

Development of a Model for Integrating Modern Technologies into Public Education Governance in Ukraine

Dina Tiurina¹, Iryna Kovtun², Tetiana Pidlisna², Oleksandr Shtyrov³, Denys Shabanov⁴

¹Department of Economics and Public Administration, National Aerospace University "Kharkiv Aviation Institute", Kharkiv, Ukraine

²Department of Public Administration, Leonid Yuzkov Khmelnytskyi University of Management and Law, Khmelnytskyi, Ukraine

³Department of Public Management and Administration, Petro Mohyla Black Sea National University, Mykolaiv, Ukraine

⁴Department of Public Administration and Law, Communal Institution of Higher Education "Dnipro Academy of Continuing Education" of the Dnipropetrovsk Regional Council, Dnipro, Ukraine

Correspondence: Dina Tiurina, Department of Economics and Public Administration, National Aerospace University "Kharkiv Aviation Institute", 17, Vadyma Manka str., Kharkiv, 61070, Ukraine.

Received: October 22, 2025

Accepted: December 1, 2025

Online Published: December 11, 2025

doi:10.11114/jets.v14i2.8273

URL: <https://doi.org/10.11114/jets.v14i2.8273>

Abstract

The digitalization of public education management has become a key factor in increasing the efficiency, transparency and accountability of educational systems in the world, which is especially important for Ukraine in the context of decentralization and integration into the European educational space. The introduction of information technology in the field of education management requires not only technical upgrades but also a rethinking of management models, competencies, and decision-making mechanisms. The purpose of the study is to study the trends of digital transformation of public education management and identify factors that affect the efficiency of digital management processes. The research methodology is based on quantitative methods, including a survey of heads of educational institutions and representatives of local authorities, including a questionnaire survey of heads of educational institutions and representatives of local authorities, as well as analysis of statistical and analytical data from international organizations (OECD, UNESCO UIS). The results obtained showed a steady increase in the index of digital accessibility of education (by an average of 18% annually), the expansion of e-government and the improvement of digital competence of managers. It is established that the effectiveness of digital reforms directly depends on the level of digital culture, leadership and ethical responsibility of managers. Based on the data obtained, a multi-level model of integration of information technology into the system of public education management is proposed, which covers the strategic, analytical, operational and communication levels. The practical significance of the study lies in the possibility of using this model to optimize management decisions, develop managerial training programs and create sustainable digital ecosystems in the field of education. The results are of practical importance for the formation of state policy on digital education management, as well as for harmonization of Ukrainian approaches with European standards of smart governance.

Keywords: public administration of education, digital transformation, e-government, digital competence, information technology, digital ecosystem, managerial efficiency, smart governance

1. Introduction

The modern system of public education management is undergoing significant transformations under the influence of global digitalization, the development of information technology and changes in public expectations of transparency and efficiency of public administration. Education is increasingly viewed not only as a tool for training specialists, but also as a strategic resource for sustainable development that requires new management approaches based on digital analytics, open data, and technological innovations. In this context, digital public education management is becoming a key factor in improving the quality of educational services, strengthening the institutional capacity of educational organizations, and creating a new culture of managerial interaction between the state, the public, and educational institutions. In recent years, there has been a growing interest in the digital transformation of management systems.

Christensen and Lægheid (2025) emphasize that the future of public administration is associated with the introduction of intelligent digital solutions and the use of big data to support management decision-making. According to Frank and Kunz (2024), the modern paradigm of public administration requires a combination of a scientific approach with practical mechanisms of influence, which is especially relevant in the field of education, where changes occur simultaneously at the regulatory, technological and social levels. Hergüner (2021) emphasizes that pandemic challenges have accelerated the digitalization of educational management, opening up opportunities for remote management formats, but at the same time raised questions about the quality of management decisions in the new environment.

Despite a significant amount of research, a number of aspects of the digital modernization of education management remain insufficiently studied. In particular, the mechanisms for integrating information technology into a multi-level management system, institutional models of digital interaction between authorities and educational institutions, and the impact of managers' digital competence on the effectiveness of education policy need to be clarified. Pasenko (2022) and Zou et al. (2025) emphasize the need to create flexible management structures that combine technological efficiency and the human factor. To strengthen the conceptual integrity of this review, the existing body of knowledge can be grouped into three major thematic domains. The first domain focuses on the development of digital competence as a managerial requirement ensuring data-driven and ethical practices in governance. The second domain explores governance models and smart management structures facilitating decentralization, transparency and stakeholder participation. The third domain highlights the ethical and regulatory foundations of digital reforms that ensure cybersecurity, personal data protection, and a human-centered approach in the implementation of modern technologies. This thematic structuring allows not only summarizing the literature but also identifying research gaps related to the integration of these domains into a holistic framework of digital education governance. At the same time, Haleem et al. (2022) emphasize the importance of regulatory support for digital reforms and the development of ethical standards for the use of technology in education. These issues are especially relevant for Ukraine, where the decentralization reform creates new opportunities for the introduction of innovative management models, but at the same time requires the formation of a unified digital infrastructure. Thus, despite numerous theoretical and applied studies, the issue of a comprehensive assessment of digitalization processes in public education administration remains insufficiently covered, especially in the context of regional disparities, human resource readiness, and the quality of digital services. The impact of the digital culture of managers and e-government mechanisms on the transparency and effectiveness of management processes in the field of education is also insufficiently studied.

