

Digital Transformations in Education: The Cultural Dimension of the Algorithmic Age

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ABSTRACT:

Against the background of rapid advances in information and communication technologies, the educational environment and the broader cultural sphere are undergoing significant transformation. The integration of artificial neural networks into educational tools creates new opportunities to enhance the quality and accessibility of learning, while simultaneously posing challenges to cultural development. Digital culture increasingly influences identity formation and the perception of social and cultural values, generating both risks and prospects for education. This study aims to analyze the impact of the digital transformation of education on contemporary cultural development. Particular attention is paid to the practical outcomes of educational digitalization. Empirical data indicate substantial growth in the use of digital educational platforms (from 21% in 2021 to 45% in 2023), mobile learning applications (from 15% to 34%), and immersive technologies (from 7.5% to 20.7%). These trends contribute to the formation of digital culture, requiring the development of digital competence, critical thinking, responsible online behavior, and collaborative skills. Digitalization also reshapes the educational process through increased interactivity, individualization, inclusiveness, and expanded access to knowledge beyond spatial and temporal limitations. It fosters

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essential competencies such as adaptability, communication, and social integration. At the same time, the quality of education positively correlates with the level of digital integration. Ensuring a balance between technological innovation and humanistic values remains crucial to preserving cultural heritage.

Keywords: digitalization, cultural genesis, learning environment, digital educational environment, ethical aspect.

1. Introduction

The dynamics of cultural development in the course of civilization, as well as the dialectic of the relationship between the universal and the national within the phenomenon of educational and cultural development, is of particular importance against the background of the active integration of artificial intelligence and digitalization. Given the growth of information and the expansion of the boundaries of its influence, the development of skills for critical reflection on information data, as well as the strengthening of communication competencies based on cultural and ethical principles, is of particular importance.

The digital educational environment, based on modern information and communication capabilities, creates new conditions for the unrestricted exchange of information, which not only provides users with access to knowledge but also creates the preconditions for its generation. The information block of a student's general cultural competencies includes the ability to learn, process large amounts of information, and use various forms of access to information.

A number of modern studies have been devoted to the study of the phenomena of the digital learning environment and digital culture of the individual. In particular, in the publications by Cruz et al. (2021), Shonfeld et al. (2021), Emejulu and McGregor (2019), the issues of the impact of digital technologies on the general culture of the digital society are being scientifically developed. The understanding of the value-motivational and worldview components of digital culture and approaches to their formation are presented in the

studies of Mihelj et al. (2019), Inglehart (2020), Park et al. (2021).

The cultural genesis of modern society is characterized by a certain opposition to the classical principles of organizing philosophical knowledge regarding the existence of the subject matter of the subject of knowledge outside the person and cultural context. Digital learning environments contribute to the development of digital culture, which includes the skills of using digital tools, critical thinking, responsible online behavior, and collaboration in the digital space. Digital literacy is becoming essential for successful adaptation in modern society.

This necessitates a deep critical analysis of the formation of digital education as a factor of decisive influence on the consciousness of society at the present time. Also, the need to develop critical thinking skills, communication ethics and cultural identity within educational systems deserves special attention. The study focuses on filling in the significant gaps and pays special attention to the cultural concept of digital development of education.

2. Literature review

The issue under study is one of the priority areas of understanding the cultural role of the digital educational environment, as evidenced by the scientific works of scientists Knox (2019), He and Li (2019), Emejulu and McGregor (2019). Contemporary researchers (Kozhyna et al., 2022; Zhang et al., 2020; Park et al., 2021), analyzing educational traditions and their dynamics under the influence of digitalization, position the phenomenon of culture as a complex phenomenon

that expresses a system of subject-object relations. According to the established approaches to the development of the learning environment, the phenomenon of cultural development is considered by scientists as a reflexive and conceptual basis for social development.

