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Digital architecture of information governance for education and research in Ukraine

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Abstract: The article substantiates information governance as an integrated mechanism for enhancing the quality, resilience, and innovation capacity of education and research in the context of digital transformation, war-related risks, and European integration. The target of research is to define the concept and scope of information governance, identify systemic problems in the use of education and research data, and develop a practical model for transforming such data into evidence-based governance decisions. The methodological framework comprises systemic, comparative, analytical-synthetic, and institutional approaches.

Based on data from Eurostat, Eurydice, the ITU, the OECD, the Ministry of Education and Science of Ukraine, the State Statistics Service of Ukraine, UNESCO, and the World Bank Group, the study analyses trends in digital accessibility, the development of education information systems, R&D funding, open science, the use of artificial intelligence, and the impact of the war on the development of education and research infrastructure in Ukraine. The findings indicate that Ukraine has a relatively high level of digital coverage and has established key elements of an integrated education and research information ecosystem. However, their effectiveness is constrained by data fragmentation, which contributes to inadequate metadata quality and digital inequality, alongside cybersecurity threats, risks to academic integrity, and weak linkages among R&D statistics, R&D funding, and actual research outcomes.

A four-domain information governance model encompassing data, analytics, decisions, and outcomes is proposed. The practical significance of this model lies in its potential application by public authorities, educational and research institutions, local communities, and international partners for evidence-based planning, monitoring, and adjustment of education, research, investment, and innovation policies. Simultaneously, implementing this model requires the creation of a unified education and research data architecture incorporating integrated analytical dashboards, FAIR data and open science policies, data literacy development programmes, results-based financing mechanisms, responsible use of artificial intelligence, and regular audits of data quality and cyber resilience.

Keywords: information governance; education; research; digital transformation; education and research data; open science; artificial intelligence; cyber resilience.

1. Introduction

The development of education and science is increasingly determined not only by the volume of financial, human, and material-technical resources, but also by the capacity of the system to obtain, verify, integrate, and use information in a timely manner. In modern governance of the education and science sector, information becomes a strategic resource, as it makes it possible to assess the real needs of personnel through the planning of funding for education, and also scientific and innovative activities. This, in turn, requires accurate forecasts of investment risks for business entities capable of controlling the quality of research commercialization, identifying data inequalities, and ensuring academic integrity, which necessitates the adaptation of innovation-investment and information policy to rapid social, technological, and security-related changes.

This issue is of particular relevance for Ukraine, where the educational and scientific system maintains access to information under wartime conditions, directing it toward the restoration of damaged infrastructure and the advancement of integration into the European Research Area. At the same time, increasing the competitiveness of universities and research institutions requires the introduction of digital services as factors of open science, the use of which would ensure the evidence-based nature of governance decisions. Under such conditions, information management ceases to be an auxiliary administrative function and becomes the foundation of strategic development.

Along with this, digital platforms, registries, information systems, scientometric databases, indicators of research quality, journal rankings, budgetary data, and monitoring results often exist in a fragmented manner. As a result, governance decisions may be based on incomplete or incompatible data, while educational and research institutions are forced to duplicate reporting, spend resources on manually reconciling indicators, and respond to problems with delay. Therefore, the key task becomes the transition from the accumulation of information to its integrated management.

2. Object and subject of research

The object of the research is the information management system as a complex organizational-technological and managerial mechanism that ensures the formation, collection, verification, integration, analytical processing, use, monitoring, and reuse of educational and research data. The content of this object is not limited to the digitalization of individual administrative procedures, since information management encompasses the full life cycle of data and knowledge required for making evidence-based governance decisions.

The object has a complex nature, as it combines legal and regulatory, institutional, organizational, technological, analytical, personnel-related, and security components. Its main properties include systemic character, interagency interaction, dynamism, dependence on data quality, orientation toward evidence-based decision-making, the need for interoperability of information systems, sensitivity to cyber threats, and the capacity to influence the quality of human capital development.

The parameters of the research object include the digital accessibility of education and science, determined by the level of integration of educational and scientific information systems, which are based on the processing of data and metadata according to unified standards. The quality of this processing depends on the level of statistical and analytical support, the degree of reporting automation, and the openness of educational and scientific data. In this context, the development of FAIR/open science policies plays a significant role, influencing the effectiveness of artificial intelligence, the state of cyber resilience, the level of academic integrity, the transparency of budget planning, and the system's capacity to ensure results monitoring and feedback.