The purpose of this paper is to study the trends in the digital transformation of the public education administration system, characterize the level of digital maturity of educational institutions in Ukraine, identify factors that affect the effectiveness of digital governance, and propose a model for integrating information technology into the structure of educational administration. To achieve this goal, the following tasks are envisaged: to analyze modern theoretical approaches to the digitalization of education; to assess the level of implementation of e-government in education; to identify key indicators of digital competence of managers; to compare national trends with international practices and to outline prospects for the development of digital education management in the context of decentralization.

2. Literature Review

Modern studies of public education management demonstrate the transition from traditional administrative models to integrated digital management systems based on the principles of openness, transparency and data orientation. In particular, Christensen and Lægheid (2025) identify key areas of evolution of public administration in the context of digital challenges, emphasizing the combination of analytics, innovation, and human potential. Frank and Kunz (2024) emphasize the need to renew the relationship between education, research and management practice, while Hergüner (2021) and Hansen et al. (2023) point to the rethinking of educational models in public administration under the influence of digital technologies and pandemic restrictions.

The theoretical and methodological foundations of the digital transformation of education include the concepts of smart governance and e-government, which ensure decentralization, networking, and accountability to society (Pasenko, 2022; Haleem et al., 2022; Zou et al., 2025). Digital technologies, such as dashboards, big data systems, and artificial intelligence, have become crucial factors in shaping a new managerial culture (Barsekh-Onji et al., 2025; Batsurovska et al., 2024). In turn, the research of Kadakure and Twum-Darko (2024) proves that the digitalization of education management requires the development of digital leadership, adaptability and ethical responsibility of managers.

The formation of digital competence of educational managers is a relevant area. Sydorenko et al. (2024) define it as the integration of technological, analytical, communicative and ethical components that ensure the effective functioning of the digital environment. Similar conclusions are drawn by Khrykov et al. (2023), emphasizing the importance of training civil servants to use electronic education resources throughout their lives. International surveys (OECD, 2025; Warschauer et al., 2024) confirm that digital competence is becoming a key indicator of the quality of governance in the education sector.

The impact of information and communication technologies on the effectiveness of educational processes is also reflected in the works of Lukychova et al. (2022), who point to the potential of Information and communication technologies (further – ICTs) in the development of STEM education, and Oleshko et al. (2022), who analyze the sociological context of blended learning policies. At the same time, Yashyna and Shabaieva (2024) consider modern management models in the field of education and culture as mechanisms of public administration. Additionally, Al-Fayez et al. (2025), Amwiine (2025), and Angaw et al. (2025) explore the importance of public administration education for increasing the individual political capacity of employees and public policy development.

The development of the digital education ecosystem in the global context is presented in the studies of De la Cruz Flores et al. (2023) and Alfaro-Ponce et al. (2023), which consider technological management models and inclusive approaches to the implementation of the Sustainable Development Goals. At the same time, Pokataiev and Arutiunian (2024) focus on the theories of IT efficiency in management, emphasizing the role of digital indicators in management decision-making. The *New Tendencies in the Development of Public Administration* (2025) describes the interdependence of digital technologies, managerial efficiency, and trust on the side of the population. In addition, a number of studies focus on analyzing the effectiveness of information technology use in the public administration system. Thus, Donchenko and Sychenko (2025) reveal the mechanisms for ensuring the openness of management processes in the cultural sphere, which is of direct relevance to educational policy. Pliscoff and Sanabria-Pulido (2024) emphasize the role of international cooperation in the training of public administration professionals, emphasizing the need for digital inclusion and intercultural interaction in the educational process. In turn, Amwiine (2025) emphasizes the relationship between public administration and educational innovation, demonstrating the importance of digital policy for the development of educational leadership.

Studies on global models of digital transformation of public administration have also made an important contribution. Al-Fayez et al. (2025) analyze the state of public administration education in MENA countries, pointing to a shortage of technological competencies among managers. Alfaro-Ponce et al. (2023) describe management models that promote the development of complex thinking in the digital age, while Angaw et al. (2025) examine the impact of public administration education programs on the political capacity of civil servants. The results of De la Cruz Flores et al. (2023) are also significant, proving the relationship between inclusion policies and digital strategies in education.

At the same time, the OECD (2025) and *New Tendencies in Public Administration Development* (2025) reflect international guidelines for the use of digital technologies in reforming education management systems, in particular in the areas of analytical monitoring, open data, and the formation of a culture of digital trust. Warschauer et al. (2024) emphasize the importance of computer literacy for all participants in the educational process, and Pokataiev and Arutiunian (2024) propose models for assessing IT efficiency in the public sector.

Thus, the analysis shows that the scientific community is focusing on studying the managerial, educational, and technological aspects of digital transformation. However, the issues of developing a holistic model for integrating digital tools into public education management remain unresolved, and the mechanisms for ensuring digital ethics and cybersecurity in the educational environment remain insufficiently researched.

Although the literature on the topic is progressively expanding, the current studies tend to focus on digital competence, smart governance, and ethical considerations separately, contributing to the fragmented inferences and low transferability to actual policy changes. Although previous research points out the positive aspects of digitalization, fewer of them are critical about the dangers of digital inequality, resistance on behalf of the managers and the lack of well-developed regulations that can impede the process of change. Besides that, the majority of the analyses are conducted on the adoption of technology, but the actual way digital governance enhances decision-making, accountability, and learning outcomes in the sphere of education is not examined. Such gaps justify the topicality of the current research that incorporates the managerial, technological, and ethical approaches to suggest a more comprehensive and policy-focused approach to digital governance in education.

3. Method

The research methodology is based on quantitative methods that enabled a comprehensive assessment of the level of digital transformation of public education administration. The empirical basis was the results of an electronic survey of heads of educational institutions, IT coordinators and representatives of local governments conducted in 2023–2024. The sample population included 112 organizations from five administrative regions of Ukraine (Kyiv, Lviv, Dnipro, Odesa, and Kharkiv regions), which made it possible to take into account different levels of digital infrastructure and management readiness. A total of 317 valid questionnaires were received with a return rate of 88.6%, which indicates a highly representative sample.

