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Transforming Educational Content and Forms in the Context of European Integration and Artificial Intelligence

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Abstract: Education plays a key role in shaping the identity of civilisations. This is particularly important in contexts where high-quality human capital serves as a major factor in socio-economic growth and a fundamental tool for attracting investment resources. As a result, the global competitiveness of education has come to the forefront in various sustainable development strategies. In a knowledge-based economy, higher education plays a crucial role in the formation of highly productive human capital. It creates favourable conditions for generating knowledge and promoting innovation. At the same time, investment in education enhances the competitiveness of the EU and stimulates its socio-economic growth. In particular, this article emphasises the role of transforming educational content and forms through the integration of artificial intelligence (AI) into the learning process. It discusses the transition from classical models to personalised learning pathways based on Big data and AI algorithms. It also explores how technological challenges force a reconsideration of educational content, shifting the focus from knowledge transmission towards the development of critical thinking and neuroethical responsibility. Conceptual approaches are proposed to align European educational standards with the requirements of the digital age, in which humans remain responsible for controlling automated systems.

Keywords: Global community; higher education system; European Union; Bologna Process; human capital formation; UN sustainable development agenda; artificial intelligence in education; digital transformation; transformation of educational content; neuroethics.

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1. Introduction

Recently, significant shifts have occurred in the relationship between the state and educational institutions. This transformation has affected the educational content, the structure and management of the education systems, research methods, and pedagogical approaches and principles. Most of these changes, being both external and objective, are associated with the growing economic importance of knowledge.

This transformation is taking on a new dimension under the influence of two major factors: the deepening of European integration and the rapid implementation of artificial intelligence (AI) tools. The response to global challenges in the late 20th century was reflected in the emergence of global studies. Meanwhile, the 21st-century response has increasingly taken the form of “digital pedagogy” and the intellectualisation of the educational space.

These processes are often linked to the growing economic importance of knowledge. They are implemented through the neoliberal political concept of reducing the state’s social role. This has required educational researchers to examine emerging global phenomena. It has also encouraged them to consider prospects for the further development of educational practice. In turn, the emergence and development of global studies and related fields of research and educational directions became an inevitable scientific response to the global challenges of the late 20th century. The recognition of globalisation and global problems, together with an understanding of the prospects for the further expansion of global activity, has become an important field of scientific inquiry and a new direction in the development of education.

This perspective demonstrates that finding a balance between the intensity and scale of integration into the global educational space and the preservation of the identity of national educational systems at all levels is an extremely complex task. In the context of Ukraine’s European integration, this objective assumes particular strategic importance. Ukrainian higher education institutions (HEIs) face specific challenges related to geopolitical instability, ongoing reforms, and the digital transformation. Addressing these challenges may require not only alignment with European standards but also the proactive adoption of AI technologies. Such technologies are increasingly becoming an important tool for maintaining the competitiveness of European higher education.

As some researchers point out, the impact of globalisation on educational models is ambiguous. The strengthening influence of the United States as a single superpower and its not entirely unsuccessful attempts to establish a unipolar world contribute to the homogenisation of education. Neoliberal reforms implemented in various countries, the dominance of market forces, and the withdrawal of the state from the social sphere contribute to its excessive pragmatism and the reduction of fundamental research that does not yield short-term profits.

Thus, globalisation processes observed in global society encompass virtually all institutions and organisations and affect key social processes. For example, the Bologna Process is viewed by the Ukrainian educational community as a framework for cooperation among European HEIs. It is also regarded as a means of modernising the national higher education system and addressing global challenges. Objectively, the Bologna Process can be considered a concept for creating a European Higher Education Area.

The transformation of educational forms is expressed in the transition to hybrid models and adaptive learning. At the same time, the transformation of content shifts the focus from simple knowledge acquisition towards the development of critical thinking and the ethical use of neural networks.

