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The role and impact of information technology on the educational process

El papel y el impacto de las tecnologías de la información en el proceso educativo

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Abstract

Digital technologies have influenced various spheres of social relations, transcending national borders and legal system peculiarities. As a result, the determinants of social relations have been transformed, impacting the educational process. This study aims to examine the current state of the educational process in Ukraine concerning the application of information and telecommunication technologies. During the research, general methods of scientific inquiry were employed, including dialectical, formal-logical, and structural-functional methods, as well as several empirical methods. The conclusion was drawn regarding the necessity of restructuring elements of the educational process, primarily to enable distance learning. Also, the authors of this research identified the absence of a single correct strategy for adapting entrepreneurial entities to digital technologies. Therefore, an approach to structuring the educational process was proposed, highlighting the measures that need to be modified when utilizing digital technologies. The research findings are relevant and useful for the authorities to implement tools to influence the digitalization of education in Ukraine.

Keywords: information technologies, educational process, distance learning, digitalization, educational process participants, provision**.**

124

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Resumen

Las tecnologías digitales han influido en diversas esferas de las relaciones sociales, trascendiendo las fronteras nacionales y las peculiaridades del ordenamiento jurídico. Como resultado, los determinantes de las relaciones sociales se han transformado, impactando en el proceso educativo. Este estudio tiene como objetivo examinar el estado actual del proceso educativo en Ucrania en relación con la aplicación de las tecnologías de la información y las telecomunicaciones. Durante la investigación, se emplearon métodos generales de investigación científica, incluidos métodos dialécticos, lógico-formales y estructural-funcionales, así como varios métodos empíricos. Se llegó a la conclusión de la necesidad de reestructurar elementos del proceso educativo, principalmente para posibilitar la enseñanza a distancia. Asimismo, los autores de esta investigación identificaron la ausencia de una única estrategia correcta para la adaptación de las entidades emprendedoras a las tecnologías digitales. Por lo tanto, se propuso un enfoque para estructurar el proceso educativo, destacando las medidas que deben modificarse cuando se utilizan tecnologías digitales. Los hallazgos de la investigación son relevantes y útiles para que las autoridades implementen herramientas para influir en la digitalización de la educación en Ucrania.

Palabras clave: tecnologías de la información, proceso educativo, educación a distancia, digitalización, participantes del proceso educativo, provisión.

1. Introduction

The rapid development of new information and communication technologies is changing the nature of knowledge acquisition, dissemination, and development. The new technologies expand possibilities for updating the content and methods of education and enhancing access to it. They also transform the role of the teacher in the educational process, emphasizing the importance of continuous dialogue and facilitating the transformation of information into knowledge and understanding.

The relevance of utilizing digital technologies is mediated by the need to respond to emerging destructive socio-legal phenomena, such as the COVID-19 pandemic or the legal regime of martial law in Ukraine. Quality learning mechanisms must be proposed when face-to-face education is impossible. In turn, digital technologies serve as a means to simplify and provide effective learning methods. Therefore, the urgent need for the informatization of education in the context of Ukrainian realities should be purposefully and systematically carried out through the methodology, technology, and doctrinal analysis of utilizing scientific-pedagogical, educational-methodical, and software-technological developments aimed at realizing the potential of digital technologies.

2. Literature Review

Some of the main areas of scientific and practical research on the educational process development toward the use of digital technologies are the following:

– individualization of learning;
– features of information technology support for the educational process;
– identification of negative characteristics that characterize the state of implementation of digital technologies in the educational process; features of information technology support for distance education.

Special attention in shaping the educational process based on digital technologies is given to works that analyze the process of individualizing learning. In addition, the importance of information technology support for the educational process is substantiated in many studies by foreign and national researchers.

The electronic educational resource of the information environment of distance learning (EER IEDL) can be defined as a collection of information for educational purposes presented in electronic formats. Its mastery provides conditions for various types of learning activities. At the same time, the data reflects a particular subject area. The study of this area, as well as the selection of information from the repositories, its delivery to the learner, content navigation, and interactive mode of working with the content, are implemented using the software of the distance learning system.