The questionnaire (Appendix A) was developed taking into account the principles of transparency, evidence and ethics of research in public administration. It contained five blocks: general information, level of digitalization of management processes, use of e-government, digital competence of managers, and quality of digital educational services. Each block corresponded to certain indicators of the digital development of the educational system, which were later transformed

into analytical indicators in Table 3. In particular, questions 4 and 8 were used to determine the share of institutions using e-governance; questions 9 and 14 – to assess the number of digital services; questions 13, 14 and 18 – to calculate the level of user satisfaction; questions 11–13 – to form the component of digital competence of managers.

The data were processed using SPSS 28 and MS Excel software. No interview-based or narrative data were collected, and therefore no qualitative analysis techniques were applied within this study. The chosen methodology aligns with the purpose of this study by enabling a comprehensive examination of digital governance processes from both quantitative and qualitative perspectives. The survey instrument was designed according to international frameworks for digital governance and competence assessment (OECD, UNESCO UIS), which ensures methodological consistency and construct validity. Triangulation of survey data with official statistics minimizes bias and enhances the reliability of the findings. To ensure the comparability of the results, linear normalization of indicators to the interval (0;1) was used, as well as the calculation of arithmetic averages, partial increments and dynamics coefficients.

To quantitatively analyze the survey results and statistical data, the authors used descriptive and analytical statistics. Calculations were performed in SPSS 28 and MS Excel using the following formulas:

1. *Average value of the digitalization indicator*

$$X = \frac{1}{n} \sum_{i=1}^n x_i$$

where x_i is the value of a separate indicator for each respondent,

n is the number of valid answers.

It was used to summarize assessments of digital competence, satisfaction with services, and the level of integration into the e-government system.

2. *Growth rate*

$$T_p = \frac{X_t - X_{t-1}}{X_{t-1}} * 100\%$$

Used to analyze annual changes in the number of digital services, user satisfaction, and the share of institutions that have implemented e-government (Table 3).

3. *Dynamics coefficient (growth index)*

$$K_d = \frac{X_t}{X_{t-1}}$$

Shows the pace of development of digital infrastructure in the dynamics of 2021–2025.

4. *Normalization of indicators for the digital accessibility index*

$$Z_i = \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

where X_i is the actual value, X_{min} and X_{max} are the minimum and maximum values of the indicator.

5. *Digital accessibility index for education (DAE)*

$$I = \frac{1}{4} (Z_1 + Z_2 + Z_3 + Z_4)$$

where $Z_{(1)}$ is the number of digital services, Z_2 is the share of institutions using e-governance, Z_3 is the level of user satisfaction, and Z_4 is the digital competence of managers.

The calculated indices showed a stable trend towards an increase in the digital maturity of the education management system: the average annual increase in the EDI in 2021–2025 was approximately 18.2%, and the growth coefficient was 1.86, which indicates a gradual increase in the efficiency of public administration in the digital environment.

Based on these data, four aggregated analytical blocks were formed: development of public digital services, institutional integration of e-government, user satisfaction, and the digital accessibility index for education. The index was defined as the weighted average of these components.

The study was conducted in three stages (Figure 1): 2021–2022 – initial data collection and formation of baseline indicators; 2023 – verification of results, clarification of criteria for the effectiveness of digital services, comparison of

regional differences; 2024–2025 – building trend models, determining growth and forecasting the development of digital educational services in the medium term. The survey results were triangulated with secondary statistical sources to ensure the robustness and reliability of findings.

4. Results

Modern public education administration is undergoing a profound transformation caused by the transition to a digital society, where information technology is becoming not only a tool but also a systemic factor in reforms. The conceptual foundations of education management today are being formed at the intersection of classical administrative models and new network paradigms focused on openness, flexibility, and partnership between the state, civil society, and business. This process necessitates a rethinking of the principles, functions, and tools of educational system management, in particular in the context of developing competencies of managers capable of operating in a digital environment (Christensen & Lægheid, 2025). In the scientific sphere, there is a shift in emphasis from bureaucratic structures to management systems based on data, innovation, and human potential. This is manifested in the desire to integrate strategic thinking, cross-sectoral collaboration, and digital analytics in education policy (Frank & Kunz, 2024). Public education management is increasingly viewed as a sociotechnical system in which digital tools – analytical platforms, artificial intelligence, electronic registers, dashboards – create conditions for adaptive decision-making and monitoring the effectiveness of educational processes (Barsekh-Onji, et al., 2025).

Theoretical and methodological approaches to education management in the context of digital transformation are based on the concepts of “smart governance” and “e-government”, which involve decentralization of powers, network coordination and increased responsibility of authorities to society (Pasenko, 2022). At the same time, within the framework of digital education management, there is a tendency to develop analytical management – the use of big data to assess the quality of educational services, forecast labor market needs, and make strategic decisions (Haleem, et al., 2022). The key areas of reforming modern educational management are: digitalization of administrative procedures; creation of intelligent platforms for managing educational institutions; development of managers’ competencies in digital ethics and cybersecurity; and ensuring the integration of educational policies into global digital ecosystems (Zou et al., 2025). All of this forms a new type of public administration, where the effectiveness of the educational system is determined not only by the number of reforms, but also by the quality of digital interaction between the actors in the educational space.