The structure of the object may be represented as a multi-level information-management system consisting of four interrelated circuits. Here the data circuit covers the collection, standardization, verification, protection, and updating of primary educational and scientific data, as the analytics circuit ensures the transformation of these data into indicators, forecasts, risk profiles, development scenarios, analytical dashboards, and managerial conclusions. Then the decision-making circuit involves the use of analytics for budgeting, network planning, accreditation, allocation of funding, quality management in education and science, as well as the formation of priorities in research and innovation policy. In conclusion, the results circuit is aimed at monitoring the actual impact of adopted decisions on accessibility, quality, security, innovation capacity, integrity, international integration, and the resilience of the educational and scientific system. In practical terms, such a structure should ensure not only the accumulation of information, but also its transformation into governance decisions aimed at improving the quality of education, advancing science, supporting innovation, protecting data, and strengthening public trust.

Foreign analogues of the research object include European and international approaches to the management of educational and scientific data, in particular the European Union's digital education policies, UNESCO's open science principles, OECD approaches to the use of artificial intelligence,

FAIR data practices, repository infrastructure, results-based funding, information systems, and analytical dashboards for making governance decisions. In the countries of the European Union, the interoperability of educational data is being actively developed to improve the quality of digital educational services and provide open access to scientific results. These results are subject to continuous quality monitoring in accordance with data management standards as part of evaluating the effectiveness of research and development. Such approaches may serve as a reference point for Ukraine's transition from fragmented digitalization to an integrated information ecosystem.

The subject of the study comprises the organizational, legal, technological, analytical, and institutional mechanisms of information management through which data are transformed into an instrument for improving the quality of education and science development in Ukraine. Particular importance is attached to analyzing the ways in which data on access to education, learning quality, staffing needs, infrastructure losses, funding, scientific productivity, international cooperation, open-access publications, research projects, and innovation outcomes can be integrated into a unified system of evidence-based governance. Therefore, the subject of the study encompasses not only technical digital tools but also governance procedures that define the persons responsible for data creation and quality, the methods of data verification, their use in decision-making, the monitoring of outcomes, and the provision of feedback among the state, educational institutions, research institutions, communities, learners, researchers, and international partners.

The shortcomings of the research object that become apparent in the course of its practical application primarily concern the fragmented use of digital platforms, registries, information systems, and scientific databases in assessing budgetary indicators and interpreting monitoring results. Under such conditions, governance decisions may be made on the basis of incomplete, outdated, or incompatible data, while educational and research institutions are forced to duplicate reporting, reconcile indicators manually, and respond to problems with delay. The insufficient quality of metadata contributes to inequalities in digital access, while weak system interoperability increases exposure to cyber threats. At the same time, the inadequate linkage between R&D statistics and the assessment of scientific performance, together with the growing use of generative artificial intelligence, creates risks to academic integrity. Collectively, these factors increase the danger of reducing information management to formal rankings and quantitative KPIs. Consequently, the current education and science system requires a transition from the mere accumulation of information to its integrated, coherent, and evidence-based management.

3. Target of research

The target of research is to provide a scientific substantiation of information governance as an instrument for improving the development of the education and science sector and for formulating practical proposals aimed at increasing the effectiveness of educational and scientific management in Ukraine.

Achieving the stated target requires addressing the following tasks:

- clarifying the meaning of the concept of "information governance" in the context of education, science and innovation;
- analyzing current national and international trends in digitalization, open science, the development of information systems, and the use of artificial intelligence;
- summarizing recent statistical data characterizing the information environment;
- identifying governance problems that limit the effective use of educational and scientific data;
- providing recommendations for the development of an integrated information governance system.

4. Literature analysis

Contemporary literature considers information governance as a comprehensive institutional function that encompasses the financing of digital infrastructure, supports data formation and integration processes and analytical provision, and thereby contributes to open science while enabling the use of artificial intelligence and the monitoring of results. The corresponding research objects are examined by international organizations and government institutions using institutional, statistical, comparative, analytical, monitoring, and program-targeted methods.

So, in Ukraine the digital transformation of education constitutes a strategic direction for ensuring economic resilience and innovation-driven development by expanding digital access, automating data collection and processing, and assessing the need to improve digital literacy among academic and teaching staff [1]. In EU countries the analysis of digital access among the population confirms that Internet access is a fundamental prerequisite for the development of e-learning, particularly in the context of implementing educational registries, scientific platforms, and digital communication [2]. Alongside this, the analysis of the volume of R&D expenditure, its share in gross domestic product, and the structure of research funding made it possible to assess the resource capacity of their scientific systems [3]. However, quantitative financial indicators need to be supplemented with data on research outcomes, innovations, patents, international cooperation, and the practical implementation of scientific developments. International comparisons indicate that the expansion of digital access is uneven, while a significant proportion of the world's population remains without Internet access [4]. For information governance, this necessitates considering not only formal access, but also connection quality, the availability of digital devices, territorial disparities, and the level of digital competencies.

