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Strategic reflections on digital transformation, scientific literacy, and labor market development in the Eurasian Economic Union: Insights from the case of Kazakhstan

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ABSTRACT

This article examines the digital transformation processes in the Eurasian Economic Union (EEU), focusing on Kazakhstan to explore the intersection of technological development, scientific literacy, and labor market evolution. Drawing on official documents, regional initiatives, and scholarly literature, the study analyzes national and supranational strategies that foster digital ecosystems, respond to workforce adaptation challenges, and promote citizen science and technology competencies. The analysis identifies key initiatives adopted by the EEU, including cross-border employment platforms, digital customs systems, and national education and cybersecurity strategies. It also evaluates these initiatives' implications from socio-educational and economic perspectives. Particular attention is given to scientific and digital literacy, which is defined as the ability to critically engage with technological environments and scientific information in daily and professional life. The study argues that Kazakhstan's digital agenda should prioritize inclusive access to infrastructure, reform the educational system toward competency-based learning, align workforce reskilling with scientific and digital competencies, and strengthen research and innovation ecosystems. In this context, the article formulates strategic guidelines for Kazakhstan and the EEU to ensure equitable, participatory, and scientifically grounded digital transformation processes. Ultimately, the study contributes to the broader debate on how emerging economies can align digital development with inclusive education and labor strategies, thereby reinforcing the role of scientific literacy as a structural component of sustainable digitalization.

Keywords: digital transformation; scientific literacy; digital literacy; Eurasian Economic Union; labor market; citizen science.

1. INTRODUCTION

Scientific literacy is a process that enhances citizens' confidence and ability to engage with science and technology issues in their daily lives in an informed manner. This has direct implications for their employability and adaptability in the labor market (Laugksch, 2000). According to Holbrook and Rannikmae (2009), the concept of scientific literacy has evolved from a focus on acquiring isolated scientific knowledge and skills to an emphasis on making informed decisions about socio-scientific and technological issues. This evolution acknowledges the fundamental role of scientific literacy in civic participation in the real world. Pedagogical approaches centered on inquiry-based learning bolster this type of literacy by moving beyond the traditional model of memorizing facts and promoting active understanding and application of scientific methods. In this context, advances in digital technologies have broadened training opportunities in both formal and informal settings (Okada, 2013).

Defining the concept of scientific literacy, or, more broadly, scientific and technological literacy, is highly complex due to its expansive and multidimensional nature, particularly when its close connection to everyday life is acknowledged (Holbrook & Rannikmae, 2009). The effective use of digital technologies is closely tied to this concept. Consequently, processes of digital transformation are vital for cultivating a society that is highly literate in science and technology. This has resulted in initiatives focused on digitally transforming society.

Digital transformation has emerged as a pervasive trend impacting various social and industrial sectors. While the term is not yet clearly defined, it typically refers to the ongoing change driven by information technologies that facilitate the optimization of practices, the automation of processes, and the creation of new forms of knowledge applicable across multiple fields, including commerce, education, and public management (Gray & Rumpe, 2017). Vial (2019) defines digital transformation as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies".

According to Bonnet and Westerman (2023), successful digital transformation is based on nine elements organized into two broad capabilities. The first is digital capability, which involves transforming processes, customer experiences, and business models through new technologies. The second is leadership capability, which encompasses transformative vision, organizational commitment, and appropriate governance. The balance between these two capabilities distinguishes organizations that effectively and sustainably integrate digital transformation. Digital transformation has attracted the interest of numerous researchers and specialists due to its capacity to reconfigure work dynamics and social practices, along with the challenges and benefits it entails (Zaoui & Souissi, 2020).

The concept of digital technologies and the digital economy emerged in the late 90s. During this time, the first mobile devices started appearing in the countries of the Eurasian Economic Union (EEU).[1] Over the last 30 years, a digitalized lifestyle has become the global norm. Today, nearly everyone uses smart devices at home. In developing countries, it is important to note that digitalization, through its integration into various aspects of life and production, represents a significant global economic activity.