The problems of organizing the learning process based on the electronic educational resource implemented using distance learning technologies in higher education institutions have also been repeatedly investigated (Korsunska, 2000; Kukharenko, 1999).

The basis of this research is formed from works related to distance learning. On the one hand, such learning is an updated pedagogical technology that differs from traditional face-to-face technology without direct contact between the educator and the student (Kose & Kose, 2014). On the other hand, it is a self-contained mechanism of purposeful and methodically organized guidance in educational and cognitive activities (Simonson, Smaldino & Zvacek, 2014; Negash, Whitman Michael & Woszczynski, 2008). As for the domestic perspective on the issue, according to the statements of scholars, it is a universal, synthetic, integral, humanistic form of education that creates conditions for higher education learners. It is adapted to the basic level of knowledge and specific learning objectives (Botsula, Krechman & Plakhotnyk, 2015). Ukrainian experts in creating the Ukrainian Center for Distance Education adopted a similar interpretation. They agreed that the distance form of education would be understood as a form that utilizes global computer communications such as the Internet. It is based on the individual work of students with well-structured learning materials and active communication with educators and other students (Bykov, 2001).

Conceptually, distance learning involves receiving educational services remotely through the use of computer and communication technologies through purposeful and controlled independent activities of a higher education student. Such a student can study at a convenient location, according to an individual schedule, utilizing a set of specialized distance learning tools and coordinated opportunities for interaction with the teacher (Bilous-Osin & Panfilov, 2020).

Theoretically, there is no universally established approach to interpreting this concept: starting from its absolute universalization as a new universal form of education that can replace the traditional one and ending with its interpretation as a set of means and methods of transmitting educational information.

The U.S. National Center for Education Statistics (NCES) has identified four generations of distance learning tools when analyzing technological progress (Negash, Whitman Michael & Woszczynski, 2008). The main criteria that differentiate the characteristics of each generation are:

– the number of individuals who can interact with each other simultaneously (unilateral, bilateral, or multi-user interaction);
– the amount and type of information (voice, video data) that can be transmitted;
– the speed of information transmission.

The tools used in distance education from the mid-XIXth to the mid-XXth century (mail, radio, and television) can be characterized as one-way communication. The fourth generation of distance learning tools represents the next stage. It is characterized by improved interaction among higher education institutions (HEIs) and between HEIs and faculty, increased information transmission speed, and the ability to transmit large volumes of information. At this stage, distance learning encompasses tools from all generations, two-way video, the Internet with synchronous and asynchronous communication, and CD-ROM.

The provisions of the special legislation regarding the use of digital technologies in the educational process have been analyzed. Primarily, these provisions are outlined in the Resolution of the Cabinet of Ministers of Ukraine, "On Some Issues of Digital Transformation" (Resolution of the Cabinet of Ministers of Ukraine No. 365-r, 2021). Furthermore, Bilous-Osin T. I. (2022) correctly emphasized in this regard that the idea of digital transformation in the chosen sphere is reflected through:

a) creating an information system intended for competitive funding of scientific research;
b) establishing an electronic system for accessing existing scientific information resources, an electronic scientific information system;
c) establishing a registry of Ukrainian research infrastructures;
d) developing the Ukrainian scientific citation index;
e) creating an electronic system for awarding scientific degrees and conferring academic titles;
f) modernizing the document submission systems and conducting state accreditation of research institutions and higher education establishments in terms of their scientific activities;
g) ensuring the development of an academic text repository and connecting it with local repositories.

In general, the prioritized directions for transforming education include the following:

– automation of the admissions campaign,
– organization of recruitment and training (internship) for foreigners and stateless persons,
– ordering education documents and their European-style supplements,
– implementation of electronic licensing,
– modernization of the Unified State Electronic Database on Education,
– creation and modernization of a unified electronic monitoring system for graduates' employment, and so on (Resolution of the Cabinet of Ministers of Ukraine No. 365-r, 2021).

