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THE DILEMMAS OF THE POST-DIGITAL TRANSITION IN HIGHER EDUCATION: CHALLENGES AND HIDDEN THREATS

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ДИЛЕМИ ПОСТЦИФРОВОГО ПОВОРОТУ У ВИЩІЙ ШКОЛІ: ВИКЛИКИ ТА ПРИХОВАНІ ЗАГРОЗИ

The article examines the conceptual dilemmas surrounding the use of digital technologies in higher education to create an innovative learning environment, and their impact on students' cognitive processes; the risks of excessive reliance on algorithms and easy access to educational information, and the resulting decline in the ability to analyse such information in depth and critically; ethical issues surrounding the use of artificial intelligence in education and the threat of a loss of agency for both teachers and students; the 'replacement' of genuine emotional contact in the learning process with mechanical interaction, which has a negative impact on psycho-emotional health, and others. It has been established that the profile of a modern teacher's digital competences is determined by their ability to integrate technical resources

and innovative tools into the process of developing cognitive flexibility and creativity among learners in higher education institutions. The key components of this model are identified as proficiency in data visualisation, effective organisation of communication in the digital space, and the validation of learning outcomes through instant feedback systems. It is emphasised that, under such conditions, the intensification of professional training for future specialists (teachers), focused on mastering innovative digital technologies in education, takes on strategic importance. It is confirmed that the realisation of the potential of digital technologies in the educational process of a modern university encompasses a wide range of organisational forms that transform traditional learning into a flexible digital ecosystem. Some practical case studies are presented on the use of digital tools to achieve various educational objectives in the professional training

of specialists. Specific aspects are analysed based on experience working with students at Vasyl Stefanyk Carpathian National University (Ukraine) and the Pomeranian University in Słupsk (Poland). Continuous self-improvement in the use of multifunctional digital services, as presented in this study, is a fundamental prerequisite for improving the quality of higher education.

Key words: digitalisation of education, post-digitalisation, digital technologies, higher education, professional training, educational innovations, artificial intelligence, professional competence.

The aim of this article is to examine the conceptual dilemmas surrounding the implementation of digital technologies in higher education, the challenges and risks faced by teachers and students in the educational process in the post-digital era, and to present a practical case study on the use of digital services in working with

students in Ukraine and Poland.

A general overview of the problem.

The digitalisation of education is viewed as the latest phase of informatisation, the essence of which lies in the widespread adoption of electronic and digital systems within the university learning environment. This creates conditions for continuous communication between technological agents, which effectively determines the emergence of a cyber-physical educational space – an environment where virtual and physical realities exist in integral unity. This process is dichotomous: it encompasses both the development of an infrastructure framework (online courses, services, digital content) and a fundamental transformation of the didactic paradigm, aimed at adapting the individual to the demands of the global digital economy (Bykov, Liashenko, Lytvynova *et al.*, 2022, p. 9).

The concept of "post-digitality" in higher education is profoundly deep, as it transcends the mere implementation of computing technologies (Jandric *et al.*, 2018). The core premise suggests that digital technologies have become so seamlessly woven into the fabric of our lives that we no longer perceive them as distinct entities; instead, they have become an integral part of our biological, educational, and social reality (Tsependa & Budnyk, 2021). The current stage of post-digitalization in education is characterized by a deep convergence of traditional and digital teaching methods, alongside the minimization of various barriers to their application (Diana *et al.*, 2025). The scaling of virtual educational platforms not only optimizes pedagogical activities in distance (blended) environments but also fosters a specific digital environment - a contextual background where technologies are integrated into the daily practice of higher education via global networks and mobile services. Such an environment becomes a pivotal factor in ensuring educational accessibility, enabling the overcoming of psychological barriers and the realization of individualized learning trajectories through flexible formats of

content delivery.

