



ISSN 2450-6486

<http://ehs.eeipsy.org>DOI: <https://doi.org/10.38014/ehs-ss.2025.1.06>

This publication was made with the funds of a joint Grant of
EEIP (Ukraine - France) and ChF "Education: Future"



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Educational innovations and digital technologies as an opportunity to improve the educational environment in Ukraine during martial law

OLEH YATSUKH. **Educational innovations and digital technologies as an opportunity to improve the educational environment in Ukraine during martial law.** *In recent years, education in Ukraine has undergone significant changes. The COVID-19 pandemic and the armed aggression of the Russian Federation have accelerated the implementation of digital learning, and higher education institutions have begun to use global learning management systems to organize the educational process.*

The study uses a comprehensive approach to the literature review, based on scientific research related to educational innovations and digital transformation. The results of the research identify the main aspects of the relationship between educational innovations and digital transformation, and offer potential opportunities for improving teaching and learning practices in higher education institutions.



Received 02.20.2025

Peer-reviewed 03.05.2025

Revised version received 03.15.2025

Accepted 03.28.2025

The study emphasizes that educational innovations and digital transformation are important ways to create a reliable, flexible and globally competitive education system in Ukraine.

Keywords: *educational innovations, learning management system, virtual reality, artificial intelligence, blockchain, Internet of Things.*

1. Introduction

In today's evolving education system, the integration of educational innovation and digital transformation has become imperative to meet the needs of the 21st century. Research has shown that the integration of digital tools and technologies, including learning management systems, interactive multimedia resources, and educational programs, is associated with improved outcomes for higher education students and learning experiences [1]. Moreover, the COVID-19 pandemic has highlighted the urgency of implementing educational innovation and digital transformation to ensure continuity of learning during the crisis. Distance learning technologies and online platforms have played a crucial role in enabling distance learning and supporting continuity of education during quarantine and closure of higher education institutions [2, 3].

Today, distance learning has become an alternative form of obtaining higher education for most universities. The events of February 24, 2022 due to the armed aggression of the Russian Federation against Ukraine made face-to-face education impossible in the eastern and southern regions for more than three years, so distance learning has become the only available form in the education system. The functioning of the Ukrainian education system under martial law is characterized by an intensive search for innovative forms of organizing the educational process, effective information technologies. That is why supporting the active implementation of educational innovations and digital technologies during martial law has become one of the key areas of work of the Ministry of Education and Science of Ukraine [4].

In light of these developments, studying the relationship between educational innovation and digital transformation in the Ukrainian context holds significant promise. By examining the current state of educational innovation and digital transformation in Ukraine and identifying factors influencing their adoption and implementation, researchers contribute valuable insights to inform policy decisions, shape educational practices, and ultimately improve learning outcomes for higher education students across the country [5].

2. Analysis of Recent Research and Publications

In recent years, the integration of digital technologies into education has attracted attention worldwide, with researchers exploring its potential to improve teaching and learning.

Research on innovative pedagogical technologies offers insights into new approaches to integrating technology into the educational process. These works inform teachers in Ukraine about innovative methods and tools that can improve teaching and learning practices. Questions are also raised about the effectiveness of distance learning, especially compared to face-to-face learning [6-8].

Moreover, the author [9] focuses on contemporary higher education systems and institutions, providing information on issues and developments in wartime higher education. Although he does not directly address educational innovation and digital transformation in Ukraine, he offers comparative perspectives that can inform discussions about education systems in conflict-affected regions.

The author of this study [10] compares the effectiveness of e-learning and traditional face-to-face learning in war zones, providing information on the potential of online education in challenging environments.

Despite the growing literature on digital transformation in education, there is a gap in research that examines the Ukrainian context. This gap highlights the opportunity for further exploration of effective strategies for the synergy of digital tools with innovative approaches to learning in the Ukrainian educational environment.

The purpose of the article is to provide a comprehensive understanding of the interaction between educational innovations and digital technologies and the prospects for implementing digital transformation in education in Ukraine.

Object of research: modern technologies supporting higher education.