Members of the EEU are implementing innovative technologies at the national level, making them a norm in political life. In the Republic of Kazakhstan, for instance, there is a strong emphasis on digitalizing education and addressing private educational institutions that fail to provide quality education to their students. In his 2025 State of the Nation Address, President Tokayev underscored the crucial role of digital transformation and scientific advancement in shaping Kazakhstan's future (Kassym-Jomart Tokayev, 2025). He highlighted the strategic importance of advancing digital technologies and scientific development as pillars of national competitiveness. He emphasized the need to modernize public administration through comprehensive digital transformation, strengthen

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[1] The Member-States of the Eurasian Economic Union are the Republic of Armenia, the Republic of Belarus, the Republic of Kazakhstan, the Kyrgyz Republic and the Russian Federation (See https://eaeunion.org/?lang=en#about).

the domestic IT sector, and train a new generation of tech professionals. He also stressed the importance of long-term investment in science, calling for structural reforms to ensure stable funding for research institutions and improved working conditions for scientists. These reforms aim to establish Kazakhstan as a regional leader in innovation and knowledge.

This article aims to analyze the digital transformation processes within the Eurasian Economic Union through the lens of Kazakhstan's experience, highlighting their intersections with scientific and digital literacy and labor market dynamics. Based on a documentary review and regional policy analysis, the study proposes strategic guidelines to promote inclusive and knowledge-driven digital development.

2. DIGITAL AGENDA OF THE EURASIAN ECONOMIC UNION

Erokhin (2022) examines projects that demonstrate ongoing efforts to promote regional digital integration. Notably, the digital connectivity initiatives advanced by the International Institute for Applied Systems Analysis (IIASA) in 2019 and 2020 aimed to strengthen economic ties between Eurasian countries through shared technological solutions. The author also discusses international workshops and multilateral forums focused on digital economic cooperation. At these events, proposals were made to facilitate cross-border trade and harmonize digital infrastructure. Erokhin addresses joint projects promoted by the European Union (EU), the EEU, and China. These projects aim to establish shared transnational digitization strategies and create compatible regulatory frameworks. The author analyzes interoperability initiatives and pilot digital platforms as part of the effort to consolidate a common digital space in Eurasia and overcome the technological and legal fragmentation that hinders effective digital integration.

However, several key regulatory documents guide digital transformation within the EEU framework. One such document is Provision No. 140 of the Eurasian Economic Commission (EEC) Board, issued on September 2, 2019 (Eurasian Economic Commission, 2019). This regulatory instrument establishes a roadmap for developing the EAEU's digital ecosystem and demonstrates the commitment of member countries to creating a shared digital space that transcends national borders. The provision responds to the strategic guidelines previously adopted by the Eurasian Supreme Council and outlines a coordinated approach to integrating digital infrastructures, platforms, and services across various sectors of the regional economy.

At its core, the document establishes unified standards for electronic data exchange. This represents a significant technical and legal effort to achieve interoperability among member states. However, beyond its technical nature, implementing the measures in this provision has important social and educational implications. The digital transformation of key societal sectors can only be achieved if the population possesses the necessary skills to actively participate in new technological environments. This means recognizing digital and scientific literacy as essential elements for the success of the described processes. Interoperable digital platforms, automated services, and integrated data accessibility require citizens who can understand and adapt to these technologies. This underscores the need for education policies that align with the challenges of the emerging digital ecosystem.

Another relevant document is Decision No. 52 (Eurasian Economic Commission, 2021). It represents one of the initial regulatory formalizations in institutionalizing the EEU's digital agenda. This decision establishes the framework for evaluating, prioritizing, and implementing cooperation projects in the digital economy sector, specifying technical, organizational, and strategic criteria for selecting initiatives to be integrated into the core of the Eurasian digital ecosystem.

A key contribution of the decision is the establishment of a systematic mechanism for evaluating proposals for interstate digital projects. Such projects must demonstrate alignment with the EEU Digital Agenda's objectives, be innovative and cross-border, and generate measurable economic benefits for participating countries. Additionally, it introduces an evaluation framework that considers factors such as technological maturity, potential for replicability, participation of private and public entities, and the financial viability in the short and medium terms.

Decision No. 52 clearly defines the roles of the bodies responsible for receiving and analyzing proposals, including the technical units of the EEC, national agencies, and intergovernmental committees. In this context, the document establishes the foundation for a multilevel governance system that balances supranational cooperation with the technological sovereignty of each member state. The document also outlines the creation of a consolidated portfolio of priority projects, the implementation of which would be monitored by the EEC and supported through co-financing mechanisms and shared technical resources.

