

Educational transformation in the Digital Age: artificial intelligence, digital competence, and innovation trends from DigiTransfEd 2025

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Abstract

This editorial introduces the peer-reviewed international seminar dedicated to the theory and practice of digital transformation in education. The volume presents a collection of 13 carefully selected studies, offering significant contributions to the field of educational sciences. Research has been contributed from Ukraine, Belgium, and Japan, addressing contemporary educational trends, innovative pedagogical approaches, and the integration of digital technologies in teaching and learning. The accepted papers employ diverse methodological designs, including mixed-method approaches that combine questionnaire surveys with literature reviews, as well as statistical and descriptive analyses. The contributions highlight both innovative applications of widely used educational software and the development of specialized digital tools created by the authors. Key findings underline the transformative potential of digitalization in education. Out of 50 submissions, only 13 papers were accepted following a rigorous double-blind peer-review process and critical evaluation by the organizing committee, ensuring a fair and effective assessment of both the academic content and the outcomes of discussions during the seminar.

Keywords

LaTeX class, paper template, paper formatting, CEUR-WS

1. Introduction

The annual DigiTransfEd 2025 workshop focuses on the digital transformation of education, a subject of critical importance worldwide. Now in its fourth year, this peer-reviewed international seminar continues to bring together experts and researchers to explore the challenges and opportunities associated with the digitalisation of educational processes at all levels. Since its inception in 2022, DigiTransfEd has provided a platform for meaningful academic dialogue on how digital transformation can improve education systems, promote equity, and address the evolving needs of learners in an increasingly complex global environment.

Digital transformation has reshaped societies and economies across the globe, redefining the ways in which people communicate, work, and acquire knowledge. These global changes directly affect education, urging institutions to adapt swiftly and effectively. Crises in recent years, from the COVID-19 pandemic to broader geopolitical and social disruptions, have acted as catalysts for accelerating digitalisation in education. They have highlighted the growing importance of digital technologies, including artificial intelligence, while raising new pedagogical, ethical, and societal challenges that require careful consideration.

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The mission of DigiTransfEd has always been, and remains, to unite the scientific community in researching and advancing digital transformation in education.

2. Program Committee of DigiTransfEd 2025

We would like to express our sincere gratitude to the members of the Program Committee and the Organizing Committee of DigiTransfEd 2025 for their dedicated work, expertise, and invaluable support in preparing this workshop. Their contributions were essential to ensuring the high academic quality and organizational success of the event.

The Program Committee brought together experts from a wide range of countries and academic institutions, representing diverse research traditions and perspectives. This broad geographical and disciplinary scope significantly contributed to the quality of the proceedings by ensuring balanced evaluations and comprehensive coverage of the field. The majority of committee members also served as reviewers, providing detailed feedback and valuable recommendations that strengthened the accepted contributions. Through their efforts, only 13 out of 50 submitted papers were accepted, ensuring that the proceedings reflect both scholarly excellence and relevance.

Finally, we warmly thank all authors for their valuable scientific contributions. Their research advances the ongoing discourse on digital transformation in education and demonstrates the richness and diversity of approaches to addressing today's global educational challenges.

Organizing committee. The authors of this paper were the sole members of the Organizing Committee of the workshop.

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3. Themes and aims of DigiTransfEd 2025

The workshop invites researchers, doctoral students, and academics to share their insights on the integration of digital tools in teaching, learning, and educational management, with the ultimate goal of advancing best practices in education. The call for papers highlighted, though did not restrict participation to, a wide spectrum of themes (<https://digitransfed.ztu.edu.ua/>):

- digital transformation strategies for educational institutions;
- development digital resources for education;
- digital educational resources and practices;
- assessment and evaluation of digital learning environments;
- integrating digital technologies in teaching and learning;
- online and blended learning models for K-12 and higher education;
- student engagement and motivation in online learning;
- teacher training and professional development for digital transformation;
- ethical and social implications of digital transformation in education;
- gamification and game-based learning in digital education;
- innovative technologies and tools for digital education;
- adaptive learning technologies;
- digital transformation and educational equity;
- digital citizenship and digital literacy in education;
- digital learning environments for cooperation, collaboration and communication.

The accepted papers reflect several dominant areas of scholarly interest. Particularly well represented are studies on artificial intelligence in education [1, 2, 3, 4], teacher and University Educators' professional development in the context of digital transformation [5, 6, 3] and the design of digital environments and resources [7, 8, 9]. Further contributions explore innovative technologies, such as virtual reality, platform, tokenomics, and collaborative software [10, 8, 11, 12], alongside investigations into digital literacy and competence development [7, 13].

