronic document management, open cooperation among participants of the educational process. Digitization confidently permeates all components of the educational process: from management mechanisms to the learning environment.

Research and publications analysis. Ukrainian research is outlined by a wide range of various works, in particular:

• informatization of education and its digital transformation (O.B. Avramenko, V.Iu. Bykov, Yu.M. Bohachkov, R.M. Horbatiuk, H.B. Hordiichuk, R.S. Hurevych, A.M. Hurzhii, M.I. Zhaldak, O.Iu. Zhuk, M.Iu. Kademiia, S.H. Lytvynova, N.V. Morze, N.R. Opushko, V.V. Osadchyi, O.P. Pinchuk, Ye.M. Smyrnova-Trybulska, O.V. Strutynska, H.V. Tkachuk, Yu.V. Tryus, V.M. Franchuk, A.V. Yatsyshyn, and others);

• digital technologies in the educational process (Yu.P. Biliai, L.O. Varchenko-Trotsenko, T.A. Vakaliuk, T.Ia. Vdovychyn, I.S. Voitovych, M.A. Hladun, Ya.M. Hlynskyi, I.V. Ivaniuk, V. M. Kukharenko, M.S. Korets, I.S. Mintnii, O.V. Ovcharuk, O.V. Semenikhina, V.V. Sydorenko, S.V. Shokoliuk, O.M. Shparyk, S.M. Yashanov, and others);

• information and communication, digital competence (O.P. Buinytska, V.P. Vember, M.A. Hladun, O.H. Kuzminska, L.L. Makarenko, O.I. Lokshyna, O.V. Ovcharuk, O.M. Spirin, M.M.

Tymenko, S.V. Tolochko, and others);

• digital didactics, e-didactics, information pedagogy (S.V. Alieksieieva, O.P. Kyvliuk, O.V. Sahan, and others).

Results. The relevance and significance of education digitalization are reflected in HEI legislative documents, concepts, and regulatory decisions, in particular, it is presented the meaning of the concepts of "digitalization" and "digital technology", the long-term state priorities are interpreted taking into account world achievements (the Law of Ukraine "On the National Informatization Program", 2023); manifestations of the digital educational transformation are prescribed; the principles of the educational electronic platform functioning (e-platform) are defined ("On the approval of the Regulations on the National Educational Electronic Platform", 2018).

O. M. Shparyk emphasizes on the alignment of the digital transformation of education in Ukraine with the requirements of the world's educational spaces, which means, first of all, "consistent implementation of documents" that contain descriptions to develop the digital education system, and to improve digital competencies *(Shparyk, 2022, p. 39).* O.V. Ovcharuk specifies digital solutions in educational institutions that deal with "digital management of educational processes; an ecosystem and an environment that is safe for all users; online learning; distance and mixed, personalized learning" *(Ovcharuk, 2023, p. 87).*

In regulatory and dictionary-reference sources, it is founded individual definitions of the concept of "digital educational environment" (DEE), as it is a modern term that has been widely used in recent decades.

The digital environment "refers to the digital presentation of audio and video data on the World Wide Web and other technologies that can be used to develop and distribute digital content", and the term "digital" describes "the electronic technology with the help of which data is generated, stored, and processed in terms of two states: positive and negative one" (Explanatory Computer Science *Dictionary, 2010, p. 587).*

DEE is more widely presented in such scientific and methodical works as:

• an open set of information systems designed to provide various types of classes in the educational process *(Malko, Sharovatova, 2020, p. 43);*

• a complex system that combines various technologies, software, Internet resources and other tools used to support digital educational process *(Hutz, 2023, p. 83);*

• a specially organized protected, open environment where the conditions of equal access to education are developed for all participants of the educational process, and the use is aimed to acquire certain competencies *(Lytvynova, 2016, p. 18).*

The author interprets DEE as an artificially developed educational environment where the didactic goals of students' training, participants' cooperation and communication in the educational process are achieved through the balanced and appropriate use of digital technologies.

It is clarified that digital technologies are "technologies of developing, transmitting and saving information messages, which involves encoding their content using numbers" and if digital technology is used to implement tasks for educational purposes, then the concept of "digital educational technology" is used *(Grynko, 2021, p. 60).*

DEE combines educational, didactic, management resources with the use of modern digital and communication technologies, ensuring free access of the educational process subjects to information resources and digital content basing on effective cooperation within this environment. It is also worth mentioning that DEE is formed by a set of technical and programmatic, technological and informational, communicative and didactic aggregates that implement the educational process and are aimed to achieve the learning outcomes by the students.

DEE is determined by digital society needs and students' modern generation, specifically, to have access to education in a 7–24 format (that is, 7 days a week, 24 hours a day). DEE provides the other, different from the traditional approach, construction of the educational process. Thus, students can receive educational materials through different devices and platforms, and the same information can be displayed in different formats. In addition, the organization of education is diverse; students' independence and their responsibility for the performed activities are increasing.