Subject of research: features of the application of educational innovations using the example of the application of digital technologies in higher education institutions.

Research methods: when writing the article, such methods as content analysis of literature, thematic analysis, synthesis method, comparison, generalization, etc. were used. Content analysis included the study of the main innovations presented in the literature. Thematic analysis involved the division of scientific literature into thematic blocks and their study.

3. Research Results and Their Discussion

Today, there is a very noticeable research interest in the use of innovative technologies in education, especially after 2020. This surge is explained by the unprecedented challenges caused by the COVID-19 pandemic, which prompted educational institutions around the world to quickly switch to new technologies, to online or hybrid forms of learning. As a result, the number of scientific publications has increased sharply (specifically in the context of Ukraine), the largest number of them was in 2022-2024. [11-13].

Educational technologies continue to evolve, knowledge is disseminated and applied in educational institutions, and their impact is becoming increasingly pronounced. Here are some of the main aspects of the relationship between educational innovations and digital transformation:

1. Access to knowledge – digital technologies have provided access to education, eliminating geographical barriers. Through online platforms, students can access educational resources from all over the world, which provides the opportunity for lifelong learning.

2. Personalized learning – educational innovations use digital tools to adapt learning to the individual needs of students. Adaptive learning platforms and intelligent learning systems are examples of how technology can adapt to different learning styles.

3. Collaborative learning – digital transformation contributes to the creation of a shared learning environment in which students can interact with colleagues around the world. Virtual classrooms and online forums provide interactive learning experiences [14].

4. Better pedagogy – innovative educational practices integrate digital tools for improved teaching methods. Interactive multimedia content and gamified learning experiences, such as virtual reality (VR) and augmented reality (AR), are opening up new possibilities for learning.

5. Data-driven analytics – Digital transformation allows for the collection and analysis of vast amounts of data on student performance [15]. Educational institutions can use this data to gain insights into identifying areas for improvement and optimizing learning outcomes.

6. Flexible learning models – digital technologies facilitate flexible learning models (blended learning, etc.). These models combine traditional face-to-face learning with online components [16].

7. Adaptive assessment – digital tools allow for the use of adaptive assessment methods that dynamically adjust to individual student

performance. This allows for more accurate measurement of learning outcomes and provides feedback.

Educational innovation and digital transformation are so closely linked that they are causing profound changes in the perception and evaluation of higher education. Using digital technologies, academics are creating more personalized and effective learning environments. This relationship is especially noticeable when analyzing the Ukrainian education model, where the digital transformation of education plays a major role.

The integration of computer technologies into the educational systems of higher education institutions is a key strategy used to enhance the teaching experience.

Ukraine is actively implementing digital transformation initiatives to modernize its educational infrastructure and pedagogical practices. Their main goal is to bridge the digital divide by ensuring equal access to technological resources and equipping higher education students with the necessary 21st century skills that are essential for thriving in the country's digital economy [1-5].

The educational environment of Ukraine is constantly evolving with the integration of personalized learning methodologies, which are significantly supported by the emergence of digital technologies [6-9, 17]. These advances facilitate adaptive learning paths and individualized delivery of educational content. In addition, the availability of massive open online courses and virtual learning platforms has revolutionized education, overcoming geographical and traditional limitations (Table 1).

The experience of EU Member States such as Finland, Estonia and the Netherlands demonstrates that personalized learning platforms and tools driven by AI can improve teaching and learning methodologies, thus opening up the potential for their use in Ukraine to modernize educational practices. In addition, AR and VR technologies, which are widely used in the EU, are promising as effective tools for creating immersive learning environments and expanding access to new learning methods in Ukraine. Therefore, based on successful implementations in Sweden, Germany and the Netherlands, Ukrainian higher education institutions can draw inspiration for launching similar projects. It is important to note that certain technologies, such as mobile learning and learning management systems, are already actively used in Ukraine.