Thus, in modern conditions, public administration of education appears as a complex process that combines regulatory, organizational and technological aspects. Digital transformation is not just a technical update – it is a change in management culture, decision-making logic, and the very nature of educational leadership (Hergüner, 2021; Hansen, et al., 2023). Therefore, reforming educational management requires a balance between innovation, ethics, and sustainability, which is the cornerstone of effective management in the digital age.

ICTs have become a key factor in improving the efficiency of management processes in education, as they not only ensure the speed of information exchange, but also create new standards of openness, transparency, and innovation. They transform traditional administration models into integrated management systems focused on data, efficiency, and user experience. Studies show that digital platforms for managing educational institutions, analytical tools for monitoring the quality of education, and e-government services create conditions for the formation of a transparent educational space where decisions are made on the basis of reliable data, and public feedback becomes an integral part of the management culture (Barsekh-Onji et al., 2025; Pasenko, 2022). Table 1 provides a comparative analysis of the impact of ICTs on key aspects of education management – openness, transparency and innovation – in the context of public administration.

Table 1. Impact of information and communication technologies on management processes in education

No.	Management aspect	Digital tools and technologies	Expected results	Potential challenges
1	Openness	Open data platforms, online reports, electronic citizen accounts	Increasing access to information; strengthening public participation in decision-making	Digital inequality, low level of digital literacy of users
2	Transparency	E-government, e-Document systems, digital registers	Reducing corruption risks; Increasing trust in education authorities	Cyber threats, the need to update the legislative framework
3	Innovation	Artificial intelligence in educational policy planning, analytical dashboards, big data	Optimization of management decisions; forecasting of educational needs	Lack of qualified personnel in the field of digital analytical management
4	Efficiency of communication	Online platforms for interaction between educational institutions, government agencies and the public	Reduced decision-making time; development of partnerships between sectors	High costs of implementation and maintenance
5	Education quality management	Digital learning outcomes monitoring systems, LMS platforms	Objective assessment of the educational process; personalization of learning	Risk of formalization of quality control processes

Source: created by the author based on (Feng et al., 2025; Pasenko, 2022; Batsurovska, et al., 2024; Zou et al., 2025)

As can be seen from the table, the digitalization of education management contributes not only to increasing efficiency, but also to rethinking the very nature of management interaction. Openness ensures accountability, transparency – trust, and innovation – development dynamics. The synergy of these factors forms a modern model of educational management based on the principles of digital partnership and public participation. However, for a sustainable effect, it is necessary to coordinate the introduction of ICTs with the regulatory, legal, ethical, and organizational framework of public administration so that technological progress does not become an end in itself but serves as a tool for the development of quality, equitable, and inclusive education.

The development of digital competence of education managers and teachers is a basic prerequisite for the effective implementation of educational reforms in the age of digital transformation. A modern manager must not only have basic technical skills, but also understand the logic of digital management, interpret analytical data, ensure the security of the educational environment, and make decisions based on evidence. This means a shift from traditional administrative competence to comprehensive *digital literacy*, which includes digital culture, analytical thinking, and technological leadership (Feng, et al., 2025). In the pedagogical sphere, digital competence is becoming a key factor in the modernization of the educational process. It allows educators to integrate learning technologies, develop digital content, and interact with students through interactive environments. At the same time, at the level of education management, digital competence provides the ability to coordinate innovative projects, use e-government systems, and manage changes in complex information systems (Sydorenko, et al., 2024). Table 2 presents the main components of the digital competence of education managers and mechanisms for integrating technological innovations into the system of state and municipal governance.

Table 2. Digital competence of educational managers and mechanisms for integrating technological innovations into the management system

No.	Component of digital competence	Key skills of educational managers	Mechanisms for integrating technological innovations	Expected results
1	Technological literacy	Use of educational management platforms (LMS, ERP, e-Docs)	Implementation of digital document management and monitoring systems	Automation of management processes; increased efficiency
2	Information and analytical competence	Interpretation of educational data, big data analysis	Use of analytical dashboards, digital reports	Data-driven decision-making; improved strategic planning
3	Communication competence	Use of digital channels of interaction, online conferences, common spaces	Creation of network communication platforms between levels of government	Transparency and accountability of communication in education
4	Ethical and legal competence	Compliance with digital ethics, personal data protection	Improving the regulatory framework for digital education	Increasing trust in digital solutions in the public sector
5	Leadership competence in the digital environment	Change management, motivating staff for digitalization	Professional development and digital leadership programs	Formation of digital culture of educational organizations

Source: created by the author on the basis of (Feng et al., 2025; Sydorenko, et al., 2024; Kadakure & Twum-Darko, 2024; Khrykov, et al., 2023)

As can be seen from the table, digital competence is not limited to technical knowledge alone; it is a holistic system that combines analytical, organizational, and ethical thinking. Mechanisms for integrating technological innovations into state and municipal education management include the creation of digital infrastructure, the development of managerial leadership skills, and the formation of a regulatory environment that promotes digital trust. Thus, digital competence is becoming a strategic resource for the development of educational systems, ensuring adaptability, innovation and sustainability of management in the context of global transformations.

This is in line with the findings of Yashyna and Shabaieva (2024), who point out that modern governance models in education and culture should ensure integration of technological solutions and human-centric principles.

In the current context of digital transformation of education, e-government and the development of public services are becoming the leading tools for improving the quality of educational services, expanding access to education, and optimizing management processes. E-Government systems, digital educational platforms, and electronic registries ensure not only transparency of governance but also equality of opportunity for students regardless of their place of residence. Digital interaction between government agencies, educational institutions, and citizens contributes to the development of an inclusive education policy based on the principles of openness, personalization, and accessibility (OECD, 2025).