By contrast, certain themes received limited or no representation. Topics such as gamification and game-based learning, educational equity and accessibility, and the broader ethical and social implications of digital transformation were only marginally addressed. Likewise, models for K-12 education appeared only in the context of primary-level STEM integration. While some of these topics were the focus of rejected submissions, the overall academic quality of those manuscripts was insufficient for inclusion.

This distribution highlights the current priorities of educational research, particularly the strong emphasis on artificial intelligence and teacher preparation as the most pressing issues. At the same time, it underlines the need for future workshops to foster more contributions on inclusion, educational justice, digital citizenship, and gamification – areas that remain crucial for a comprehensive understanding of digital transformation in education.

4. Review of accepted articles on DigiTransfEd

Based on the keywords provided by the authors of accepted contributions to DigiTransfEd 2025, the research interests of the workshop participants can be grouped into the following thematic clusters:

1. Artificial Intelligence, Data Science & Educational Analytics;
2. Digital Transformation & Learning Environments;
3. Pedagogy, Teacher Training & Professional Development;
4. Digital Competence & Soft Skills;
5. Higher Education & Research Training;
6. STEM & Subject-Specific Education;
7. Ethics, Blockchain & Emerging Technologies in Education.

In comparison with DigiTransfEd2024, where the main clusters included: Digital Transformation & Education, Pedagogy & Teacher Development, Military Education, Physics & STEM Education, Data Science & Machine Learning in Education, and Higher Education, the 2025 edition shows both continuity and change.

In 2025, the thematic scope has both expanded and shifted. While the traditional clusters of digital transformation, teacher development, STEM education, data science, and higher education remain central, new and more diverse directions have emerged. In particular, the prominence of artificial intelligence and large language models (GPT2, BERT) marks a stronger orientation toward cutting-edge AI applications in education. Furthermore, the appearance of blockchain, tokenomics, and ethical aspects indicates growing attention to socio-technical and economic dimensions of digital transformation. At the same time, compared to 2024, the cluster of military education has disappeared, while the emphasis on digital competence, collaboration, and soft skills has become more explicit.

4.1. AI in education: from learning and teaching to well-being

The cluster of contributions [1, 2, 3, 4] reveals how artificial intelligence reshapes education in multiple, complementary dimensions. A clear commonality is their orientation toward the transformation of human capacities (whether cognitive, professional, institutional, or emotional) under conditions of AI integration. At the same time, each paper positions its inquiry within a distinct segment of the educational ecosystem, producing a layered picture of technological change.

One line of research engages directly with learners' intellectual development. Dziubanovska and Maslii [1] show how AI-based environments stimulate students' critical thinking while simultaneously raising ethical concerns over data reliability and confidentiality. Their work demonstrates that AI not only supports analytical learning but also foregrounds new domains of digital ethics, pointing to the dual role of technology as both a tool and a challenge. A parallel focus on human agency is evident in the study by Osadcha et al. [2], which shifts the lens to academic staff. By conceptualising seven emergent teaching roles in the AI era, the authors underline how professional identities must adapt when educational tasks are redistributed between human and machine actors. Both studies thus emphasise the interplay of cognitive and ethical judgement in contexts where AI is already embedded.

A different layer of inquiry concerns structural readiness in primary education. Barna et al. [3] introduce a STEM-AI Readiness Model that diagnoses teachers' preparedness through five interlinked components, with motivation and institutional support proving decisive. Their results underscore that successful adoption is not reducible to individual competence; it depends on systemic provision of resources and policy frameworks. Here, the contrast with [1] and [2] is notable: this work identifies the enabling conditions for teachers at earlier educational levels.

The most interdisciplinary direction is represented by Mazurets et al. [4], who apply a hybrid BERT-GPT model to detect depressive states among students. In doing so, they extend AI from pedagogy into the domain of psychological well-being. Although the approach achieves high technical accuracy, the authors caution that diagnosis does not guarantee intervention, highlighting the limits of

technological optimism in sensitive human domains. This paper connects computer science, linguistics, education, and psychology, thereby broadening the scope of AI's relevance well beyond instruction.