Modern sectoral scientific developments and publications are mainly focused on certain areas. Among them is the impact of information and communication transformation and digital development on the process under study. Representatives of the scientific community (Peck, 2023; Sofilkanych, 2022) analyze the impact of culture-building activities and effective communication on the philosophical and ethical progress of society in an interdisciplinary context.

The digitalization of education is closely related to the philosophical and ethical understanding of cultural processes. In particular, this is evidenced by the publications of Dutta (2020), Zubtsova et al. (2024). The researchers analyze current philosophical traditions in the light of the digitalization of communication interaction and the global influence of social networks, positioning the cultural development of society as a complex phenomenon that represents a multifaceted system of subject-object relations.

The issue is further developed in the publications of Yuldashev et al. (2022), Mihelj et al. (2019), which explore various aspects of the development of the modern learning environment in the context of cultural and ethical approaches. According to Ortina et al. (2023), Shonfeld et al. (2021), the newest stage of the cultural development of society is characterized by the manifestation of the idea of synergy.

The synergistic approach to socio-cultural dynamics considers culture as an open, non-equilibrium, self-organizing system. In this case, changes in culture occur as a result of the interaction of its components and the influence of external factors, which leads to the emergence of new structures and trends. Zapata-Barrero and Mansouri (2022) studied the socio-philosophical basis of the process of information culture formation. At the same time, Sauro and Zourou (2019) focus on analyzing the

synergy of cultural aspects, social values, priority ideas, and communication ethics in educational strategies.

A number of scholars have explored the possibilities of increasing the level of digital culture development through innovative educational technologies. In particular, Inglehart (2020), Kovalchuk and Ovsyankina (2020) present the results of experimental studies on the implementation of digital learning projects. Instead, Donelli (2019) discuss the potential of cultural concepts and in-depth ethics in the context of digital education development.

According to Derstuganova (2025) and Nikitenko (2020), cultural evolution should be based on the digital development of modern society. The authors emphasize the value of the synergy of ethics, digital education, and communication, and emphasize that cultural social development is interconnected with the dynamics of the educational system. The researchers actualize the concept of social dynamics of participation, community engagement, and cultural development in the digital learning environment.

These modern studies convince us of the need to rethink the impact of the digitalization of education on the development of the cultural and ethical basis for the development of modern society and the upgrade of the educational field itself.

The aim of the article is to determine the specifics of the impact of the digital upgrade of the education system on the modern cultural development of society and the educational environment.

3. Methodology

The main materials of the study were selected industry publications indexed in leading scientific databases (Web of Science, Scopus), as well as statistics from official sources. The sample period is 2019-2025. The keywords used for the search were “digitalization, culture genesis, learning environment, digital educational environment, ethical aspect, digital culture, critical thinking”. The sample size is representative in terms of scientific and statistical power.

To achieve this goal, theoretical research methods were used. Analysis and synthesis were used to comprehensively study scientific approaches to the definitions, essence and functionality of digital education in the context of cultural genesis.

The method of induction made it possible to generalize the trends in the development of the phenomenon under study on specific facts, while deduction made it possible to verify them on specific examples. Abstraction was used to identify the most important aspects of the problem. Forecasting made it possible to predict potential trends in the development of cultural processes and the educational field in the context of digitalization.

The study is limited by the complexity of experimental verification of theoretical conclusions.

4. Results

The digital educational environment is understood as a system of technical, information, communication and software tools, as well as pedagogical technologies and conditions that provide information support for the educational process, intensification of the quality of education, personal and general cultural development of participants in the educational process. The above implies the need for a certain level of digital culture development, including in the context of teacher competencies.

The characteristic features of the digital learning environment include a systematic combination of material, technical, communication and information support, which allows to improve the quality and efficiency of educational services, develop interdisciplinary links, provide information and methodological support to participants in the educational process through the use of digital technologies.

Obviously, within the digital learning environment, the digital competencies of the student are actively developing, which include searching for and critical evaluation of information, compliance with information security, and interaction in the digital

learning environment based on ethical principles. This is how the digital culture of the modern educational field is formed.