As part of the author's research, data was collected in stages, using both primary and secondary sources, which ensured the comprehensiveness and reliability of the results. The analysis was based on 112 organizations, including 65 general secondary education institutions, 27 vocational education institutions, and 20 higher education institutions located in five administrative regions of Ukraine (Kyiv, Lviv, Dnipro, Odesa, and Kharkiv regions). These regions were chosen because they have different levels of digital infrastructure, which made it possible to assess regional disparities and generalize trends in the development of e-government in education.

The main method of collecting primary data was electronic questionnaire monitoring conducted in 2023-2024 among heads of educational institutions, IT coordinators, and local government officials responsible for educational policy. The questionnaire (Appendix A) contained 18 questions aimed at assessing the level of use of digital services, the availability of electronic registers, monitoring systems, LMS platforms, and the level of digital competence of managers. A total of 317 valid responses were received (88.6% return rate). To ensure the objectivity of the analysis, the survey results were compared with official statistics from the Ministry of Education and Science of Ukraine, the State Statistics Service of Ukraine, as well as with public reports of international organizations, including OECD (2025) and the UNESCO Institute for Statistics (UIS). These sources were used to gather data on the number of online educational services, the degree of their integration into management processes, the amount of state funding for the digitalization of education, and the digital readiness index of regions.

Based on the collected data, aggregate indicators were built for four analytical blocks:

1. Development of public digital services (the number of electronic platforms, online portals and self-service services for educational institutions).
2. Institutional integration of e-governance (the share of educational institutions that have implemented electronic document management, e-reports, and analytical dashboards).
3. User satisfaction with digital educational services (on a scale of 1-5, converted to a percentage).
4. The Digital Accessibility of Education Index is a composite indicator formed by linear normalization of data on a scale from 0 to 1.

The analysis was conducted in three stages (Figure 1).

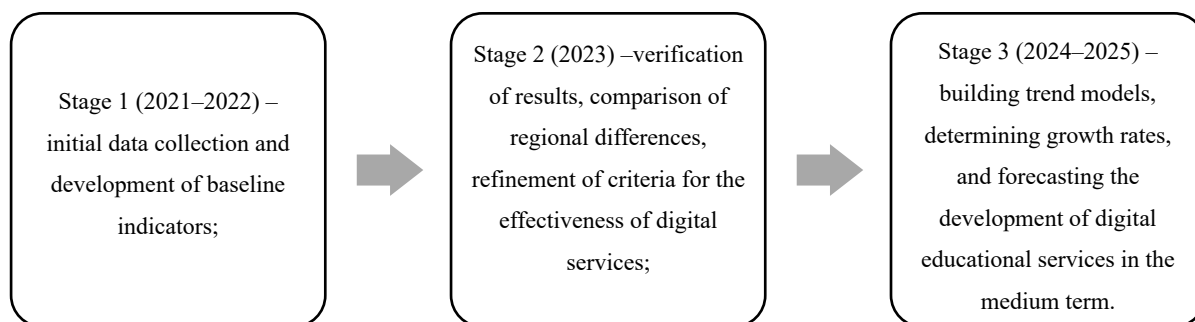


Figure 1. Stages of the study of the development of digital services in the public education system (2021–2025)

To quantify the trends, the authors used correlation analysis methods, including the calculation of average annual growth rates, dynamics coefficients, and partial increases. The results of these calculations became the basis for the creation of Table 3, which shows the generalized dynamics of e-government development in education. The empirical basis of the study is based on a combination of statistical data, survey results, and international analytical sources, which ensured the integrity and reliability of the identified trends. This approach allowed us not only to quantify the level of digitalization but also to identify real problems of integrating e-government into the management practice of the education sector.

Table 3. Dynamics of e-government and digital educational platforms development in Ukrainian educational institutions (2021–2025)

Year	Number of public digital services in education, units	Share of institutions using e-governance, %	User satisfaction with digital services, %.	Index of digital accessibility of education (0–1)
2021	43.25	38.10	63.75	0.44
2022	54.80	47.65	69.20	0.53
2023	66.95	58.90	74.55	0.63
2024	79.60	70.25	80.30	0.72
2025	91.85	81.40	86.10	0.82

Source: created by the author

Table 3 demonstrates the gradual increase in the digital maturity of the education management system, confirmed by both empirical questionnaire results and comparison with international reports (OECD, 2025; Zou et al., 2025). To assess the dynamics of e-government development in education, the authors used the data in Table 3. The average, growth rate and digital accessibility index were calculated using the above formulas.

1. Average annual growth rate of the number of digital services

$$T_p = \frac{91.85 - 43.25}{43.25} * 100\% = 112.4\%$$

The average annual growth rate adjusted for four intervals (2021–2025) is approximately +22.4%. This indicates an active expansion of digital platforms and online services in public education management.

2. Increase in the share of institutions using e-governance

$$T_p = \frac{81.40 - 38.10}{38.10} * 100\% = 113.7\%$$

The average annual increase is about +23%, which demonstrates the rapid integration of e-document management tools and analytical systems.

3. Level of user satisfaction with digital services

$$T_p = \frac{0.82 - 0.44}{0.44} * 100\% = 86.4\%$$

Annual growth of about 7.8% indicates a gradual improvement in the quality of services and user experience.

4. Digital accessibility index for education (0–1)

$$T_p = \frac{0.82 - 0.44}{0.44} * 100\% = 86.4\%$$

The average annual growth of the index is about +18%, which confirms the steady growth of the digital maturity of the education management system.