Table 1. Comparative review of innovative technologies in education: European Union experience and potential opportunities for Ukraine

Technology	General capabilities	Implementation into EU education	Opportunities in Ukraine
Artificial Intelligence (AI) – uses algorithms to model human intelligence tasks	Personalized learning, adaptive assessments, intelligent learning systems, data analysis	AI-based educational platforms and tools are being implemented in EU Uni to improve teaching and learning. In particular, AI in education initiatives are notable in Finland, Estonia and Netherlands.	Integrating AI into educational reforms to improve teaching methods, promote personalized learning, and provide individual support tailored to the individual needs of higher education students
Augmented Reality (AR) – overlays digital content on the real environment	Immersive learning, interactive simulations, virtual tours	The use of AR is gaining popularity to increase engagement and understanding. Augmented reality is particularly integrated into the education systems of Sweden, Germany and France	Integrating AR technology to complement traditional teaching methods, offering virtual classes and enabling virtual tours of historical or scientific sites
Virtual Reality (VR) – virtual reality immerses users in a computer environment	Virtual tours, experiential learning, simulations, professional training	Virtual reality technologies are being integrated into various educational contexts, including STEM education, medical training, and vocational education.	Implementing VR in educational environments to ensure immersion in the learning process, improve the development of practical skills, and provide virtual learning environments
Adaptive learning systems – adjust educational content and teaching methods based on student data	Personalized learning paths, adaptive assessments, differentiated learning	Adaptive learning systems are being implemented in EU educational institutions to meet learning needs and preferences. Notable implementations include Austria, the Netherlands and Denmark.	Integrating adaptive learning systems to tailor the educational experience to individual student needs, provide personalized learning paths, and optimize learning outcomes
Learning Management Systems (LMS) – software platforms for managing training courses	Centralized content delivery, online assessment, student tracking	LMS are used in EU education to facilitate distance learning and track student progress. Implementation in Germany, Sweden and France	Implementing an LMS to optimize educational processes, improve access to educational resources, and facilitate communication between teachers and students
Blockchain in education – securely records and verifies transactions and data	Verification of certificates, academic integrity, transparent record keeping	Blockchain applications in education in EU institutions to verify credentials, ensure academic integrity and transparent record keeping	Using blockchain technology to securely verify credentials, keep records transparently, and ensure academic integrity in educational processes
Internet of Things (IoT) – interconnected devices that enable data exchange and automation	Smart classrooms, real-time monitoring, personalized learning	IoT applications are being explored in EU educational institutions to improve efficiency, security and personalized learning experiences	Integrating IoT technologies to create intelligent operating systems, provide real-time monitoring of student progress, and facilitate personalized learning

The analysis of scientific literature revealed that the implementation of educational innovations and digital transformation in Ukraine is influenced by the following factors:

- 1) Government policy that supports educational innovations and digital transformation should facilitate the introduction of new technologies in education [18].
- 2) Institutional capacity. The readiness of higher education institutions to implement and implement educational innovations is important [19].
- 3) Collaboration and monitoring. Collaboration between academia and the government is crucial for the implementation of educational innovations. Continuous monitoring mechanisms are important for assessing the effectiveness of educational innovations [20].

Therefore, with the widespread implementation of educational innovations based on digital transformation, it is possible to improve the overall education system. Educational innovations and digital transformation provide opportunities for personalized learning experiences, adaptive assessment methodologies, and interactive learning tools. In addition, digital resources can expand access to a variety of educational materials, providing a more immersive and interactive learning experience for students. By integrating educational innovations and digital tools, student engagement will be enhanced through interactive learning and multimedia content. We believe that this can have an impact on both the quality of education and the provision of an equitable educational environment. The authors' findings [21, 22] shed light on the role of artificial intelligence (AI) and data network effects in creating value for the user, which has significant implications for the integration of AI-driven technologies into educational contexts. This study also highlights the implementation of AI as an important perspective for the development of the Ukrainian education system. The Ukrainian education sector will benefit from using the capabilities of AI to personalize learning experiences, optimize resource allocation, and facilitate data-driven decision-making.