While this provision primarily addresses the technical and management aspects of digital projects, its purpose is to strategically promote digitalization as a driver of regional integration. By strengthening shared infrastructures, common standards, and interoperable platforms, the goal is to create a technological foundation that will enable a unified digital economy to compete in an increasingly digital global environment.

Finally, we regard Provision No. 63 of August 4, 2021, issued by the EEC, as vital. It represents a decisive step in advancing the EEU's digital agenda. The provision formally approves the updated Implementation Program for the EEU Digital Agenda through 2025. This reinforces the member states' strategic commitment to building a modern, interoperable, sustainable, and development-oriented regional digital ecosystem.

The new program serves as a planning tool that organizes joint digital transformation priorities and projects with a clear focus on regional economic integration through digital technologies. It outlines lines of action that include the automation of trade and logistics processes, the standardization of electronic data exchange, the development of cross-border digital services, and the establishment of shared regulatory and technological conditions. This document reflects an evolution from previous provisions by adopting a more comprehensive view of digital transformation that encompasses the technical infrastructure, as well as the regulatory and governance frameworks, necessary for effective implementation.

One of the most significant aspects of this provision is the consolidation of priority interstate projects, which the EEC will supervise and coordinate in close collaboration with national governments. These projects include digitizing regional logistics chains, implementing digital platforms for real-time information exchange between regulatory authorities, and constructing a system for mutual recognition of electronic documents. Additionally, there are initiatives to promote technological innovation and cooperation in artificial intelligence, cybersecurity, and the data economy.

Provision No. 63 indirectly emphasizes the importance of fostering digital literacy and technological skill development among the population. While the text maintains a technical and regulatory tone, it implicitly acknowledges that effective digital transformation requires a social foundation that can operate, understand, and adapt to new technological tools. Thus, digital education and training are positioned as cross-cutting dimensions of the regional agenda, necessary to ensure the inclusiveness and sustainability of the process.

A review of key policy documents issued by the EEC reveals a progressive evolution in the governance of digital transformation in the Eurasian region. Decision 52 establishes technical criteria for selecting interstate digital projects. Provision 140 promotes the implementation of common digital platforms and services. Provision 63 consolidates a more comprehensive regional program that incorporates innovation, cybersecurity, and artificial intelligence. This evolution reflects a shift from operational planning to a strategic vision of digital integration, where scientific and digital literacy are essential for ensuring the full and equitable participation of citizens. As a key player in the region, Kazakhstan has the opportunity to lead these processes if it can connect technological development with inclusive, sustainable educational policies.

3. DIGITAL TRANSFORMATION IN EURASIAN INTEGRATION CONTEXTS

In recent years, the digital transformation of public institutions, labor markets, and educational systems has become a central priority on the strategic agendas of the EEU. Each member state has developed national frameworks, policies, and pilot initiatives to promote digital

innovation and enhance regional interoperability. Although these countries share the common objective of modernizing governance and economic processes, their distinct approaches are influenced by institutional capacities, socioeconomic conditions, and integration aspirations. This section reviews existing scientific literature examining digitalization processes across the five member states, providing a comparative analysis of their achievements, challenges, and trajectories.

3.1. The context of the Republic of Armenia

Several recent studies have shown that Armenia is actively transitioning to a digital economy. This transition is characterized by structural reforms, the development of technological infrastructure, and transformations in the labor market. A study by Melkumyan and Sahakyan (2022) reveals that digitization has significantly influenced the Armenian labor market infrastructure. It has promoted the creation of new, highly skilled job opportunities in the information technology sector and highlighted the importance of soft skills, such as teamwork, communication, and conflict resolution. The article also emphasizes that human resource management in Armenia must adapt to new digital environments by utilizing tools such as e-recruitment and the development of E-HRM systems.

The report by Avedisyan & Asatryan (2022) on digital technologies in agriculture illustrates how Armenia has embraced innovative solutions to enhance the sustainability of the agricultural sector. It demonstrates that integrating technologies such as smart sensors, crop monitoring platforms, and geographic information systems allows for more efficient management of natural resources, increased productivity, and improved adaptation to climate change.