DEE subjects perform organizational, educational, communication, evaluation and correction, reflective activities. However, its content for those who study and those who teach is different. It is necessary to understand that DEE contains considerable amounts of information presented in various formats and, therefore, it is important to be able to process them, turn them into knowledge and competence. This skill is formed during training, a person's performance of this or that activity and giving its results personal significance.

DEE develops a number of challenges for educational process subjects. One of them is the teachers' readiness to work with DEE, which requires updating the education content, organizational forms and teaching methods, mechanisms to manage the educational process, which are designed for a significant bias towards independent, motivated, research-searching, creative educational and cognitive activity of those who study.

A community of scholars (O.B. Budnyk and others) substantiated the need to train future teachers in the use of digital technologies based on the results of a survey of respondents of different age generations (Boomer, Millenials, etc.) (Budnyk, Zozuliak-Sluchyk and others, 2020). Scientists have proposed digital tools, organizational forms of distance learning (online courses, online consultations, hackathons, webinars, online trainings, interactive educational platforms, virtual/remote laboratories, etc.

O.M. Spirin and O.P. Pinchuk talk

about the fact that digital content is not always of high quality and, therefore, the teacher needs to be able to correct this situation, and an increase of distance learning share can lead to "social isolation and lack of personal contact between students and teachers" *(Spirin, Pinchuk, 2023).* Even the most perfect DEE cannot replace "live" communication. Thus, it is important to predict balanced, rational and moderate use of both DEE and digital technologies in the educational process.

It is hard not to agree with the opinion of scientists, that DEE increases the role of the teacher, as it acts as "the organizer of the digital educational environment; moderator of the students' training according to individual educational trajectories within this environment; integrator of educational electronic content; developer of the plan-script for learning online courses by future specialists; methodologist for didactic and programmatic support to implement this process; instructor of virtual communication" *(Tkachova, Tkachova, Shcheblykina, 2022, p. 193).*

Under such conditions, teachers' special training is necessary, including future Computer Science teachers, who through the content of the school subject "Computer Science" ensure students' digital development and socialization under the conditions of the challenges in the modern digital society. The author stresses on the importance of the students' skills in the use of digital technologies and modern educational innovations in combination with the method of the subject teaching. Therefore, training under the educational and professional program "Secondary Education (Computer Science)" should be proactive, provide methodical training of competent teachers who have the ability and willingness to work under the conditions of society digitalization. Among the significant number of digital technologies that cover a wide range of activities for a Computer Science teacher, there are such services as: learning management (Moodle, MoodleCloud, Edmodo, Office 365, Google Class, "My class", Human, etc.); communication support (Meet Google, Zoom, Hangouts, etc.); development and use of educational and didactic content (Mentimeter, LearningApps, ThingLink, Pinterest, Playposite, Wizer, etc.); knowledge monitoring and control tools (Google Form, Quizizz, Kahoot, QuizWhizzer, Classtime, etc.).

When implementing DEE for methodical training of Computer Science teachers, it is necessary to rely on the results of fundamental research dealing with Computer Science, the position of psychological and pedagogical sciences, advanced pedagogical experience, and achievements in the field of Computer Science. At the same time, "one cannot give up existing assets and create something new. The author highlights the necessity to find the integration ways to ensure comfortable and familiar activities for the educational process participants" *(Buinytska, Varchenko-Trotsenko, Hrytseliak 2020, p.70).*

Another challenge of the education digitalization is the development of such an educational environment that would meet the requirements of society informatization, didactics and digital pedagogy, would act as an effective means of people's comprehensive development who are in it, would ensure the implementation of educational programs and the achievement of the outlined goals, tasks and expecting learning outcomes. Also, DEE should be safe and open, informative and protected, effective and integrated while using wisely and appropriately by the educational process participants.

The author considers DEE for methodical training of the future Computer Science teachers as an artificially developed educational environment that combines digital technologies, information objects and other resources for the purpose of students' methodical training, involving them in creative cooperation, open communication with all participants of the educational process.

S. H. Lytvynova believes that the environment should meet the following requirements: be developed and used in accordance with the purpose of education; provide educational activities; be open and accessible to all participants of the educational process; comply with the principles of pedagogical integrity, expediency, synergy, cognitive activity, individualization, independence; ensure the effectiveness of the educational process; be innovative; contain a variety of educational