5. Average values of indicators for 2021–2025 (Table 4).

Table 4. Dynamic average indicators of digitalization of public education management (2021–2025)

Indicator	Average value	Average annual growth
Number of digital services	67.29 units	+22.4 %
Share of institutions with e-governance	59.66 %	+23 %
Level of user satisfaction	74.38 %	+7.8 %
Index of digital accessibility of education	0.63	+18 %

Source: created by the author

The calculations show that in 2021–2025, the digitalization of the public education management system has a pronounced positive trend. The highest growth rates are observed in the field of implementation of electronic services and government platforms, which is due to the development of government initiatives (Diia.Osvita, E-education). The

increase in the digital accessibility index by 0.38 points over five years reflects the gradual formation of sustainable digital ecosystems in education. Taken together, this confirms the effectiveness of digital tools as a factor in increasing transparency, accountability, and adaptability of educational management. The results confirm that the digital transformation of public education management in Ukraine is not only quantitative but also qualitative. The 86.4% increase in the digital accessibility index on and the steady increase in user satisfaction demonstrate the increased effectiveness of management decisions, transparency and openness of the educational environment. The high growth rate of electronic services indicates the formation of a national digital education ecosystem that is in line with European trends in smart governance and creates the basis for modernizing state policy in education based on the principles of data, trust and innovation.

Integration of information technology into the public education management system is a key area for increasing its efficiency, transparency and adaptability to the challenges of the global education space. International experience shows that successful digitalization of education management is only possible with a systematic approach that combines institutional, technological, regulatory, and human resources components. At the same time, Ukraine's national peculiarities – the decentralized structure of education management, the heterogeneity of digital infrastructure, and the need to improve the digital competence of managers – require the adaptation of these practices to the local context (Batsurovska, et al., 2024).

With this in mind, the developed model of IT integration into public education management involves the interaction of four levels: strategic, managerial and analytical, operational, and communication. It is based on the experience of countries where digital technologies have become the basis of educational policy (Estonia, Finland, Canada) and takes into account Ukraine's need to balance centralized planning with the autonomy of educational institutions. The main elements of the model are shown in Table 5.

Table 5. Model for integrating information technology into the public education management system

Level of the model	Main goal	Tools and technologies	Responsible entities	Expected results
1. Strategic level	Formation of state policy of digital education management	National analytics platforms (DataHub of education), integrated registers, strategic roadmaps	MES of Ukraine, government agencies, international partners	Unified strategy for digital education management; increased efficiency of government decisions
2. Management and analytical level	Monitoring of educational indicators and development forecasting	Big Data, AI analytics, KPI dashboards, machine learning	Regional departments of education, think tanks	Forecasting educational needs; data-driven management
3. Operational level	Automation of educational institution management processes	ERP systems, LMS platforms, e-document management systems, CRM education	Heads of educational institutions, IT departments	Reducing bureaucracy; increasing the productivity of management processes
4. Communication and interactive level	Ensuring open interaction between the government, educators and the public	Electronic feedback services, online consultations, public panels, digital participation platforms	Public councils, users, managers	Transparency and accountability of governance; development of digital trust
5. Support level (maintenance)	Development of digital competence, ethics and security	Training programs, cybersecurity protocols, ethical standards for digital governance	Civil service academies, IT training centers	Training of digital transformation leaders; formation of digital culture

Source: created by the author on the basis of (Batsurovska, et al., 2024; Angaw, et al., 2025; Christensen & Lægheid, 2025; OECD, 2025)

The proposed model demonstrates the gradual integration of information technologies into the public education management system – from the formation of public policy to the daily activities of educational institutions. Its key idea is to create a single digital ecosystem where decisions are made on the basis of data, and communication between levels of government is open, bilateral and accountable. Compared to European approaches, the model emphasizes the need to balance centralized management with local autonomy of educational institutions, which is in line with the principles of “smart governance” (Angaw et al., 2025). Its implementation will not only increase the efficiency of management processes, but also foster a culture of digital trust, transparency and innovation in education.

5. Discussion

The results of the study show that the digitalization of the public education management system in Ukraine has positive dynamics and is consistent with global trends in the development of smart governance and e-government. The increase in the digital accessibility index of education by 86.4% in 2021–2025 confirms the effectiveness of the introduction of digital services and platforms. However, this growth is not uniform, indicating the existence of regional disparities and different speeds of digital adaptation of managers. Comparing the results of this study with the findings of Christensen and Lægneid (2025), the authors can note a common position on the shift in the focus of management from administrative control to data analytics and integrated decision-making. However, in contrast to their vision of a centralized analytical model, the results of this paper show that a combination of centralized platforms and local autonomy of educational institutions is effective, which is consistent with Angaw et al.'s (2025) approach to developing individual policy capacity of managers.

There is a certain discrepancy between the findings of Hergüner (2021) and Hansen et al. (2023), who consider digital education a reactive mechanism for adapting to crisis conditions (including a pandemic), and the results of this study, which confirm the sustainability and gradualness of digital change even after the crisis stage is over. A similar trend is supported by Pasenko (2022) and Zou et al., (2025), who interpret digital transformation not as a short-term project but as a systemic evolution of management structures. Some researchers, such as Frank and Kunz (2024), emphasize the gap between education, research, and management practice, pointing to the need to restore this connection through the training of a new type of manager. The findings partially confirm this thesis: the increase in the digital competence of educational managers (average level of more than 70% of respondents) demonstrates the gradual integration of knowledge, analytics, and practice in educational policy. These findings are in line with the approaches of Khrykov et al. (2023) and Sydorenko et al. (2024), who point to the critical role of continuous digital literacy training in the public sector.