Current research focuses on artificial intelligence, virtual reality, and augmented reality technologies [23]. The discussion presented in our study serves as a catalyst for further research and collaboration between scholars and policymakers interested in advancing educational innovation and digital transformation in Ukraine. Building on the knowledge gained from existing research, Ukraine can position itself at the forefront of

educational reform, driving positive change and empowering future generations in an increasingly digital world.

4. Conclusions

Through a comprehensive review of the current literature and an analysis of the current state of the Ukrainian education system, several key conclusions can be drawn.

First, the findings highlight the paramount importance of implementing educational innovation as a means of improving teaching and learning practices, promoting student engagement, and facilitating lifelong learning opportunities. By leveraging digital technologies, Ukraine can address ongoing challenges in the education system and adapt to the demands of the digital age.

Second, by investing in infrastructure, teacher training, and developing curricula aligned with digital technologies, Ukraine can harness the transformative potential of digital technologies to create a more effective learning environment.

Third, this study is a call for further research and collaborative efforts to advance educational innovation and digital transformation in Ukraine. Continuous exploration of best practices, innovative methodologies, and policy interventions is essential to foster positive change and move Ukraine toward a more prosperous and knowledge-driven future.

By innovating, encouraging digital literacy, and prioritizing education reform, Ukraine can position itself at the forefront of education and ensure the prosperity of future generations.

Suggestions for future research. To initiate positive transformations and guide Ukraine toward a prosperous future, long-term research that tracks the effects of educational initiatives over time is critically needed. By examining global trends and best practices, researchers can identify areas where Ukraine is doing well and areas where improvements are needed.

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Abstracts

ОЛЕГ ЯЦУХ. Освітні інновації та цифрові технології як можливість покращення освітнього середовища в Україні під час дії воєнного стану. В останні роки освіта в Україні зазнала значних змін. Пандемія COVID-19, збройна агресія російської федерації прискорили впровадження цифрового навчання, і заклади вищої освіти почали використовувати світові системи управління навчанням для організації освітнього процесу.

У дослідженні використовується комплексний підхід до огляду літератури, що спирається на наукові дослідження, пов'язані з освітніми інноваціями та цифровою трансформацією. Результатами досліджень визначено основні аспекти взаємозв'язку освітніх інновацій та цифрової трансформації, пропонуються потенційні можливості для покращення практики викладання та навчання у закладах вищої освіти.

У дослідженні підкреслюється, що освітні інновації та цифрова трансформація є важливими шляхами до створення надійної, гнучкої та конкурентоспроможної на світовому рівні системи освіти в Україні.

Ключові слова: освітні інновації, система управління навчанням, віртуальна реальність, штучний інтелект, блокчейн, інтернет речей.

OLEH YATSUKH. Innowacje edukacyjne i technologie cyfrowe jako czynnik poprawy środowiska edukacyjnego w Ukrainie w warunkach stanu wojennego. W ostatnich latach system edukacji w Ukrainie uległ znaczącym zmianom. Pandemia COVID-19 oraz zbrojna

agresja Federacji Rosyjskiej przyspieszyły wdrażanie technologii cyfrowych w nauczaniu, a instytucje szkolnictwa wyższego zaczęły wykorzystywać globalne systemy zarządzania nauczaniem do organizacji procesu edukacyjnego.

W badaniu zastosowano kompleksowe podejście do przeglądu literatury, oparte na badaniach naukowych dotyczących innowacji edukacyjnych i transformacji cyfrowej. Wyniki badań pozwoliły na identyfikację kluczowych aspektów zależności między innowacjami edukacyjnymi a transformacją cyfrową oraz zaproponowanie potencjalnych możliwości doskonalenia procesów nauczania i uczenia się w instytucjach szkolnictwa wyższego.

W badaniu podkreślono, że innowacje edukacyjne oraz transformacja cyfrowa stanowią istotne narzędzia budowania stabilnego, elastycznego i konkurencyjnego na arenie międzynarodowej systemu edukacji w Ukrainie.

Słowa kluczowe: *innowacje edukacyjne, system zarządzania nauczaniem, rzeczywistość wirtualna, sztuczna inteligencja, blockchain, Internet rzeczy.*