This article aims to conceptually justify transformational processes in the content and forms of higher education in the context of European integration and the active implementation of artificial intelligence. It also seeks to identify strategic directions for the development of the European educational space. These directions are based on the transition from the unification of diplomas to algorithmic unity and neuroethical responsibility. It is also essential to formulate

practical recommendations for adapting Ukrainian higher education to the requirements of the digital era.

2. Literature Selection Methodology and Conceptual Framework Development

A thematic literature review was conducted to substantiate the conceptual framework of the study. The literature search covered the Scopus and Web of Science databases and Google Scholar. It also included official analytical repositories of the European Commission, UNESCO, and the European University Association (EUA).

The selection criteria included: a) the publication period (analytical reports and regulatory documents published between 2020 and 2025), b) relevance to the Bologna Process, c) digital transformation of higher education, and d) neuroethical challenges associated with AI implementation.

The conceptual framework was developed through the synthesis of two analytical vectors:

- Institutional-structural vector (traditional Bologna model): harmonisation of educational standards, comparability of qualifications, academic mobility, and implementation of the European Credit Transfer and Accumulation System (ECTS).
- Technological-cognitive vector (Education 4.0 paradigm): transformation of educational processes through AI, adaptive learning, neuroethics, and preservation of human agency.

The intersection of these vectors provides the basis for the “algorithmic unity” concept. This concept is proposed as a new stage of European educational integration. At this stage, cooperation among HEIs extends beyond the institutional alignment of educational programmes. It also involves shared ethical and technological protocols, including transparency in AI-based decision-making and interoperable systems for knowledge validation. A comparative analysis of these stages is presented in Table 1.

3. Globalisation of Higher Education and Strategic Priorities of the Bologna Process

An analysis of the Bologna Process documentation leads to the following conclusions. This process aims to address the objective necessity of establishing international and global cooperation in the field of higher education. It also seeks to ensure a high level of global competitiveness for Europe in response to the anticipated dominance of the US higher education system.

While higher education has become an essential element of the successful development of human civilisation, university education plays a particularly important role in this process. Its main task is to establish an effective organisation of the higher education system. This is based on the recognition that higher education plays a significant role in the development of civilisation by ensuring the economic, organisational-political, and cultural development of each country (European Commission/EACEA/Eurydice, 2024).

An important stage of globalisation was characterised by the emergence of the first universities. These institutions contributed to overcoming the narrow boundaries of traditional professional methods and practices. They bring under their cosmopolitan umbrella religion, science, and art, inviting them to compete within a dynamic disciplinary framework, “embedding” their knowledge and culture in the minds of new generations. In essence, the current era (modern and contemporary periods) begins when universities have already prepared generations of educated individuals capable of applying science, art, and technology in all spheres of social life (Organisation for Economic Co-operation and Development, 2025).

According to the United Nations Sustainable Development Agenda, one of its goals is to expand access to education, ensure inclusive and high-quality education, promote lifelong learning, and reduce gender inequality. The implementation of this policy is expected to lead to the following outcomes by 2030: 91% of the global population will have basic education, compared with 88% in 2015, while 55% will obtain higher education, compared with 50% in 2015 (World Economic Forum, 2024).

Considerable progress has been achieved towards creating a unified educational space within EU countries. The value of education has sharply increased in the world order, which is now predominantly viewed as a post-industrial or information society, likely based not so much on power and wealth as on information and knowledge (European University Association, 2025).

At the present stage, the strategic priorities of the Bologna Process are expanding. Europe is moving beyond structural unification, including common approaches to credits and diplomas, towards the formation of unified ethical and technological standards for AI use. These standards are becoming a new criterion of global competitiveness for universities (Nerubasska & Maksymchuk, 2020; Nerubasska et al., 2020).