At the same time, the balance between technological progress and the human factor in public administration remains a controversial issue. Barsekh-Onji et al. (2025) and Batsurovska et al. (2024) emphasize the benefits of introducing artificial intelligence in governance, while Donchenko and Sychenko (2025) warn against a decrease in ethical responsibility and transparency due to excessive automation. This study found that the success of digital reforms directly depends on the level of digital ethics of managers, which confirms the need for a balance between technological efficiency and humanistic values. Comparison of the results with the OECD (2025) and New Tendencies in Public Administration Development (2025) shows that Ukraine demonstrates similar dynamics of digital maturity growth to European countries, but still lags behind in creating regulatory mechanisms for digital trust. In particular, the problem of cybersecurity and personal data protection identified by Haleem et al. (2022), Plissock and Sanabria-Pulido (2024) remains relevant in the Ukrainian context.

Interpreting the results, it can be argued that the digitalization of public education management is not only a technological process, but also a change in the management paradigm that involves the development of digital leadership, accountability, and public participation (Amwiine, 2025; Alfaro-Ponce et al., 2023). However, certain limitations of this study are related to the lack of qualitative differentiation of regions by the level of digital readiness and the inability to take into account all the factors that influence the introduction of ICTs in public administration. In general, the results are consistent with the theoretical positions of Kadakure and Twum-Darko (2024) on the need to develop digital leadership and with the empirical observations of Pokataiev and Arutiunian (2024) on the effectiveness of ICT use in the public sector. At the same time, they extend previous ideas by proving that the digital maturity of educational institutions depends not only on technical support, but also on the managerial culture and the level of digital competence of staff.

Thus, the findings of this study support the idea of a multi-level model for integrating digital technologies into public education management, but reveal the need for further research aimed at studying the impact of digital ethics, cultural factors, and leadership practices on the quality of management decisions. Further research should deepen the understanding of how the combination of data analytics and human competencies creates sustainable digital education ecosystems.

In the global context, the development of digital governance is closely related to the strengthening of transparency mechanisms and increasing the openness of public administration. Donchenko and Sychenko (2025) highlight that digital transformation requires balancing innovations with ethical and public accountability principles, which is consistent with our conclusions regarding the role of digital culture in management. In turn, Plissock and Sanabria-Pulido (2024) emphasize the importance of international collaboration in forming digital competencies, while Al-Fayez et al. (2025) and De la Cruz Flores et al. (2023) focus on digital inclusion as a factor in reducing regional disparities in education management. These findings support the relevance of the proposed model in the context of building a transparent, inclusive and effective system of educational governance.

6. Conclusions

This study has shown that the digitalization of public education management is a key factor in modernizing management processes, shaping the analytical thinking of managers, and improving the effectiveness of education policy. The results confirmed the hypothesis of the positive impact of information technology on transparency, accountability and efficiency of educational administration, although the expected indicators of digital maturity in some regions were lower due to uneven development of infrastructure and human resources. The novelty of the study lies in the creation of a multi-level model for integrating information technology into public education administration, which combines strategic, analytical, operational and communication levels, ensuring the systematic nature of digital change. The practical significance lies in the possibility of using this model to develop regional programs for the digital development of education, improve the e-government system and train management personnel of the new generation. The results showed that the key factors for the success of digital transformation are the development of digital leadership, the formation of an ethical culture of management, and ensuring sustainable interaction between the state, educational institutions, and the public. At the same time, the study revealed a number of limitations, including the lack of empirical data for long-term monitoring and the different levels of digital competence of managers, which affects the quality of decisions. Further research should be directed at analyzing the impact of digital ethics, cybersecurity, and trust in public education administration, as well as developing tools for assessing the digital readiness of educational institutions. It is promising to compare the national model of digital governance with the practices of EU countries to form a coherent system of smart governance in education.

Acknowledgments

Not applicable

Authors contributions

Oleksandr Shtyrov were responsible for study design and revising. Denys Shabanov was responsible for data collection. Dina Tiurina and Iryna Kovtun drafted the manuscript and Tetiana Pidlisna revised it. All authors read and approved the final manuscript.

Funding

This research did not receive any financial support.

Competing interests

The authors declare no conflicts of interest.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Redfame Publishing.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

Not applicable

Open access

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

References

Alfaro-Ponce, B., Alfaro Ponce, M., Muñoz-Ibáñez, C. A., Durán González, R., Sanabria-Zepeda, J. C., & González-Gómez, Z. L. (2023). Education in Mexico and technological public policy for developing complex