The "Strategy for the Digital Development of Innovation Activity in Ukraine for the Period until 2030" (2024) outlines the implementation of innovations through two primary vectors. During the first stage (2025–2027), the focus shifts toward the institutional foundation: optimizing the regulatory and legal framework, stimulating the R&D sector, and developing the infrastructural backbone for the startup ecosystem. The subsequent cycle (2028–2030), which will be based on a rigorous analysis of previous outcomes, envisions the intensification of financial support for innovative entrepreneurship and the enhancement of synergy between academia and business. Within this framework, higher education oriented toward creativity serves as the fundamental cornerstone of the system. Strategic priority is given to the formation of an innovation ecosystem directly within educational institutions, where advanced mathematical and natural science training is viewed as a driver of national competitiveness and economic progress in the post-digital era.

At the same time, alongside the obvious advantages, the total diffusion of technology into the educational space generates a series of challenges that require scholarly and pedagogical reflection. These include, in particular: over-reliance on algorithms and easy access to information, which may lead to a diminished capacity for deep critical analysis (*digital frustration*); ethical issues concerning the application of Artificial Intelligence in education (academic integrity and the threat of losing the agency of both teacher and student); and the 'replacement' of live emotional contact in the instructional process with mechanical interaction, which may negatively impact the development of soft skills and psycho-emotional health. Furthermore, cybersecurity remains a critical concern when utilizing digital learning resources or other virtual information.

In addition, the challenges of educational digitalization include the

digital divide, uneven access to technology, and the necessity of revising curricula for the effective implementation of digital tools (Blyznyiuk *et al.*, 2025). There is also a pressing need to prepare future educators for organizing the educational process and implementing digital innovations to enhance the quality of higher education (Tsiuniak *et al.*, 2024).

Analysis of Recent Research. The implementation of digital technologies in education is a multidisciplinary issue reflected in the publications of both Ukrainian and international authors. Specifically, V. Bykov developed the theory of creating electronic educational environments and cloud-oriented systems; O. Spirin and O. Pinchuk focused on the methodology of using ICT in scientific research and professional teacher training; S. Lytvynova addressed the issues of cloud technologies and the virtualization of educational spaces; R. Gurevych examined digitalization within the context of vocational and technical education; and N. Morze explored the conceptual foundations for developing digital competencies and implementing STEM education, among others. Among foreign researchers are P. Jandric (theoretical foundations of post-digital education), L. Liukas (the development of algorithmic thinking and programming visualisation for children), N. Selwyn and D. Schiff (the use of artificial intelligence in education), and others.

However, the dilemmas, challenges and threats facing contemporary higher education in the post-digital era from an educational perspective have not been adequately addressed in current academic literature.

Presentation of the Main Research Material. A Model of Post-Digital Dilemmas in Higher Education. In response to the challenges outlined above, this article proposes a four-dimensional analytical model of post-digital dilemmas in higher education, encompassing the cognitive, relational, agency-related, and institutional dimensions. The proposed model serves as a conceptual framework that enables a more systematic

interpretation of the complex and interrelated processes shaping contemporary academic education, moving beyond a purely descriptive account toward a more analytically grounded approach.

The first dimension – the cognitive dilemma – refers to the tension between the unprecedented availability of information and the limited human capacity for its deep, critical, and reflective processing. As noted by Selwyn (2024), generative artificial intelligence tools primarily reproduce existing content through statistical associations rather than genuine understanding. Consequently, the increasing reliance on algorithmically generated responses may foster superficial learning, based on the consumption of ready-made content rather than the autonomous construction of knowledge. In this context, a fundamental contradiction of post-digital education becomes evident: the growing volume of information does not necessarily translate into a corresponding increase in understanding or cognitive depth.

The second dimension – the relational dilemma – concerns the growing dominance of technologically mediated communication within academic teaching and learning processes. While digital environments enable continuous, multi-channel interaction, they may simultaneously contribute to the weakening of direct interpersonal relations between teachers and students. As indicated in empirical studies (Lukasiewicz-Wieleba & Romaniuk, 2022), the shift toward online communication often results in reduced non-verbal interaction, increased anonymity, and the erosion of informal academic contacts. Consequently, relationships within higher education may become more functional and task-oriented, rather than dialogical and relational in nature.