It should be noted that the educational process design based on the use of digital technologies is constantly changing. In EU member states, high quality of knowledge is ensured through the academic nature of courses, consideration of market needs, and increased responsibility of higher education recipients for the quality of their knowledge, as they are the main controlling link in the learning process (Wilson, 2018). The most interesting are training programs using new information technologies, including satellite television, computer networks, media, etc. An illustrative example in this regard is the National University of Distance Education (Universidad National de Educacion a Distancia-UNED) in Spain, which includes 58 educational centers in the country and 9 abroad (Rogers, Berg, Boettecher, Howard, Justice & Schenk, 2009).

3. Aims

The research aims to identify possible ways of using digital technologies in the educational process by addressing the following research tasks:

– determining the current state of digital technology utilization in education;
– analyzing priority directions for the development of digital technology utilization in the specified field;
– outlining the characteristics of distance education as a sphere that requires maximum digital transformation.

4. Materials and Methods

The educational process and its components define the peculiarities of the subjective dimension of organization and its normative regulation regarding the use of digital technologies. Therefore, the research on the mentioned issue employed the method of retrospective analysis. This method allowed identifying the usage of digital technologies in implementing distance education from the moment of Ukraine's

independence to the present. Furthermore, the formal-dogmatic method and the method of comparative analysis enabled the comparison of normative provisions related to the use of digital technologies.

The dialectical method was used to determine the national regulatory acts governing the educational process in Ukraine. The method of comparative analysis was employed to investigate international practices of using digital technologies in education. The modeling method was utilized to delineate the structure and ensure the elements of the educational process in the digital era. Meaningful blocks were identified to systematically address the problem, characterizing homogeneous groups of social relations using the structural-functional method.

5. Results

In Ukraine, the right to education is enshrined at the constitutional level and expressed through the following powers: the right to unimpeded access to education, free education, and, if necessary, the right to receive education in the language of national minorities (Article 53) (The Constitution of Ukraine, 1996). The right to education applies to any level, form, and type of education, including vocational (professional-technical), specialized secondary, higher education, and adult education (Law No. 2145-VIII, 2017). The educational process should occur by properly providing state funding for relevant socio-economic, educational, and scientific programs, creating conditions for effective and accessible educational services (Law No. 1556, 2014).

To fulfill these tasks, the state, through authorized bodies, should take all necessary measures, including ensuring access to higher education under any circumstances. It includes the functioning of social relations in education during quarantine measures (Decree of the Cabinet of Ministers of Ukraine No. 211, 2020) and under the conditions of a legal regime of martial law (Law No. 2102-IX, 2022). In such a situation, the use of distance learning instead of full-time and part-time forms has become a way to ensure the right to education.

The priority of the aforementioned direction was indicated in the National Strategy for the Development of Education in Ukraine until 2021. This document identifies the implementation of information and communication technologies as a priority for educational development, aiming to improve the educational process, accessibility, and efficiency of education and prepare the younger generation for life in an information society. The measures aimed at achieving this goal include:

– creating an information support system for the educational process to fulfill its main functions (providing education, socialization, internal control over the implementation of academic standards, etc.);
– providing vocational and higher educational institutions with educational computer complexes;
– creating electronic textbooks and scholarly encyclopedias;
– establishing a distance learning system, including for individuals with special educational needs, and so on (Decree of the President of Ukraine No. 344/2013, 2013).

Regarding the key direction of using digital technologies in the educational process, providing distance learning is the primary focus. It creates an opportunity for the organic integration of educational, scientific, and innovative activities in the educational process. Furthermore, it involves creating the following necessary conditions for participants in the educational process:

– to realize their abilities and talents;
– spreading knowledge among the population;
– raising the educational and cultural level of citizens;
– establishing international connections;

– engaging in international education, science, sports, art, and cultural activities (Law No. 2145-VIII, 2017).