Meanwhile, Simonyan & Aleksanyan (2023) analyze Armenia's role in Eurasian digital cooperation. It recognizes that the country has adopted digital development strategies aligned with the guidelines of the EEU and emphasizes the importance of linking digitalization to public policies for social inclusion and human development. The document also identifies challenges related to digital governance, the skills gap, and unequal infrastructure in rural areas.

3.2. The context of the Kyrgyz Republic

The Kyrgyz Republic is actively developing its digital infrastructure and promoting strategies that encompass key sectors such as higher education, agriculture, logistics management, and foreign trade. One priority has been the internationalization of the education system by digitizing the adaptation processes for foreign students. Kydyrbaeva et al. (2023) proposed an intelligent system based on functional models of the educational process with a client-server structure to provide academic support to international students at Kyrgyz medical universities. This initiative aligns with the National Development Strategy 2018-2040 by fostering educational equity and efficiency through digital tools.

In the agricultural sector, Osmonov et al. (2024) note that digital and green technologies are emerging as solutions to enhance productivity and sustainability. However, the authors caution that current conditions hinder the effective adoption of these innovations, primarily due to limited rural connectivity and farmers' insufficient technical preparation.

From a macroeconomic perspective, Toktomushev (2020) analyzes the regulatory and political environment for digital development in Kyrgyzstan. The author points out that although the country has developed ambitious digitization plans, structural and governance barriers continue to exist, hindering effective implementation. The necessity of strengthening the digital ecosystem through investments in infrastructure, digital literacy, and institutional reform is highlighted.

Meanwhile, efforts in e-commerce and cross-border cooperation have gained traction. Mamatova et al. (2024) demonstrate that Kyrgyzstan is adopting electronic platforms to enhance transparency and efficiency in logistics and customs. These digital tools simplify trade flows and represent a strategic step toward greater integration with the Eurasian Economic Union.

Finally, Mambetalieva et al. (2024) examine the growing role of higher education as a driver of digital service exports, emphasizing the use of ICT in international academic programs. An increase in foreign students and collaboration through digital platforms has strengthened the country's position as an emerging educational destination in Central Asia.

3.3. The context of the Republic of Belarus

The Republic of Belarus has adopted a strategic vision for digitalization aimed at driving economic modernization, strengthening public services, and reconfiguring the relationship between the state and its citizens. Numerous studies have documented the institutional, technological, and social advances associated with this process, along with its inherent tensions.

Mashevskaya (2020) traces the systematic evolution of Belarus's digital economy, emphasizing regulatory milestones such as Presidential Decree No. 8 and national informatics strategies. These have enabled the development of sophisticated electronic services in critical sectors like health, finance, and public administration. Similarly, Zhuravleva (2021) analyzes the institutional structure of digital governance, highlighting the state's efforts to build its own technological infrastructure that promotes digital sovereignty and enhances governmental efficiency.

From a critical perspective, Hradziushka *et al.* (2023) examine how Belarusian state institutions' use of digital platforms like Telegram has reinforced a model of one-way communication. In this model, vertical transmission of information predominates, and there are no effective mechanisms for citizen participation. In contrast, Pugacheva (2022) explores the potential of these channels to facilitate citizen dialogue, suggesting that their democratizing potential hinges on their adoption by civil society.

Other studies have examined the impact of digitalization on the labor market and education. Solodovnik *et al.* (2021) address the need to adapt job skills to the new digital environment by proposing training programs that integrate advanced digital literacy and technical skills for future jobs. In education, an anonymous study included in a national methodological guide emphasizes the progressive transformation of universities through online learning platforms and integrated digital assessment systems.

Similarly, Bykhovskaya (2017) discusses how e-commerce and the digitization of customs services are key factors in enhancing national competitiveness and regional integration within the EEU. Finally, Vysotsky's (2017) economic analysis suggests that digitization could reshape the Belarusian economy, but also cautions against the concentration of state power over strategic digital infrastructures.

3.4. The context of the Russian Federation

The complexity of implementing digital transformation in Russia's economic, educational, organizational, and governmental contexts has sparked increasing academic interest in the subject. From a business perspective, Lukyanova (2021) emphasizes the importance of information technology management in helping Russian companies advance their digital transformation. This digital leadership requires technological investment and structural transformation of management models. Similarly, Seliverstov *et al.* (2020) emphasize that digitization influences human capital development and necessitates reskilling and redesigning work processes in industrial companies.