The dilemma of agency, as the third dimension of the proposed model, highlights the tension between technological support and the risk of so-called cognitive offloading. The widespread use of artificial intelligence may limit the autonomy of both

teachers and students when such systems begin to provide ready-made, direct answers instead of merely offering hints that guide users toward solutions. This raises serious concerns regarding the gradual erosion of critical thinking skills and creativity, as well as the weakening of motivation for independent learning. Uncritical reliance on algorithms may lead to the marginalization of individual cognitive styles and unconventional problem-solving approaches, promoting instead passive task completion at a low level of engagement. Consequently, rather than making users 'more intelligent,' such technologies may contribute to the uniformization of the educational process and the atrophy of key future competences (*Sekcja Edukacji Cyfrowej Komitetu Informatyki PAN, 2025*).

The final dimension referred to as the institutional dilemma concerns the transformation of the university as a social and cultural community increasingly shaped by post-digital conditions that redefine academic life, relationships, and institutional identity. As technological, organizational, and social orders increasingly intersect, universities more often adopt flexible, networked, and platform-based models of education that enhance accessibility and optimize didactic and administrative processes. At the same time, however, these processes entail the risk of weakening the communal character of the university and reducing academic relationships to a logic of process management.

In this context, the role of the academic teacher is being redefined: increasingly perceived not as an autonomous agent shaping the intellectual environment, but as a moderator or operator of complex educational systems functioning within a technological-organizational infrastructure. Consequently, a tension emerges between growing institutional flexibility and efficiency on the one hand, and the preservation of the formative, ethical, and communal function of the university on the other – understood not merely as a teaching organization, but as a space of relationships, reflection, and critical

engagement with knowledge and its social significance (*Jandric et al., 2018*).

It should be emphasized that these dilemmas do not operate in isolation but rather form a system of interrelated dependencies, in which changes in one dimension generate consequences in others. Therefore, the post-digital condition of higher education requires not only technological adaptation, but above all critical reflection on its cognitive, social, and institutional implications.

Within the framework of the post-digital approach, the digital educational environment is viewed as a well-established ecosystem that functions beyond the limits of specific tools, creating conditions for the total technologization of the educational process. Despite the emergence of new problematic nodes, digitalization significantly expands the boundaries of inclusion: the application of ICT allows for the minimization of students' socio-psychological deprivation and ensures universal access to knowledge in accessible and appropriate formats (*Budnyk, Matveieva et al., 2021*). This confirms the transition from the simple use of resources to the creation of a comprehensive environment where digital devices and internet networks serve as the fundamental prerequisite for high-quality education (*Kondur, Tsiuniak & Budnyk, 2025*).

While at the beginning of the 21st century – an era of active technological advancement – the focus was on the intensive implementation and use of digital technologies in higher education, and during the COVID-19 pandemic, the global pedagogical community adapted swiftly and effectively to new challenges to maintain instructional communication, today it is logical to identify a conceptual dilemma. Digital technologies no longer serve merely as tools in education but rather as a background, creating an effective educational 'computer-oriented' environment (*Bykov, Spirin & Pinchuk, 2017*). This leads to the first dilemma: a student remains online even while physically present in the classroom, as a significant

contemporary challenge is the 'disappearance' of the boundary between offline and online learning. In a pedagogical context, technology becomes invisible; we cease to critically evaluate its impact on students' cognitive processes, resulting in a certain loss of focus for the teacher, who is supposed to play a leading role in the educational process.

This observation further reinforces the cognitive dimension of the proposed model, particularly in relation to what L. Witkowski (2023) describes as paradoxes in education. In this context, the increasing volume of information available to both faculty and students does not necessarily lead to an improvement in the quality of learning or the acquisition of relevant competences, primarily due to the effects of cognitive overload. This can be captured by the well-established paradox that more information = more knowledge, as informational abundance may paradoxically contribute to the superficialisation of knowledge and a reduced capacity for critical analysis.