4. Genesis and Transformation of European University Models

Higher education is developing from a previously rare and scarcely accessible practice into an almost universal feature of developed countries. During this period, the leading economies of the world initiated various programmes and concepts aimed at reforming their educational systems. Their fundamental goal was to make education more open and accessible. Significant changes have been observed in Europe, where national borders in the field of education are becoming less pronounced. At the same time, a pan-European integrated education system is being constructed (Zilvinskis & Willis, 2019).

European higher education has undergone a long process of development. At the present stage, a unified European educational space has been formed within the framework of the Bologna Process. Common goals and the humanistic orientation of education in European countries serve as the foundation for building the European education system. A review of the efforts of European countries to establish unified approaches in higher education shows that the humanistic idea of unification is the result of the historical development of European states (Lytvyn, 2024).

For example, in France and Germany, the state is and will remain the main source of funding for the functioning and development of universities. At the same time, it retains the right to governance. The UK higher education system provides broad access to both domestic and international students (UNESCO, 2023).

The Czech Republic has a fairly developed system of higher education. Currently, 37 higher education institutions operate in the country. As noted by Berbets et al. (2021), the transformation of education in the second half of the 20th century into a means of competition between countries and regions for leadership, for a competitive and developing economy, had a decisive impact on the further development of European educational systems. This transformation contributed to an understanding that, with humanity's transition to the information age and post-industrial society, it is necessary to unite efforts in the field of education, given the specific conditions of the global world.

The transformation of educational forms observed in leading European countries is now complemented by a transition to digital ecosystems. Regardless of their form of ownership, whether public or private, European universities are required to adapt their internal content to the requirements of the digital economy. In this context, algorithmic literacy is becoming as fundamental as traditional university disciplines.

The concept of "human agency" also requires expansion through the study of its neurological and psychological foundations in the context of human interaction with AI. From a neurological perspective, agency is based on the brain's ability to predict the outcomes of its own actions through predictive coding. Using algorithms for cognitive control in AI learning settings could potentially impair the prefrontal cortex's capacities. Therefore, preserving the psychological subjectivity of students should become a priority in the design of intelligent systems.

5. Institutional Integration and Strategic Partnership in the Global Educational Space

The formation of a pan-European educational space in the context of the Bologna Process necessitated profound changes in European education systems and the intensification of internal

integration processes. The establishment of the European University Association (EUA) brought together HEIs from different countries (European Commission/EACEA/Eurydice, 2024; European Commission, 2022).

European integration processes in education are not an end in themselves or the ultimate goal of unification. Rather, they represent the first “wave” of globalisation, with the formation of a global educational space emerging as a subsequent stage. In this regard, the susceptibility of education to the influence of globalisation and the manifestation of internal globalisation trends have become increasingly relevant (UNESCO, 2023).

The creation of the European University Association has contributed to mitigating the complex and challenging processes of transforming national education systems (Council of Europe, 2024; European Commission, 2026). European universities integrated into the Association in the 21st century act as a powerful creative force. They contribute to the formation of not only the economic but also the cultural foundation of the European region as an integral part of the multipolar global system (Tsymbal-Slativnska et al., 2022; European Parliament & Council of the European Union, 2024).

An analysis of global educational practices demonstrates empirical evidence of cases in which neuroethical considerations have been implemented or, conversely, ignored. For example, the use of AI-based emotion analysis systems without proper neuroethical auditing has led to increased stress among students and violations of their cognitive privacy. In contrast, the integration of the principles of algorithmic transparency in pilot projects at European universities has contributed to the development of students’ metacognitive skills. This is because students have been able to understand the logic underlying AI recommendations while retaining the right to make the final decision.

6. Conceptual Foundations of Digital Convergence: From Diploma Standardisation to Algorithmic Unity

The transformation of educational content in the context of European integration extends beyond the harmonisation of curricula. Within this emerging educational paradigm, artificial intelligence becomes both a technical tool and a cognitive partner (European Parliament & Council of the European Union, 2024).