Conversely, Okorokov *et al.* (2019) emphasize that developing intellectual capital is essential for the success of the Russian digital economy. They also draw attention to the gap between digitization objectives and the actual capabilities of the education and professional systems. Sokolova and Borisova (2019) address this concern as well, pointing out that developing professional skills suited to the digital environment still faces institutional resistance and curricular deficiencies. Vodolazhskaya (2021) proposes an indicator-based assessment methodology to monitor the degree of digitization across different sectors. She argues that implementation levels differ by region and economic activity.

In the field of education, Zorina *et al.* (2021) examine the challenges that Russian institutions have faced during the digitization process, especially following the pandemic, which accelerated the shift towards virtual teaching. Meanwhile, Pavlova and Smirnova (2021) provide an empirical assessment of the level of digital literacy among Russian university students. They conclude that significant disparities in digital skills persist depending on the academic context, emphasizing the need for inclusive policies. Education appears to be a domain where the advances and tensions of the digital transformation converge.

In public administration, Akhmetzyanova and Makhmutov (2022) examine barriers to the digital transformation of state institutions, such as rigid regulatory frameworks and cultural resistance to change. Despite these limitations, the authors acknowledge improvements in the efficiency and accessibility of public services through digital platforms. Gura (2022) contextualizes these advances within a broader view of the Russian digital economy, highlighting its strengths, including a consolidated technological infrastructure, as well as its vulnerabilities, such as the impact of international sanctions and low foreign capital attraction.

Finally, Zaitseva's (2023) study provides a comparative assessment of the digitization process across various Russian universities and identifies different institutional models of technology adoption. Her findings reinforce the idea that digital development in Russia is not homogeneous; rather, it responds to the specific dynamics of context, institutional capacity, and political alignment.

3.5. The context of the Republic of Kazakhstan

Digital transformation in Kazakhstan is progressing into a multisectoral strategic initiative that includes public policy, technological innovation, labor adaptation, institutional communication, and enhanced global positioning. Abazov *et al.* (2023) analyzed the use of digital technologies as a tool for international projection, especially through the Astana International Financial Centre (AIFC). The AIFC integrates economic transformation with country branding strategies to attract foreign investment and enhance institutional visibility within the Eurasian context. On the other hand, Nurtayeva (2024) highlights internal challenges regarding digital sovereignty, territorial fragmentation, and cultural divides amid technological change. Her work emphasizes the need for more inclusive policies that consider regional diversity and digital literacy vital to sustaining the country's technological progress.

From an economic and comparative perspective, Abazov (2022) classifies Kazakhstan as a hybrid country concerning digital governance, drawing inspiration from Asian models like Singapore and European frameworks. His research outlines indicators and strategies for assessing national digital success and highlights efforts toward technological regionalization through shared infrastructure and regional regulatory frameworks.

4. EEU DIGITALIZATION PROCESS SLOWDOWN

Despite the EEU's active efforts to digitize, there is clear evidence that this process is slowing down. As part of this transformation, countries are developing state online services, promoting e-commerce, improving infrastructure for information and communication technologies, and refining legal regulations for digital spaces (EEC, 2021). Despite the variety of concepts (from theoretical to pragmatic) that could explain it, there is no consensus on the reasons for the slowdown of digital integration within the EEU. Disagreement among these concepts hinders the development of solutions aimed at restoring the proper dynamics of the "digital dimension" of the Eurasian integration space (EEC, 2021).

For example, T. S. Sargsyan, the former prime minister of Armenia, chairperson of the EEC board, and vice-chairman of the Eurasian Development Bank board, believes that the dramatic change in values among governments in the digital world is one source of this process. In today's geopolitical environment, digital corporations inevitably gain substantial influence over political processes at the national level. This results in significant changes in the traditional functioning of states. Sargsyan (2021) also states that digitalization has effectively opened the doors, allowing "the bulls" into the "china shop" (p. 136-149). Consequently, nations and states become more focused on preserving their influence and control, which reinforces the role of digital sovereignty as a means of combating unwanted changes. If this perspective is correct, the fight for digital sovereignty will inevitably lead to a reevaluation of integration values, including the digital dimension. It will also result in a further strengthening of national interests in the digital sphere and a tendency to create closed national digital ecosystems. This could complicate the process of common Eurasian digital integration.