Moreover, the limited development of critical thinking skills increases susceptibility to misinformation and the uncritical acceptance of unreliable content. Importantly, this issue is not confined to earlier stages of education but is equally present in higher education, where students are expected to demonstrate a relatively mature level of intellectual and cognitive development. In this context, it becomes essential to support and further develop this pedagogical identity (Popa et al., 2026), which requires not only the effective use of digital tools but also the integration of interactive, learner-centered approaches that foster critical reflection and creative engagement. These processes are closely related to the agency dimension of the proposed model, within which a fundamental tension emerges between technological support and the risk of algorithmic influence on educational processes. Indeed, universities increasingly rely on Learning Management Systems (LMS), such as Canvas or Moodle, to organize the instructional process. A separate issue

is the application of Artificial Intelligence (AI) technologies (Vetoshkin & Budnyk, 2025): used by faculty to prepare teaching materials, syllabi, and tests, or to analyze student performance; and by students to complete assignments, create presentations, or find answers to tests. In this context, we face a significant challenge regarding automated assessment and predictive analytics (forecasting student outcomes based on their digital footprint). This also poses hidden threats, primarily related to so-called 'algorithmic determinism.' This refers to a biased teacher's perception of student performance results generated by AI, where the individual personality, unique talents, or unconventional perspectives on a specific problem remain unseen. At times, the system may produce a negative evaluation and conclude that a student is 'prone to dropout.' Consequently, digitalization in higher education is fundamentally altering the 'teacher-student' interaction format.

Further developing this dimension, educators and students increasingly utilize generative artificial intelligence for creating visual and conceptual content, which further intensifies the process of cognitive offloading. This reflects a new stage of the cyber-physical educational space, in which AI systems generate content based on textual prompts, thereby partially replacing individual cognitive effort (Boiko, Gevorkian, Vyshnevskaya et al., 2026). In practice, tools such as Gamma.app are used to automatically generate presentation structures and visual designs based on lecture materials, while systems like DALL-E 3 or Midjourney enable the creation of metaphorical and illustrative representations of complex abstract concepts that are often difficult to obtain through traditional resources.

Although such tools significantly enhance efficiency and expand the range of didactic possibilities, they also reinforce the tendency to rely on automated solutions in place of independent analytical and creative processes. As noted by Schiff (2022), artificial intelligence should be understood as a supportive tool in

professional activity rather than a substitute for human agency. Nevertheless, its use in educational contexts is associated with a number of risks, including errors, misinformation, and the potential weakening of critical engagement (Kayali, Yavuz, Balat et al., 2023).

From the perspective of the agency dimension, the application of artificial intelligence in education also generates a crisis of academic integrity affecting both teachers and students. The post-digital turn has made content creation (essays, term papers) instantaneous thanks to neural networks. Consequently, traditional pedagogical methods and tools, such as written assessments, are becoming obsolete. A dilemma arises: whether to ban AI (which is impossible in the post-digital era) or to completely restructure the logic of assessing student learning outcomes and assignments in favor of oral discussions and practical tasks (Selwyn, 2024). This situation carries the risk of creating another threat - the devaluation of diplomas and critical writing skills.

From the perspective of the relational dimension of the model, the realities of digitalization give rise to the problem of social isolation in conditions of hyper-connectivity. Although faculty and students are constantly 'online' (even in distance learning modes), the physical space of the university is gradually losing its 'sacredness.' Hybrid learning formats are frequently practiced, where some students join sessions via Zoom while others are present in the classroom. However, under such conditions, the use of digital resources in the operation of an educational institution also carries hidden threats – namely, the 'erosion' of the academic community. After all, a modern university is not just a series of lectures, seminars, and workshops; it is also a network of social contacts and informal communication between students and faculty (often referred to as 'corridor education'). Therefore, if a reasonable balance in digital information consumption and resource usage is not maintained, post-digitalization threatens to transform learning into the isolated consumption

of content.

At the institutional level, the post-digital transformation of higher education manifests itself in the intensification of so-called "digital labor" among academic staff. In theory, technology should facilitate life and assist in fulfilling a range of educational or scientific functions. However, in the post-digital era, a faculty member is accessible 24/7; through messengers and email, the boundaries between their professional and personal time have become increasingly blurred. Information constantly flows from university administrative structures, departments, or individual students. This situation is frequently a primary cause of professional burnout and the transformation of a professor into a 'platform moderator' or 'technical support,' effectively pushing scientific and research activities into the background.