The structural and morphological elements of the cultural system of education are now being supplemented by new meanings. In this concept, a person is placed in the center of cognition, with the spectrum of his or her worldview. Digital technologies are changing traditional teaching methods, making them more interactive, individualized, and accessible.

New forms of learning, such as online courses, virtual laboratories, and interactive games, are emerging that promote deeper and more effective learning. Digital technologies significantly expand access to knowledge and information, allowing students to learn from anywhere in the world and access a variety of learning resources.

The digitalization of education stimulates the development of critical thinking, creativity and problem-solving skills, which are essential for successful adaptation in the modern information society. Digital learning environments can change traditional cultural values, such as the value of knowledge, the role of the teacher, and forms of communication and interaction between people. It is important to ensure that these changes meet the needs of modern society and do not lead to the loss of cultural heritage.

The peculiarities of modern social cultural genesis are manifested in the cultivation of the role of innovative technologies. The creative and innovative potential of the digital society is formed under the influence of the factors of digitalization of society, implementation of neural networks, artificial intelligence, and deep learning. The integration of algorithmicity into thought and cultural processes can potentially lead to a number of negative consequences, including the risk of personality transformation, alienation from one's own essence, and absorption by digital processes (Figure 1).

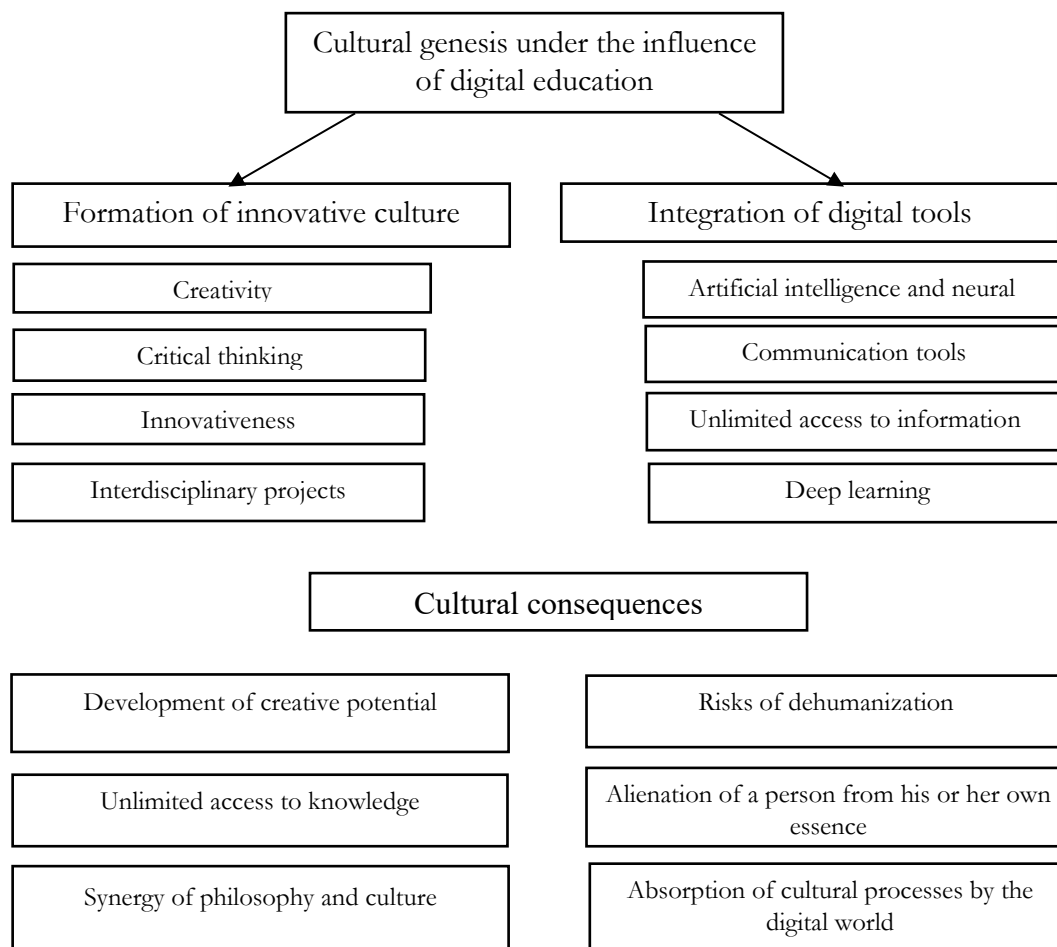


Figure 1. Consequences of the paradigm shift in cultural development under the influence of digitalization of education

Source: author's development