The traditional Bologna system is gradually shifting towards a flexible system of micro-credentials. AI allows for the creation of personalised learning paths to adapt to students’ pace and abilities. This facilitates the implementation of the concept of “student-centred learning” at the technological level, which is one of the priorities of the European Education Area (Lytvyn, 2024).

The European approach to integrating AI into education differs fundamentally from technocratic models in other regions through its emphasis on ethics. The revision of instructional materials involves the inclusion of neuroethical modules in educational programmes at all levels. This concerns the preservation of human agency: students must understand how algorithms work and be able to recognise AI hallucinations and algorithmic bias. Thus, the focus of education shifts from “knowledge of facts” towards the “management of intelligent systems” (Nerubasska et al., 2020).

AI is also becoming a catalyst for virtual mobility within the EU. European university networks use intelligent platforms to overcome language barriers and establish joint research laboratories. This creates a “seamless” educational space in which integration occurs at the level of data and shared algorithms for knowledge validation (Zilvinskis & Willis, 2019). A comparative analysis of the transformation of the educational paradigm is presented in Table 1.

Table 1. Comparative characteristics of the educational paradigm transformation

Comparison parameter	The classical Bologna model (the 20 th – early 21 st century)	Modern intelligent model (AI and European integration 4.0 Context)
Key objective	Student mobility and diploma standardisation (ECTS)	Formation of adaptive intellectual capital
Learning content	Knowledge acquisition and transmission, with a focus on standardised programmes	Development of critical thinking and AI system management skills
Form of education	Predominantly classroom-based, with a linear course structure	Hybrid and personalised learning pathways based on Big Data
Teacher's role	Knowledge transmitter and quality controller.	Facilitator, learning environment designer, and ethical expert
Assessment	Periodic examinations and standardised tests	Continuous progress monitoring through real-time analytics
Ethical vector	Academic integrity, with a focus on anti-plagiarism	Neuroethics, algorithmic transparency, and cognitive freedom

Source: The authors' own conception

Accordingly, this article suggests the following steps for integrating Ukrainian education into the European higher education landscape. Ukrainian universities need to move beyond the traditional understanding of “academic integrity” as primarily a means of combating plagiarism. A conceptual step should be the development of internal codes governing the use of AI, based on the European human-in-the-loop approach, in which humans remain responsible for controlling automated systems. This would allow students to use AI as a cognitive tool without compromising their critical thinking skills.

Pilot projects are recommended to be launched to implement adaptive learning within the Bologna cycles. This involves using algorithms to automatically adjust the complexity of learning materials according to students' current performance. Such an approach can transform formal “student-centredness” into a genuine technological process.

Given the transition of teachers towards the role of “designers of educational pathways”, it is essential to introduce professional development programmes focused on prompt engineering and digital facilitation. Teachers should become experts who teach students to verify AI-generated information and integrate it into complex research projects.

To overcome the technological gap, Ukrainian universities should initiate joint digital laboratories with the European University Association. This would enable integration not only at the level of diplomas but also at the level of algorithmic unity, including shared databases for scientific research and mechanisms for validating educational content.

7. Research Limitations and Counterarguments to the “Algorithmic Unity” Concept

Risk of technological dependence and digital inequality. Critics may argue that promoting “algorithmic unity” as a new standard of European integration could widen the gap between resource-rich universities in Western Europe and HEIs in countries undergoing reform or crisis, including Ukraine. The development of algorithmic infrastructures may require substantial financial investment. These costs include AI systems, computing resources, and server capacity. Such disparities may increase dependence on global BigTech companies and create conditions that could be described as technological neocolonialism.

Potential loss of academic and cultural authenticity. Algorithmic standardisation of curricula may contribute to cognitive and cultural homogenisation. At the same time, over-reliance on English-trained algorithms can undermine national pedagogical traditions and specialised fields of knowledge that resist straightforward digitalisation.