A Practical Case Study on the Application of Digital Tools in Higher Education. The realization of the potential of digital technologies within the instructional process of higher education institutions encompasses a wide range of organizational forms that transform traditional learning into a flexible digital ecosystem. These include distance learning courses, webinars, hackathons, virtual laboratories, and interactive platforms for scientific collaboration. At the same time, electronic content emerges as a comprehensive information and resource support system that integrates library center holdings, networked collections of educational resources, and official institutional web resources, creating a unified

foundation for teaching and research activities (Bykov, Spirin & Pinchuk, 2017, p. 194). Of particular interest are virtual laboratories and simulations, which stimulate students' engagement in educational experiments and research trials (Budnyk, Shcherbiak & Vasylyeva-Khalatnykova, 2025).

Some research offers useful insights into the psycho-emotional support of those involved in the educational process who are facing specific challenges, such as war-related trauma (Kotyk & Budnyk, 2025). To this end, relevant digital applications or platforms serve as an effective tool for identifying students' emotional and psychological indicators in crisis situations and, consequently, providing them with educational support.

Contemporary researchers demonstrate the effectiveness of using mind maps in the study of humanities disciplines in higher education institutions and their potential for improving students' analytical, reflective and cognitive skills (Valentiev et al., 2026). Indeed, digital visualisation in higher education serves as an effective pedagogical tool for teaching the 'digital' generation of future specialists. In the context of post-digitalisation, visualisation ceases to be merely an 'addition' to the text and becomes a tool for cognitive modelling in professional training.

To this end, it is worth making use of a variety of digital resources: interactive dashboards and mind maps (Conceptual Mapping), which help to organise large amounts of theoretical material. These include: Miro / Mural – digital whiteboards for group work,

strategic planning and creating complex diagrams (for example, a SWOT analysis of the educational environment); MindMeister / XMind – for building hierarchical links between scientific concepts in pedagogy. To create infographics, higher education students readily use the following services in their dissertations or coursework projects: Canva, Piktochart, and Tableau Public, which not only allow them to present their research data but also help create interactive charts based on large datasets (Excel/ Google Sheets). To create explanatory animated videos (explainer videos), which are effective for explaining didactic algorithms or methodologies in pedagogy, we use Vyond / Powtoon.

In our work with students at universities in Ukraine and Poland, we systematically utilize Mentimeter, which is one of the most popular interactive online services for creating presentations with real-time feedback. Specifically, during trainings and workshops at the "PNU EcoSystem" Center for Innovative Educational Technologies (Carpathian National University), this tool proves ideal for implementing the principles of digital and post-digital pedagogy, as it effectively dissolves the barriers between the instructor (lecturer) and the audience.

We most frequently use this software to create various types of interactive slides, such as the Word Cloud. This feature helps gather students' associations regarding a specific issue; as they input words, the system instantaneously generates a cloud where the largest terms represent those repeated most often. Within the scope of our study, we presented students at Carpathian National University (Ukraine) and Pomeranian University (Poland) with the question: "In your opinion, which innovative technologies will be prioritized in higher education in the near future?" in both 2022 and 2026. (Their responses are illustrated in Figures 1–3).

As shown, Mentimeter offers certain advantages for use in an academic setting, in particular: the anonymity of students' responses, as they are often reluctant to answer in