The Regulations on Distance Learning (Decree No. 466, 2013) contain a more comprehensive definition of distance learning. Accordingly, distance learning is an individualized process of acquiring knowledge, skills, abilities, and cognitive activities. This process occurs through remote participants' interaction in the educational process within a specialized environment. It operates based on modern psychological, pedagogical, and information and communication technologies (Decree No. 466, 2013).

Conceptually, distance learning involves receiving educational services remotely, primarily without physically attending a higher education institution, using new computer and communication technologies. Thus, distance and correspondence learning defines the technical level of the tools inherent to them as distinctive features applied in the learning process. The basis of distance learning is purposeful and controlled intensive independent work of higher education students. They can study at a convenient location, follow an individual schedule, utilize specialized learning tools, and maintain communication with the teacher through telecommunication.

The characteristics of distance learning, in comparison to traditional education, usually include the following definitions:

1) flexibility: In distance education, students have the ability not to attend regular lectures and seminars but instead work at their own convenient time, place, and pace. It is a significant advantage for those who cannot or do not want to disrupt their routines. Each individual can learn as much as they need to master the subject and obtain the necessary credits for the selected courses, thus providing fundamentally new access to education while maintaining its quality;
2) modularity is ensured by structuring the curriculum to meet individual or group needs;
3) parallelism combines the main professional activities with learning, essentially "without interrupting production";
4) asynchrony: During the learning process, the teacher and the student can implement teaching and learning technologies independently in time, according to a convenient schedule and pace, using email, software designed for user devices, and other information technology tools;
5) coverage: It ensures access to various sources of educational information (electronic libraries and databases) and communication with participants in the educational process through communication networks or other information technology means.

Thus, distance learning involves transmitting information about specific content (knowledge, skills, and abilities), and which ultimate goal is the student's ability to use this information in their activities.

It is necessary to form the corresponding strategic components to ensure distance learning based on digital technologies, as reflected in *Table 1*.

Table 1.
The characteristics of strategic components of digital-based distance learning

Strategic components	Features of the elements that form the components
Strategic principles of DL	
Management style	Human-centered, aimed at the student
Interactivity	High level of digital technology use
Means of transferring learning content	Fourth generation

Strategic components are ensured by the influence of external factors such as "culture" and "technics and technology." In this case, the "culture" factor determines the high level of individualization of societal consciousness, which defines the necessity of forming interactive learning systems. The "technics and technology" factor represents the high level of technical development of educational tools. However, achieving the aforementioned characteristics is a necessary but insufficient condition for forming interactive learning. The final element that needs to be considered in this process is the application of technologies that can implement the principle of interactivity, namely interactive didactic technologies (Kivalov & Bila-Tiunova, 2020).

Based on the conducted analysis, two levels of distance education in Ukraine can be distinguished:

– education as a whole comprises a set of learning courses
– a training course as a basic element.

It should be noted that the means of ensuring interactivity in education at these two levels are different. In the first case, the basis for providing interactivity lies in communication technologies and organizational measures that contribute to the integration into a unified system of distance education. In contrast, interactive didactic technologies are implemented based on "advanced" computer technologies in the second case. Therefore, the authors believe the next step in developing distance learning should be the intensive provision of interactivity in training courses as the essential element of didactic distance education.

Table 2.
The structure of the educational process in the context of digital technologies

Element	Methods of provision	Influence factors
Provision of the educational program	Information support Human resources support Material and technical support Educational and methodological support	Globalization Humanization Informatization
Learning environment	Form of study Methods of study Approaches to learning	

In connection with this, the authors again emphasize the importance of the comprehensive development of interactive instructional courses as essential elements. *Table 2* presents a vision of structuring the educational process and the methods of ensuring that need to be modified while applying digital technologies.