The consequences indicated in Figure 1 lead to the actualization of the problem of developing critical thinking, digital security and preserving the priority of human-centeredness. Critical thinking in pedagogical practice is positioned as the antithesis of dogmatic thinking, being identified as an independent, logical and creative thinking process.

The specific properties of this type of thinking are individuality and social orientation, which ensures the ability to realize and argue a personal position on certain issues, the ability to produce new ideas and non-standard solutions, to subject issues to critical analysis, effectively rethinking actions, and predicting potential consequences. The main

components of the process include analyzing the reliability and credibility of information sources, skills in finding interconnections and consequences of influence, forming logical conclusions and reasonable assumptions about the variability of the situation or perception of information.

The practice of developing a digital learning environment in developed European countries demonstrates the effectiveness of innovative education (Figure 2). At the same time, the dynamics of the level of integration of various vectors of digital learning for the period 2021-2023, characterized by steady growth, is representative.

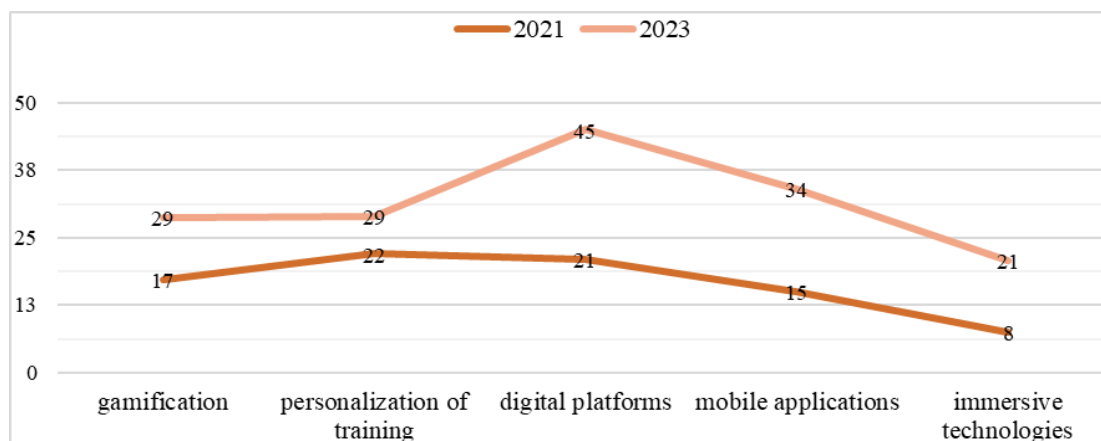


Figure 2. Integration of digital learning tools in EU countries, %

Source: compiled by the author based on (Global Education Monitoring Report, 2023)

As shown in Figure 2, digital educational platforms (from 21% in 2021 to 45% in 2023), mobile learning applications (from 15% to 34%), and immersive learning technologies (from 7.5% to 20.7%, respectively) gained particular popularity in 2021-2023.

Noting the intensification of the development of the digital educational environment in the European community, it is advisable to consider the impact of this process on the criterion of the quality of the educational process (Figure 3).