Another reason for this process is that the EEU selected a project for accelerated digital integration that includes various "radical digital reforms" in 2021 (Abdrakhmanova, Vishnevskiy & Gohberg, 2021). However, this initiative slowed due to conditions stemming from the pandemic and political crises involving conflicts between superpowers. As a result, integration goals were placed on the back burner as countries focused on their own issues. In this regard, we see a slow but steady divergence between political and pragmatic realities. Recently, member countries have chosen to address their problems independently of integration goals. Meanwhile, at the political level, the importance of coordinating efforts to preserve the advantages of the EEU common market is emphasized.

Several facts confirm the "multi-directionality" of the digital priorities of EEU member states. One example is the development of the High Technology Park in Minsk, Belarus. For many years, it has been a strategic priority for Belarus, illustrating the "multi-directionality" of the EEU's digital agenda. This park specializes in creating mass information and communication technology products and providing training for the global entertainment and media market. It exemplifies how a country can develop its digital economy outside the framework of integration processes (Eder, 2020, pp. 331-358).

It has become clear that the member states of the EEU are avoiding an accelerated transition to a common "digital reset." At the February 5, 2021, forum in Almaty, Russian Prime Minister M.V. Mishustin discussed the possibility of "enforcing the law" with their EEU partners. He stated: "If we delay digitalization and unification, including customs administration and other types of control on the external circuit, which applies to everyone, we will have to reinstate control measures at the internal border. We must create conditions for fair and transparent trade, actively lift infrastructural restrictions, and engage in dialogue with the European Union. All of this can only be realized on the basis of a common digital platform. In practice, we see a cautious approach to digitalization within the framework of the "Five" (EEU, 2021).

5. IMPACT OF DIGITALIZATION OF THE EEU LABOR MARKET

The development of technology and digitalization can enhance the labor market by substituting human labor with computers and algorithms, resulting in increased productivity. Greater productivity will enable businesses to reduce costs and expand production, creating new jobs in the EEU member states. Moreover, adopting modern technologies and automating production processes will generate new opportunities in the future. For instance, online retailing is becoming increasingly popular, especially in high-income countries. This trend has led to a new category of retailer who operates within supply chains without the need to maintain large inventories or store goods.

According to the Future of Jobs Report 2025:

Broadening digital access is expected to be the most transformative trend —both across technology-related trends and overall— with 60% of employers expecting it to transform their business by 2030. Advancements in technologies, particularly AI and information processing (86%); robotics and automation (58%); and energy generation, storage and distribution (41%), are also expected to be transformative. These trends are expected to have a divergent effect on jobs, driving both the fastest-growing and fastest-declining roles, and fueling demand for technology-related skills, including AI and big data, networks and cybersecurity and technological literacy, which are anticipated to be the top three fastest-growing skills (World Economic Forum, 2025, pp. 5).

According to Oxford Economics, the number of robots used globally has tripled to 2.25 million over the past 20 years. The global stock of robots is expected to increase nearly tenfold by 2030, reaching 20 million. China alone is projected to account for 14 million of those robots. This shift will lead to the loss of up to 20 million jobs in processing industries. Over the next decade, the U.S. will lose more than 1.5 million jobs to automation, while China and the European Union will lose approximately 12.5 million and 2 million jobs, respectively (Zhang,

2020, cited by Oxford Economics [2029]). This situation affects the entire world and some EEU countries. Experts believe that the Asian continent and Kazakhstan will be impacted later than other countries but will subsequently develop quickly based on their experience, which helps predict future steps.

However, it is important to keep in mind that automation will lead not only to the replacement of certain jobs, but also to an exacerbation of the existing employment gap between high- and low-skilled workers. Since automation aims to replace routine labor functions, people with low and medium levels of qualification (e.g., drivers, cashiers, and office staff) are at risk of being laid off and losing their income (Workforce Development Center, 2024).

Considering the era of digitalization and automation, the institutional changes associated with the integration of technology within the EEU create a favorable yet challenging environment for the labor market. The emergence of modern technologies and other innovations requires changes in workers' tasks, jobs, and skills. Therefore, the experience of other countries in these areas can be used to develop effective measures for the digitalization of the EEU, which will help minimize the negative consequences and maximize the opportunities created by this process.