6. Discussion

The main determinant of implementing digital technologies in the educational process is their perception and mastery by the participants: educators and students at all levels of education. The issue of using information and communication technologies in higher education remains relevant. In this regard, let us focus on the conclusions of Kivalov, S., & Bila-Tiunova, L. R. regarding the feasibility of implementing online seminar (webinar) technologies, which involve comparative tables, presentations, videos, and so on. Through the use of internet technologies, an online seminar retains the main characteristic of a workshop - interactivity. It provides for modeling the functions of the presenter and the audience, who work interactively. That requires significant consolidated efforts from departments, information centers, laboratories, and libraries to provide high-quality problem-oriented resources, consequently ensuring knowledge acquisition. Using educational platforms such as Moodle is beneficial, where teachers can share their developments and organize learning assessments.

If educators are motivated to use information and communication technologies, traditional teaching materials can be replaced by virtual manipulatives. Thus, the use of information and communication technologies in education depends on the choice of educators to adopt new teaching techniques (Kivalov & Bila-Tiunova, 2020).

The use of digital technologies is significant in any educational process. Its impact on overall educational effectiveness remains particularly noteworthy. For instance, Cavanaugh, C. S. (2001) examined the effectiveness of interactive distance education in teaching through 19 experimental and quasi-experimental studies involving 929 participants. The findings showed a more positive effect regarding interactive distance learning programs that combine individualized approaches with traditional classroom instruction. In a study by Altinay, F., Altinay, M, Dagli, G., & Altinay, Z. (2019), the authors concluded that distance education contributes to equal opportunities. Individuals need to recognize their role in the accessibility process, institutional support, technological infrastructure, student support, learning environment, and equality-based distance learning programs that promote lifelong learning.

The issue of studying participants' perceptions in the educational process regarding the use of digital technologies still needs to be solved. In this regard, there are studies available on reducing student anxiety and methods for addressing this condition (Schönfeld, Brailovskaia, Zhang & Margraf, 2019; Rith-Najarian, Boustani & Chorpita, 2019). Furthermore, psychological well-being, conscious choice of university, and socio-psychological adaptation significantly impact satisfaction with education, indicating the overall quality of the higher education institution. For instance, in studying the relationship between self-regulation modes, perceived stress, and academic performance, it was concluded that the degree to which a stressful situation is perceived is determined by how respondents generally react to stress (Bellino, Sinatra, de Palo & Monacis, 2017). In this regard, there are proposals for implementing training programs to enhance stress resilience among participants in the educational process. After all, the value of being able to focus attention, for example, on taking exams, is a significant indicator supporting the thesis that an assessment of their psychological state should accompany the education of Ukrainian students (Latkovska, Sidor, Goloyadova & Kalimbet, 2019).

The institutional support for using digital technologies in education is also in the stage of development. As rightly noted by Bilous-Osin T. I. (2022), the institutionalization of the priority goal, which is the use of digital technologies in education and science, holds significant importance in the activities of the Ministry of Education and Science of Ukraine. Under these circumstances, the Directorate of Digital Transformation, an independent structural unit of the Ministry of Education and Science of Ukraine, will need to reform several established working principles that serve as a practical basis for further research on the chosen issues. Among the priority tasks of the Directorate of Digital Transformation is to ensure the formulation of state policies based on continuous analysis of the state of affairs in digital transformation and digital development through the search for alternative solutions to existing problems is highlighted. Projects and initiatives of the Ministry of Education and Science of Ukraine aimed at supporting education in times of war remain essential. Moreover, the majority of such innovations are based on the use of digital technologies, which is a positive practice (for example, the launch of the Telegram bot "Info Science Bot," the conduct of free webinars in Ukrainian by the company Clarivate, the opening of the ERA4Ukraine portal to provide informational and support services to educators, and so on).

7. Conclusions

The authors of this study have concluded that during destructive social phenomena, the way to ensure the right to education is through distance learning instead of face-to-face and correspondence forms, effectively enabled by digital capabilities. It has also been established that to facilitate distance learning based on digital technologies, the formation of corresponding strategic components is necessary: management style, interactivity, and means of content delivery. The authors have proposed a vision of structuring the

educational process by identifying elements such as curriculum provision and learning environment, as well as the ways to ensure them, which need to be modified while applying digital technologies.

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