As shown in Figure 3, the digital learning environment significantly affects aspects of adaptability and individualization of learning, as well as the socialization and integration skills of students. At the same time, the level of quality of education

correlates with the level of integration of digital learning tools and is characterized by sustainable progressive development.

The digital learning environment has a significant impact on education and culture, both positive and negative. It contributes to improved access to knowledge, individualized learning, and the development of digital skills, but it can also lead to social exclusion and a deepening digital divide. Positive aspects of the impact include improved access to knowledge, individualized learning, development of digital skills, increased mobility and flexibility, and increased motivation and engagement.

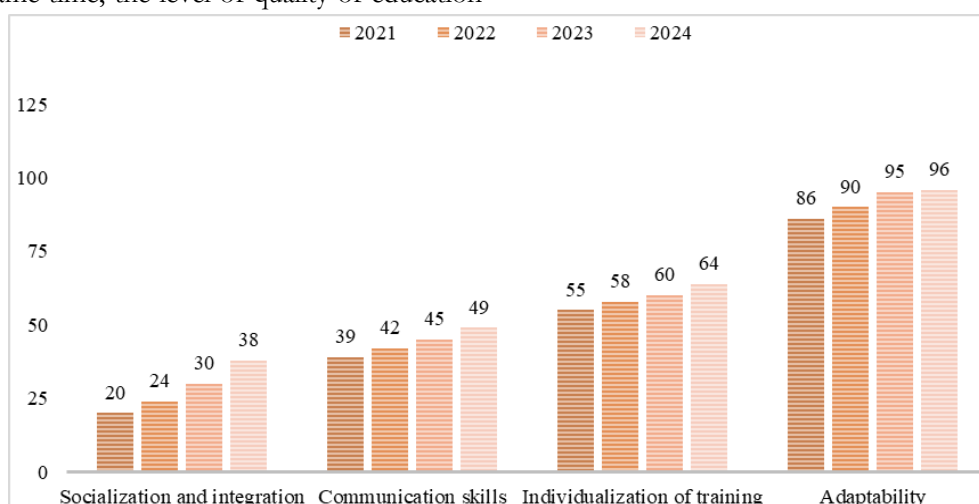


Figure 3. The impact of the digital learning environment on the quality of education in the EU, % of students with medium and high level of skills

Source: compiled by the author based on (Global Education Monitoring Report, 2023)

At the same time, a number of negative aspects have been identified, such as social isolation and a decrease in emotional intelligence, the digital divide (unequal access to digital technologies can deepen social inequality in education), the risks of information overload due to uncontrolled use of digital resources and problems with concentration, as well as the need for continuous training for teachers, updating their knowledge and skills, which can be challenging, especially for those who have no experience with digital tools.

The experiment was conducted on the basis of a higher education institution that implements the ideas of innovative learning – Lutsk National Technical University. To ensure the reliability of the work carried out, two groups were identified within the 3rd year student group: control (CG) and experimental (EG). The total sample size is 24 students. The number of respondents in the control and experimental groups was the same (12 students each).

To determine the general state of educational and cultural development, authors used the average values of the learning coefficient for individual indicators, which were determined by formula (1):

$$KN1 = A1/N1$$

(1),

where KN1 is the learning coefficient; A1 is the qualitative indicator of learning; N1 is the maximum possible result (in points) of qualitative training.

The initial level of the studied students' skills is shown in Figure 4.

In the course of the experiment, the potential of the digital learning environment was used in the EG: online platforms, gamification elements, intelligent maps and sequences, interactive learning.

The CG used a traditional teaching methodology.