Ethical and legal constraints (GDPR and the EU AI Act). The practical implementation of unified algorithmic platforms is subject to strict European legal requirements. These include the General Data Protection Regulation (European Parliament & Council of the European Union, 2016) and the European Union Artificial Intelligence Act (European Parliament & Council of the European Union, 2024). The use of generative AI and real-time profiling of students' academic performance raises concerns about personal data protection. It also raises broader questions about privacy, transparency, accountability, and the protection of cognitive autonomy.

Methodological limitations of the proposed framework. The comparative model presented in Table 1 represents a theoretical generalisation. It reduces the complexity of differentiation within the Bologna space itself. Readiness for AI implementation may vary considerably across institutions and disciplinary fields. For example, the conditions for AI adoption may differ substantially between technical disciplines and the humanities. Therefore, "algorithmic unity" should be regarded as a conceptual framework rather than as a uniform model applicable to all European HEIs.

8. Statement on the Use of Artificial Intelligence

The authors confirm that artificial intelligence tools, including ChatGPT (OpenAI) and Gemini 1.5 Pro (Google), were used for the stylistic editing of the manuscript, improving readability, and structuring individual conceptual materials. AI tools were also used to assist with information searches through search engines enhanced by large language models (LLMs).

AI tools were not used to generate scientific concepts, formulate logical conclusions, or develop theoretical propositions. The interpretation of the results, formulation of conclusions, and development of scientific generalisations were carried out by the authors. The authors bear full responsibility for the content, originality, and scientific accuracy of the final manuscript.

9. Conclusion

The analysis of transformations in the content and forms of higher education in the context of European integration and AI development suggests that the European educational space is shifting from "structural unification" (ECTS credits and degree levels) to "algorithmic unity". AI may function not merely as an auxiliary tool but also as a foundation for creating a uniform intellectual space. In this space, virtual mobility and joint research laboratories could help overcome linguistic and geographical barriers.

Findings suggest that the classical didactic model, focused on knowledge transmission, is being replaced by adaptive educational ecosystems. The use of Big Data and AI algorithms enables the realisation of genuine learner-centredness through personalised learning pathways. These pathways adjust in real time to students' cognitive characteristics.

At the same time, the teacher is evolving from an information transmitter into a designer of educational pathways and an ethical facilitator. Educational content is shifting towards the development of critical thinking and neuroethical responsibility. The key competence of the future specialist is becoming "management of intelligent systems" while preserving human agency.

For successful integration into the EU intellectual space, Ukrainian higher education must focus on proactive digitalisation. This includes the development of internal university AI ethics codes, the implementation of Prompt Engineering training programmes for academic staff, and the creation of joint digital laboratories with the European University Association (EUA). Special attention is given to strengthening the connection with cognitive psychology. This is important for addressing the potential negative effects of AI on the neuroplasticity of young people's brains.

Thus, digital convergence in education in the context of European integration is not only a technological challenge but also a strategic opportunity. It can contribute to the formation of qualitatively new human capital capable of functioning effectively in a global digital society.

Ethical Statement

This study was conducted in accordance with the ethical principles of scientific research in the fields of pedagogical and social sciences. The theoretical analysis and development of neuroethics are based on respect for cognitive freedom and academic integrity. The manuscript follows the principles of objectivity and scientific integrity in the citation and interpretation of European educational strategies.

Authors' Contributions

Author 1: Study conceptualisation, theoretical framework of digital convergence, neuroeducation section, and literature review.

Author 2: Comparative analysis methodology, preparation of Table 1, and visualisation of key findings.

Author 3: Bibliographic resources, manuscript review, and structural editing.

Author 4: Analysis of the teacher's role as a facilitator and sections on human–AI cognitive partnership.

Author 5: Practical recommendations for adaptive learning and strategic directions for Ukrainian universities.

Author 6: Ethical validation, project administration, and final manuscript review.

All authors reviewed and approved the final version of the manuscript.

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Conflict of Interest

The authors declare no financial, professional, or personal conflicts of interest that could have influenced the objectivity of the concepts and conclusions presented in this article.

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