Fig. 1. Survey of Ukrainian students in 2022



Fig. 2. Survey of Polish students in 2026

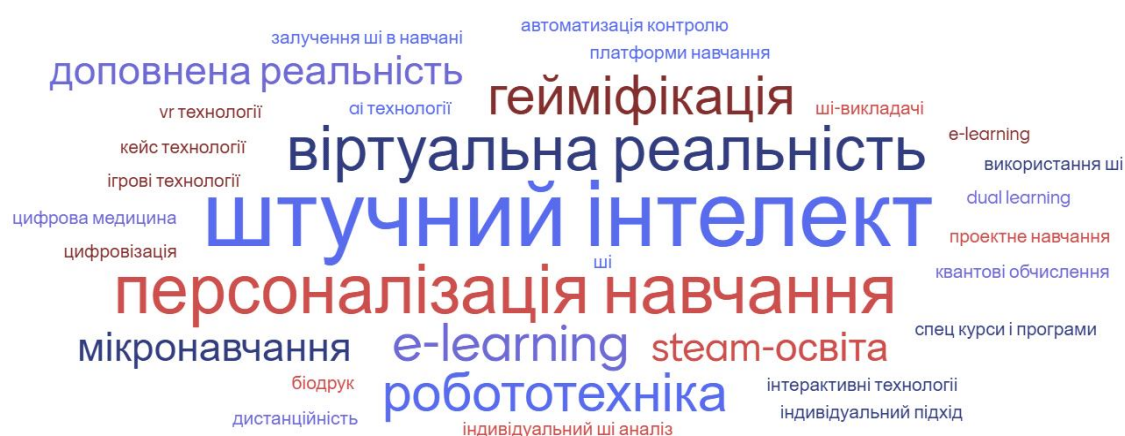


Fig. 3. Survey of Ukrainian students in 2026

front of the whole class; gamification (Quiz), as competitions can be held in real time, which significantly increases engagement, as well as instant data analytics for the lecturer, which helps to plan future work.

Analysis of the presented data allows for the formulation of several conceptual conclusions that emphasize the transformation of the educational space from 'crisis-driven' to 'globalized post-digital.'

1. A comparison of student responses for 2022 and 2026 demonstrates a gradual leveling of regional differences in educational demands. While in 2022, Ukrainian students focused on the format (distance learning) necessitated by the pandemic, in 2026, the developmental vectors of Ukrainian and Polish students fully coincide (Figs. 2–3). This confirms the thesis regarding the formation of a unified global

information space, where technological trends (AI, robotics) dominate regardless of the geographical location of the educational institution – digital barrier-free access in education.

2. The analysis reveals a qualitative change in interests: from tools that simply ensure connectivity (distance learning, projects) to tools of interaction. The priority given to 'virtual reality,' 'robotics,' and 'gamification' indicates a demand for immersive education, where the digital environment becomes not just a mediator but a full-fledged space for activity and experimentation.

3. Artificial Intelligence remains an unchanging constant in both timeframes; however, in 2026, it acts as the core around which other educational trends cluster. This indicates a transition from perceiving AI as an innovative add-on to understanding it as the basic

infrastructure of the modern educational process.

4. The inclusion of 'personalized learning' among the top priorities of 2026 is a logical consequence of post-digitalization. Students expect the higher education system to be adaptive to their individual needs, which becomes possible through algorithmization and big data analysis.

5. Although in 2026 the emphasis shifted to specific digital products (VR, robots), the foundation in the form of 'projects' and the 'STEAM approach,' recorded in 2022, laid the methodological groundwork for the perception of complex technologies. This demonstrates the continuity of educational innovations: from a change in methodology to a change in technological tools.

Conclusions. The research results certify the transition from "digitalization as a forced measure" to

"post-digitalization as a natural state" of the educational environment, where the key factor is not the mere fact of using technologies, but their ability to provide a personalized and immersive learning experience without any borders. Thus, post-digitalization is not about rejecting gadgets in higher education, but about a critical reflection on how they change our human nature and their application as an essential tool for professional pedagogical labor. In this context, the proposed model of post-digital dilemmas provides a conceptual lens that not only systematizes the identified tensions, but also enables a more critical and human-centered approach to the integration of digital technologies in higher education.

From this perspective, a teacher's digital literacy today encompasses not only technical proficiency in ICT but also the methodological capacity to use software tools for visualization, the stimulation of critical thinking, and the organization of flexible distance learning in working with students. An urgent task for higher education is the training of specialists capable of the prompt implementation of technological innovations and the constant updating of their own knowledge in a dynamic digital environment. The use of a wide range of tools described in this work will contribute to the formation of future teachers' readiness to work under the conditions of educational post-digitalization, taking into account challenges and hidden threats. Among the important cases are new standards of academic ethics and the implementation of so-called 'digital humanities,' which signifies the return of the human being (teacher or student) to the center of the technological process.

Prospects for further research are seen in studying the impact of generative AI on the formation of the future teacher's professional identity and the development of ethical protocols for AI use in the academic environment; monitoring professional burnout in conditions of intensive digitalization and searching for ways to support the psycho-emotional resilience of educators, among others.

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