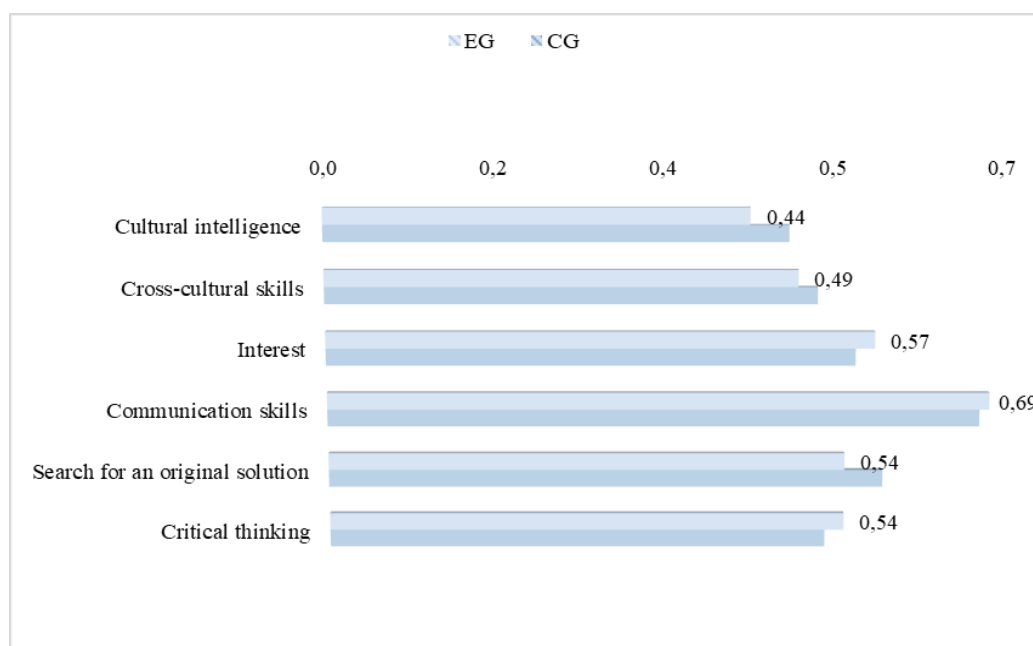


Figure 4. Initial indicators of the learning ratio by indicators of educational and cultural development

Source: compiled by the author

The experiment lasted for two months, after which the dynamics of students' skills in the EG and CG, characterizing the level of educational and cultural development, was re-analyzed (Figure 5).

The results of the experiment demonstrate a significant positive dynamics of the skills of EG students where the digital learning environment was used, especially in the aspects of cultural intelligence (by 10%), critical thinking (by 11%) and search for non-standard solutions (15%).

The author's definition of the role of the digital educational environment in the formation of digital culture and the transformation of the educational field allowed us to identify the main components of digital culture: value-motivational, reflective and action, and personal development. The value-motivational component is based on an informational worldview, awareness of value, and principles of cognition and communication. The

reflexive and interactive component involves the interaction of the student with the digital educational environment, which assimilates the vectors of analysis, critical evaluation, and purposeful information activity. At the same time, the cognitive and procedural component integrates skills, abilities and knowledge in the digital learning environment for continuous education and self-improvement.

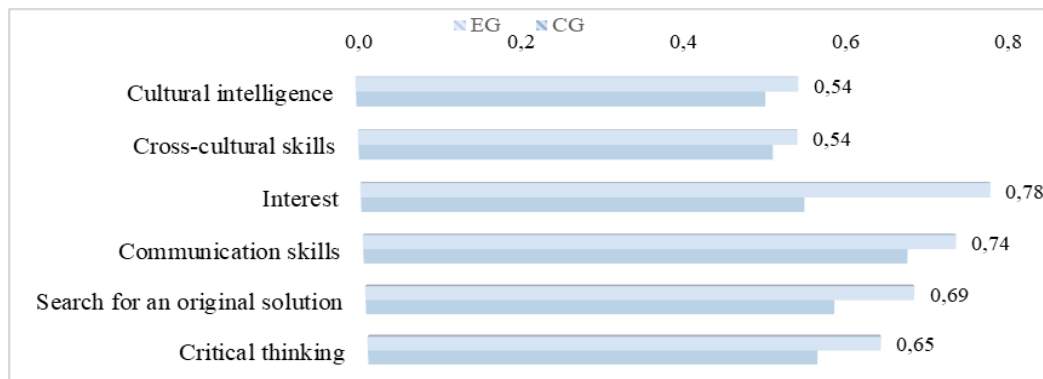


Figure 5. Benchmarks of the learning ratio by indicators of educational and cultural development

Source: compiled by the author

Thus, the interaction between the digital learning environment and cultural and educational development is a complex and multifaceted phenomenon. Awareness of these connections helps to form a more holistic view of the world and the place of a person in it, and contributes to the development of a harmonious personality and a balanced society.