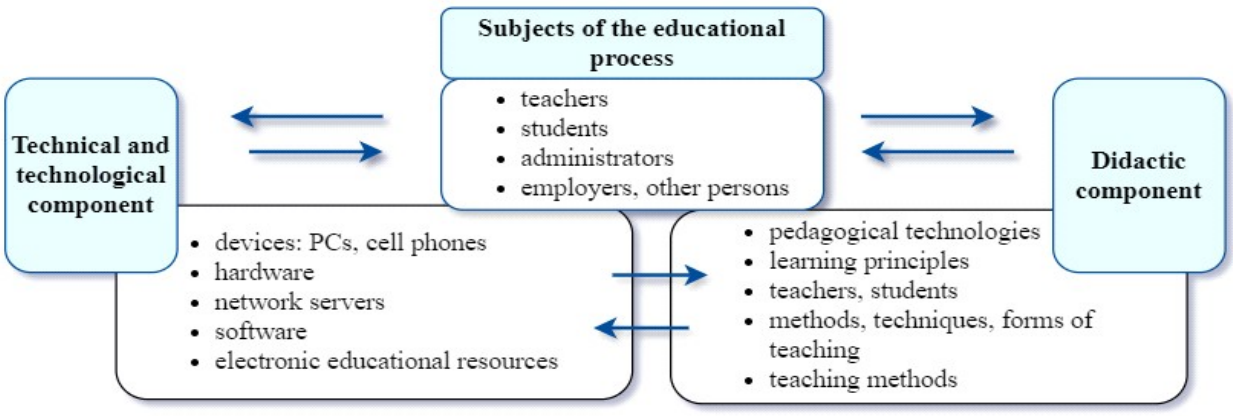

Fig. 1 DEE: structural components

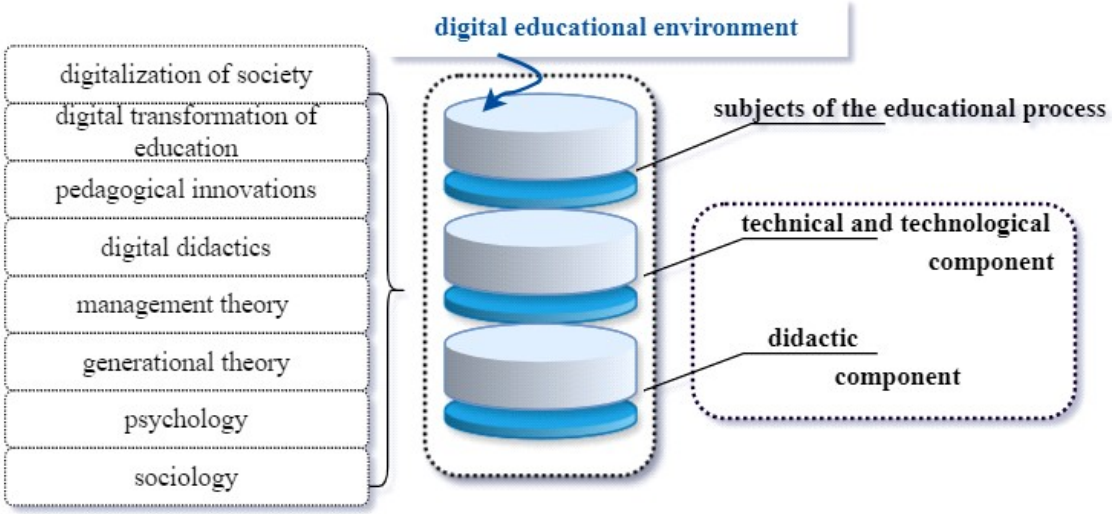

Fig. 2. DEE through the prism of external factors

materials; promote cooperation and communication within the environment *(Lytvynova, 2014).*

T.A. Vakaliuk supplements this list with the following requirements: visibility; mobility; continuity of education; integration with cloud-based resources; functionality; project activities provision; reliability; communication skills; flexibility and adaptability; fullness *(Vakaliuk, 2017, p. 155–156).* The study supports the opinion of K.R. Kolos that the educational environment "must function as a whole system, where the orderly unity of the components of this environment and their interrelationships depends, first of all, on the compliance of existing and promising technologies with the correctly established criteria for selecting the components of the environment" *(Kolos, 2017, p. 145)* . The author outlines DEE with the help of technical and technological means, didactics of the educational process, and the environment subjects *(Fig. 1).*

In order to support the interaction of DEE specified components, the content of various fields of knowledge is taken into account, in particular: psychology (motivation; reflection; person-oriented approach; thinking, etc.); didactics (learning content; approach to learning as a joint activity); teaching methods (organization of the educational process in Computer Science as a school discipline, etc.); digital didactics (application of engineering methods of designing and constructing an innovative educational environment, etc.); management (processes of planning, organization, motivation and control of activities for the purpose of various resources coordination (human, technical, informational ones etc.)); sociology (development and functioning of communities, the relationship between the individual and the team, comprehending the educational process in the context of the relations of its participants). At the same time, the environment is not a sum of subjects and objects that are united by certain characteristics, but is a dynamic system that exists on the basis of subject-subject interaction, which is defined by external factors *(Fig. 2).*

Conclusions and prospects for further research. The modern educational environment should be: a digital model, since digital technologies are confidently and variously used in the learning and development processes by all participants of the educational process; integral dynamic system, characterized by the well-founded development of both subjects of the educational process and technical and technological support, didactic components, in particular educational and didactic content.

The rapid development of digital technologies develops the need to implement a specially organized DEE as a means of learning and as an activity tool that meets modern requirements, precisely open and flexible, adapted and integrated for cooperation and communication of the environment subjects in the educational process. Students are the subjects of learning and development through their own activity in the environment, communication with teachers, administrators and other individuals in the "teacher – environment – student" system, on the basis of which various modifications are possible, for example, "student – environment – student – environment – teacher". The author highlights the prospects for further research to study DEE components, design a methodical training model for the future Computer Science teachers in DEE.

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