Taken together, the group illustrates a spectrum: from cognitive development and ethical reasoning [1], through professional role transformation [2], and systemic teacher preparedness [3], to psychosocial monitoring [4]. The unifying thread is the recognition that AI in education is not merely a technical supplement but a force that redefines what it means to teach, to learn, and to sustain well-being. Differences arise in target audiences: students, lecturers, schoolteachers, and educational institutions, and in disciplinary intersections, with psychology playing a central role in [4] and ethical analysis permeating [1] and [3]. This interplay of shared concerns and divergent emphases exemplifies the international seminar's commitment to a multidimensional understanding of AI's educational impact.

4.2. Professional growth across educational levels: teachers and university educators in digital transformation

All three studies [5, 6, 3] converge on the theme of teacher professional growth as the linchpin of digital transformation, though they frame readiness in distinct ways. What unites them is the conviction that digitalisation requires not only new tools but also systematic capacity building for educators, combining pedagogical, methodological, and technological competencies.

The matrix approach developed by Ovcharuk et al. [5] conceptualises development as a staged process, moving from knowledge acquisition to transformative practice. Its strength lies in flexibility: teachers are guided through a gradual trajectory that anticipates their evolving needs in AI- and ICT-rich environments.

The Moodle-focused study conducted by Morze and Terletska [6], by contrast, addresses professional development at a practical, course design level. It identifies concrete competencies: adaptive content creation, flexible grouping, varied assessment, and learning analytics, that educators must master to implement differentiated instruction effectively. Unlike [5], which stresses long-term competence growth, this work demonstrates how structured training can translate directly into classroom-level readiness.

The STEM-AI Readiness Model proposed by Barna, Boiko and Morze [3] widens the scope further by situating teacher readiness within systemic conditions in primary schools. Motivation and institutional support are shown to be decisive, while technical barriers severely limit progress. Here, professional development is not treated in isolation but as part of an ecosystem of resources, policies, and organisational frameworks.

In synthesis, the three papers reveal professional growth as a multi-layered construct: developmental [5], pedagogical [6], and systemic [3]. Their common ground lies in the recognition that teacher readiness must be cultivated deliberately. Their divergence lies in the level of analysis – individual pathways, concrete teaching practices, and institutional scaffolding. Taken together, they illustrate that sustainable digital transformation depends on aligning all three dimensions.

4.3. Thematic cluster: design of digital environments and resources

Within the broad spectrum of seminar topics, three studies – Pinchuk et al. [7]; Pavlenko and Pavlenko [8]; and Bodnenko et al. [9] – can be read together as a cluster addressing the design and transformation of digital environments and resources. Their common focus lies in rethinking the scientific and educational potential of digital tools, though each situates the problem differently and employs distinct experimental approaches.

Pinchuk et al. [7] examine the Ukrainian Electronic Encyclopedia of Education (UEEE), which is evolving from a static reference source into a semantic, analytic portal. Their analysis highlights role-specific digital competences required of authors, editors and moderators, identifying recurrent difficulties in semantic markup, content categorisation, and expert verification. The study is experimental in scope through its analysis of user interactions and error patterns, yielding practical evidence of gaps between

system affordances and user readiness. The authors propose ways to develop competencies supported by training, guidelines and potential AI-powered tools for semantic editing and fact-checking.

In a different register, Pavlenko and Pavlenko [8] repurpose RMS into a pedagogical hub for collaborative learning. Their research is distinguished by a rigorous quasi-experimental design ($n = 54$, with control and experimental groups), supplemented by qualitative interviews. The experiment demonstrates a statistically significant improvement in teamwork skills, attributing success to scaffolding structures, visible cognition spaces, and productive technical challenges. Unlike [7], which addresses systemic competence gaps, this study validates a replicable framework: the Collective Scientific Research Life Cycle – that turns an administrative tool into an environment for co-construction of knowledge.

Bodnenko et al. [9] present the Collaborative Online Ukrainian Learning (COUL) project, an inter-institutional initiative adapting the COIL model to the Ukrainian context. The project was structured experimentally across three phases: preparatory planning, collaborative project work, and final presentations. Multidisciplinary student teams engaged in AI-related educational projects, and survey data confirmed high levels of motivation, engagement, and satisfaction. At the same time, organisational difficulties in coordination and time management surfaced as experimental outcomes, pointing to areas requiring systemic refinement.