5. Discussion

A number of contemporary scholars have focused on the impact of the digital educational environment on the cultural aspects of society. The foundations of the theory and methodology of this process are being developed by contemporary scholars Cruz et al. (2021), Tymchuk et al. (2024), Causadias (2020). The researchers emphasize the importance of personality formation in the digital learning environment within cultural traditions and the formation of a modern philosophy of culture, which reinforces the results of the current study.

The peculiarities of the cultural development of society in digital education proposed by Houser (2023) include the diversification of academic philosophy in the context of post-comparativist

transformation and transculturalism. According to the researcher, cultural evolution is based on the motivation of people who change themselves and change the world around them. The author's position is characterized by dualism regarding the polarity of the impact of digital education on cultural evolution, and a number of risks were not taken into account in the publication. These gaps were filled by the current study.

Nikitenko (2020) emphasizes that today, the philosophy and ethics of using artificial intelligence, which transforms educational and cultural aspects, is of particular relevance, and often this transformation has a negative connotation. The author argues that the cultural development of society is closely interconnected with changes in the educational system. At the same time, the authors do not deny the future prospect of combining social, historical, and philosophical aspects of cultural and educational progress.

The theoretical and methodological foundations of modern concepts of the development of the digital educational environment and their cultural implications were developed by scientists,

educators, and psychologists who analyze innovative educational technologies. At the same time, there are some differences between their conceptual visions. Also, a number of aspects considered in this study appear in their publications in a different light.

Aspects of the influence of the philosophy of the digital learning environment on the overall cultural development are analyzed by modern researchers Kia and Sitepu (2021). The peculiarities of the cultural development of contemporary society include the diversification of academic philosophy, which synergizes emotions, civil society, and global development. At the same time, the current study reveals a number of aspects of the integration of innovative targeted educational technologies into the traditional educational field that potentially affect cultural genesis.

Neag et al. (2022) offer successful examples of integrating digital educational systems into different levels of traditional education. At the same time, experience shows that the proposed approach needs to be further clarified and adapted to socio-economic conditions and current trends in the development of digital communications. This is fully consistent with the publication of Sauro and Zourou (2019), which emphasizes the importance of the digital culture of society for the spread of negative cultural narratives.

Based on the above, it can be argued that currently, the perception of the context of the impact of digital education on the cultural aspects of society's development does not find a common vision among scholars. The current study recognizes the

significance of the digital learning environment in the context of developing the competencies necessary for effective social progress towards a culture of communication, strengthening the philosophical concepts of cultural and ethical development for social progress.

6. Conclusion

Digital learning environments have great potential for improving the quality of education and cultural development. At the same time, it is necessary to take into account related risks and negative consequences, develop strategies to mitigate them in order to ensure equal access to quality education for all students and avoid deepening the digital divide.

The analysis of various modern approaches to the impact of the digital learning environment on the overall cultural development implemented in this study has made it possible to establish that digital culture is crucial for the development of a conscious and responsible society in the dynamic information and communication global space. The studied tools and approaches to the formation of critical thinking skills in society illustrate how closely the aspects of education, digital solutions, communication, and cultural development are interconnected. There is a need to formulate and implement unified educational concepts for the development of critical thinking in the context of society's active use of digital communication.

Further research should be devoted to the development of an improved system of indicators to assess the impact of the digital learning environment on social cultural genesis.

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