6. STRATEGIC GUIDELINES FOR A SCIENTIFIC AND DIGITAL TRANSFORMATION IN KAZAKHSTAN AND THE EEU

In light of the presented findings and the regional review of digitalization initiatives across the EEU, this study proposes strategic guidelines to strengthen Kazakhstan's digital transformation, deliberately emphasizing scientific and technological literacy. The objective is to foster an inclusive, knowledge-driven society capable of actively engaging with the challenges and opportunities of the digital era, not only to improve infrastructure or access. These recommendations address the need for systemic changes that align educational reform, labor market adaptation, and innovation ecosystems while reinforcing regional cooperation within the EEU.

a. Promote inclusive digital and scientific literacy to reduce inequality

Alongside deploying infrastructure, it is essential to ensure that all citizens, regardless of age, location, or socioeconomic status, possess the fundamental skills needed to engage with digital environments and scientific knowledge. National programs should prioritize teaching critical thinking, evaluating information, and applied technology skills in formal, non-formal, and informal settings.

b. Redesign the education system to integrate STEM, inquiry-based learning, and socio-scientific reasoning

Educational transformation necessitates a shift from memorizing content to developing competencies. Curricula should embrace interdisciplinary approaches that link science and technology with social relevance. These strategies should empower learners to understand and tackle real-world challenges. Digital tools must facilitate this pedagogical shift from early schooling through higher education.

c. Strengthen workforce upskilling and reskilling through science-based qualification frameworks

To align with the evolving demands of the labor market, sectoral training centers should be established that incorporate digital and scientific competencies as core elements. A dynamic national qualifications system must integrate industry collaboration, micro-credentials, and continuous professional development programs based on technological and analytical skills.

d. Support digital labor market transitions with inclusive and science-oriented policies

Employment services must evolve beyond digitization to support individuals in professional reorientation processes. This includes providing targeted assistance to displaced workers, developing new scientific and technical job profiles, and creating tools for personalized career planning. These efforts ensure a socially sustainable digital transition.

e. Embed cybersecurity education as part of national scientific and digital literacy agendas

To protect individuals and institutions from cyber threats, it is essential to foster public understanding of risks, promote responsible data management, and encourage digital ethics. Public awareness campaigns and formal education in cybersecurity principles should be integral components of educational and civic strategies.

f. Increase investment in R&D and elevate science as a cornerstone of digital transformation

To advance, Kazakhstan must enhance its support for research and innovation, particularly in areas like data science, artificial intelligence, green technologies, and digital governance. This requires allocating funding, upgrading research infrastructure, and encouraging the dissemination and commercialization of scientific findings within society.

g. Foster innovation ecosystems through university-industry collaboration and science-based entrepreneurship

Creating vibrant innovation environments requires financial incentives, favorable regulations, and infrastructure that connects academia, business, and civil society. These ecosystems must promote scientific and digital literacy at all levels to foster the development of socially responsible and scientifically grounded technological solutions.

7. FINAL CONSIDERATIONS

The digital transformation processes occurring in Kazakhstan and the broader EEU are ambitious and complex. While significant progress has been made in developing cross-border digital services, modernizing infrastructure, and formulating innovation policies, the success of these efforts ultimately relies on citizens' willingness to engage in the transformation. Scientific and digital literacy are foundational requirements, not optional luxuries, for the current society.

This article's findings indicate that a strictly infrastructural or technological approach to digitalization is inadequate. Education systems must evolve to foster critical thinking, problem-solving, and digital fluency from an early age. Labor market policies must adapt to new job profiles and ensure smooth transitions for vulnerable groups impacted by automation and digital disruption. Most importantly, the scientific culture of the population must be strengthened to promote innovation, democratic participation, and economic resilience.

As Kazakhstan aspires to become a regional hub for digital innovation, it must demonstrate a clear commitment to equity, inclusion, and knowledge generation. The strategic guidelines outlined in this article provide policymakers with a roadmap for aligning digital ambitions with educational transformation and social cohesion. This approach serves the interests of Kazakhstan and the entire EEU region.

Conflict of interests

The authors declare that there are no conflicts of interest.

Contribution statement

Ospanova A.: Formulated the main article's idea and provided some historiographical vision.

Mukhametzhan A.: Performed some literature review, data collection, and analysis.

Mukanov M., Nurbayev Zh., Baygabylov N.: Defined the research objectives, theoretical approach, methodology, and final writing and correction.

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