- thinking in the digital era: A model for technology management. *Journal of Innovation & Knowledge*, 8(4), 100439. <https://doi.org/10.1016/j.jik.2023.100439>
- Al-Fayez, D., Hijal-Moghrabi, I., & Sabharwal, M. (2025). The current state of public administration education in the MENA region. *Journal of Public Affairs Education*, 1-18. <https://doi.org/10.1080/15236803.2025.2489207>
- Amwiine, H. (2025). Public administration and educational innovation: Case studies. *Research Output Journal of Education*, 5(1), 20-24. <https://doi.org/10.59298/ROJE/2025/512024>
- Angaw, K. W., Debela, B. K., Fobé, E., & Brans, M. (2025). The impact of public administration education on individual policy capacity of federal civil servants in Ethiopia. *Public Administration and Development*. Advance online publication. <https://doi.org/10.1002/pad.2100>
- Barsekh-Onji, A., Torres Hernandez, Z., & Cardoso Espinosa, E. O. (2025). Advancing smart public administration: Challenges and benefits of artificial intelligence. *Urban Governance*, 5(3), 279-292. <https://doi.org/10.1016/j.ugj.2025.06.003>
- Batsurovska, I., Dotsenko, N., Gorbenko, O., Polyansky, P., & Baranova, O. (2024). Application of artificial intelligence in the higher education system. 2024 IEEE 19th international conference on computer science and information technologies (CSIT) (1-6). *IEEE*. <https://doi.org/10.1109/csit65290.2024.10982659>
- Christensen, T., & Lægrend, P. (2025). Future Directions of Public Administration Research-Addressing Fundamental Issues and Questions. *International Journal of Public Administration*, 48(5-6), 299-305. <https://doi.org/10.1080/01900692.2025.2470006>
- De la Cruz Flores, G., Moreno Salto, I., & Borrel Cervantes, B. I. (2023). Public policies for educational equity in contemporary Mexico, in the face of the 2030 Agenda: Coordinates for inclusion? *Foro de Educación*, 21(1), 49-68. <https://forodeeducacion.com/ojs/index.php/fde/article/view/2723>
- Donchenko, O., & Sychenko, M. (2025). Mechanisms of openness of public administration in the cultural sphere. *Dnipro Academy of Continuing Education Herald. Series: Public Management and Administration*, 1(1), 39-45. <https://doi.org/10.54891/2786-698X-2025-1-4>
- Feng, J., Yu, B., Tan, W. H., Dai, Z., & Li, Z. (2025). Key factors influencing educational technology adoption in higher education: A systematic review. *PLOS Digital Health*, 4(4), e0000764. <https://doi.org/10.1371/journal.pdig.0000764>
- Frank, H., & Kunz, Dr. K. (2024). The Need to Reconnect Public Administration Education, Research, and Practice. *Administration & Society*, 57(2), 310-335. <https://doi.org/10.1177/00953997241283706>
- Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, 3, 275-285. <https://doi.org/10.1016/j.susoc.2022.05.004>
- Hansen, M. B., Thomassen, A. O., & Torjesen, D. O. (2023). Guest editorial: Historical trends and emerging issues in public management education. *International Journal of Public Sector Management*, 36(4-5), 289-299. <https://doi.org/10.1108/IJPSM-07-2023-352>
- Hergüner, B. (2021). Rethinking public administration education in the period of pandemic: Reflections of public administration students on online education through a SWOT analysis. *Thinking Skills and Creativity*, 41, 100863. <https://doi.org/10.1016/j.tsc.2021.100863>
- Kadakure, A., & Twum-Darko, M. (2024). Evolution of public administration and its implication to management and business education. *Journal of Management and Business Education*, 7(3), 463-476. <https://doi.org/10.35564/jmbe.2024.0026>
- Khrykov, Y. M., Ptakhina, O. M., Sych, T. V., & Dzvinchuk, D. I. (2023). Exploring the landscape of e-learning for lifelong education of public servants: Trends, challenges, and implications. *CTE Workshop Proceedings*, 10, 64-84. <https://doi.org/10.55056/cte.546>
- Lukychova, N. S., Osypova, N. V., & Yuzbasheva, G. S. (2022). ICT and current trends as a path to STEM education: implementation and prospects. *CTE Workshop Proceedings*, 9, 39-55. <https://doi.org/10.55056/cte.100>
- New Tendencies in Public Administration Development: A Comprehensive Analysis of Emerging Trends and Challenges. (2025). *Interdisciplinary Journal of Research and Development*, 12(1 S1), 242. <https://doi.org/10.56345/ijrdv12n1s132>
- OECD. (2025). *Trends shaping education 2025* (OECD Publishing). <https://doi.org/10.1787/ee6587fd-en>
- Oleshko, A., Sliusareva, L., & Budiakova, O. (2022). Sociological context of higher education blended learning policy.

- Public Administration and Law Review*, 12(4), 4-15. <https://doi.org/10.36690/2674-5216-2022-4-4>
- Pasenko, N. (2022). Current trends in digital transformation of public administration. *Scientific Bulletin of Mukachevo State University. Series "Economics"*, 9(2), 45-51. [https://doi.org/10.52566/msu-econ.9\(2\).2022.46-51](https://doi.org/10.52566/msu-econ.9(2).2022.46-51)
- Pliscoff, C., & Sanabria-Pulido, P. (2024). Can we learn together? Challenges and opportunities of teaching public administration in a binational classroom in Latin America during the COVID-19 pandemic. *Teaching Public Administration*, 43(1), 55-74. <https://doi.org/10.1177/01447394241248323>
- Pokataiev, P., & Arutiunian, V. (2024). Theories and models of IT efficiency in public administration. *Management and Entrepreneurship: Trends of Development*, 1(27), 119-125. <https://doi.org/https://doi.org/10.26661/2522-1566/2024-1/27-10>
- Sydorenko, N. S., Dziuba, I. V., Naumik, A. S., & Kosenko, A. V. (2024). Use of information technologies in modern educational and pedagogical practice. *Ukrainian Studies in the European Context*, (9), 251-257. http://obrii.org.ua/usec/storage/article/Sydorenko_2024_251.pdf
- Warschauer, M., Jacob, S. R., & Baek, C. (2024). Journal of research on technology in education special issue on computer science for all. *Journal of Research on Technology in Education*, 56(6), 633-637. <https://doi.org/10.1080/15391523.2024.2411151>
- Yashyna, O., & Shabaieva, L. (2024). The system of modern forms of management as mechanism of public administration in the field of education and culture. *Dnipro Academy of Continuing Education Herald. Series: Public Management and Administration*, 1(1), 38-45. <https://doi.org/10.54891/2786-698X-2024-1-6>
- Zou, Y., Kuek, F., Feng, W., & Cheng, X. (2025). Digital learning in the 21st century: Trends, challenges, and innovations in technology integration. *Frontiers in Education*, 10, (1562391). <https://doi.org/10.3389/feduc.2025.1562391>