These three works converge on the idea that digital environments are not passive containers of content but dynamic educational spaces requiring intentional design. Study Pinchuk et al. [7] highlights the need to develop user competences for working with the Semantic MediaWiki extension, introducing demands in semantic markup, ontology-based structuring, and fact-checking. Study [8] shows, through controlled experimentation, how reference management software can be repurposed into a collaborative learning environment. Study [9] demonstrates the value of institutional cooperation in shaping project-based digital ecosystems. Together, they trace a trajectory from micro-level competence formation to meso-level tool reconfiguration and macro-level ecosystem building, positioning design at the intersection of technological, pedagogical, and organisational dimensions.

4.4. Economic, collaborative and immersive dimensions of innovation in digital education

The three contributions under review exemplify the breadth of approaches represented in the seminar, spanning blockchain-driven educational economics [10], collaborative pedagogical frameworks [8], and immersive simulation technologies for vocational training [11, 12]. Despite their divergent foci, all three emphasise the transformation of conventional educational processes through digital innovation.

Article Peschanenko et al. [10] advances the discussion of tokenomics in education by proposing a blockchain-based model for personalised MOOC platforms. Its central contribution lies in formalising a tokenisation mechanism. The study situates blockchain not merely as a technological novelty, but as the foundation for new business models in education. The “experiment” is not classroom-based but computational.

By contrast, article [8] focuses on pedagogical repurposing of existing digital tools. It demonstrates how Reference Management Software (RMS), traditionally used for citation tasks, can be transformed into a collaborative learning hub. This contribution underscores the capacity of low-threshold tools to cultivate essential soft skills when embedded within a robust instructional framework.

Article Kanivets et al. [11] occupies a different yet complementary space, emphasising immersive technology for skill acquisition. The authors present the design and validation of a VR-based training simulator for agricultural education, enabling safe, resource-efficient practice of tractor–plough setup. Experimental evidence indicates marked improvements in theoretical knowledge, practical performance, and learner motivation, thereby affirming VR’s potential as both a cost-saving and pedagogically effective solution in applied sciences.

By presenting a conceptual model of a mining game simulator, [12] shows how educators and students can use an immersive learning environment to develop skills in economic analysis, financial planning, and strategic decision-making. The paper underscores the links between gamification, simulation learning, and professional competence development, thereby demonstrating the broad potential of

digital innovation in higher education across subject areas.

Taken together, these three papers demonstrate how digital transformation in education operates across different layers: economic models and incentive structures [10], collaborative pedagogical design [8], and experiential, practice-oriented training environments [11]. Their special contribution underscores the workshop's commitment to exploring digital strategies that reconfigure the relationship between technology, pedagogy, and learning outcomes.

4.5. Digital Skills in Educational and Research Contexts

Within the broad discourse on digital competence, articles [7] and [13] address complementary but distinct contexts. Both underline the structural gap between technological potential and user readiness, yet they differ in scope, target audience, and methodological orientation.

Article [7] analyses the evolution of the UEEE into a semantic, analytical portal, drawing attention to the role-specific competences users. Its central concern is institutional and systemic: how to equip knowledge platform contributors with the digital skills necessary to ensure reliability, usability, and academic integrity?

In contrast, article Symonenko et al. [13] turns to the individual trajectory of doctoral students, exploring their self-assessed digital competences in the context of dissertation research. Unlike many contributions in the seminar, which emphasise either tools or platforms, article [13] positions digital competence at the intersection of research ethics, methodological innovation, and professional formation.

The originality of [13] lies in its shift from institutional to personal capacity-building: while [7] examines competence gaps among platform developers, [13] foregrounds the research competences of future scholars, emphasising resilience, adaptability, and ethical responsibility. This places it apart from other seminar contributions, which are more often focused on the transformation of teaching [2], the design of digital environments [9], or the application of innovative technologies such as VR [11].

Together, articles [7] and [13] confirm the central theme of the seminar on digital transformation in education, but [13] advances the discussion on digital competence in the context of high-stakes academic research, emphasizing its role not only as a technical asset but also as a foundation for competitive scientific activity.

5. Summary

The seminar has served as a platform for the exchange of experiences, ideas, and innovations, bringing together researchers and practitioners engaged in shaping the future of digital education. The proceedings gather twelve high-quality contributions that enrich ongoing debates in educational sciences, reflecting both the transformative potential of digitalisation and the value of interdisciplinary dialogue across diverse contexts. Common across these studies is a emphasis on the thoughtful integration of technology.

We with an invitation to continue this scholarly conversation, encouraging further research and future meetings that will extend the insights of DigiTransfEd 2025 and strengthen collaboration in advancing educational transformation worldwide.

Declaration on Generative AI

The authors used Grammarly to check grammar of the article.

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