In Ukraine, the program-targeted and institutional approaches to implementing the Strategic Action Plan of the Ministry of Education and Science of Ukraine through 2027 made it possible to identify governance capacity as one of the principal prerequisites for reform [5]. The implementation of the established priorities directly depends on the completeness, reliability, timeliness, and analytical usability of data. A practical example of evidence-based governance is the results-based financing of educational initiatives presented in the materials of the Ministry of Education and Science of Ukraine concerning the LEARN program [6]. The allocation of resources based on the achievement of specific and verifiable outcomes in teacher training, the provision of textbooks to students, the development of school transportation, and the improvement of subsidy mechanisms demonstrates the possibility of integrating data on needs, funding, and societal impact.

The study of the impact of artificial intelligence on learning, the professional activities of academic and teaching staff, the assessment of outcomes, and academic integrity made it possible to substantiate the need for pedagogical guidance, personal data protection, and transparency in the algorithms used by intelligent systems [7]. This approach requires the development of digital competencies of researchers and institutional oversight of their use of artificial intelligence. The systematization of data on the performance of R&D activities makes it possible to characterize the resource base of science [8]. However, for evidence-based governance, data on R&D expenditure, the number of researchers, and the number of research institutions should be linked to publications, patents, grants, international projects, technology transfer, and the implementation of research results.

In general, digital technologies are regarded as instruments for ensuring accessibility, quality, inclusiveness, and systemic governance in education and science. A comparative and analytical synthesis of international experience demonstrates that digitalization does not automatically improve the quality of learning [9]. Its effectiveness depends on public policy concerning the regulatory framework for training academic and teaching staff, as well as on ensuring access to digital infrastructure for the systematic assessment of outcomes. In Ukraine, providing learners and academic and teaching staff with digital devices is of considerable importance for the development of digital learning centers and the support of distance education under wartime conditions [10].

Monitoring the relevant data makes it possible to assess the needs of the education and science system and to identify measures for ensuring the accessibility, safety, and resilience of learning.

A distinct area of research concerns open science, particularly the analysis of open access to publications and research data through software and the availability of educational resources [11]. In the context of developing scientific infrastructure, the principles of accessibility, transparency, reproducibility, and reuse of research results provide the foundation for establishing repositories, data management plans, and FAIR/open science policies. The use of standardized data on R&D expenditure and scientific human resource capacity enables international comparisons of scientific systems [12]. However, the assessment of scientific performance should not be limited to resource indicators but should also take into account research quality, the openness of results, innovation impact, and their contribution to societal development.

In Ukraine, war-related damage to educational infrastructure necessitates the expansion of blended and distance learning alongside the restoration of a safe educational environment [13]. Under such conditions, the adaptation of educational and research institutions to crises confirms the need for the operational management of data on the condition of facilities, shelters, transportation, digital devices, and learning losses. To this end, it is essential to strengthen human capital and enhance institutional capacity to provide financial support and monitor the performance of educational and research institutions through digital tools based on the principles of transparency and accountability [14]. In this context, information governance serves as a mechanism for aligning digital needs, available resources, and the actual outcomes of state information policy. Analysis of trends in the overall level of digital access to the Internet makes it possible to determine the potential for developing distance education, accessing electronic services, and advancing scientific communication [15]. However, the aggregate indicator does not reflect territorial disparities in connection stability, equipment availability, and the population's level of digital skills. Comparison of R&D expenditure as a share of GDP indicates the structural vulnerability of the national scientific system and the need for more precise governance of scientific priorities, resources, and results [16]. Low R&D intensity requires not only increased funding but also the integration of budgetary indicators with data on research performance, international cooperation, patenting, and innovation implementation.

Thus, the analyzed sources consistently address the digital transformation of education and science in relation to Internet access and the use of artificial intelligence, highlighting the need to develop open science under conditions of risk and within effectively designed institutional governance mechanisms. At the same time, these issues are predominantly examined in isolation, without being integrated into a unified cycle of data formation, verification, integration, analytical processing, and use, which indicates the need for further research.

5. Research methods

The choice of methods is determined by the interdisciplinary nature of the study, which combines managerial, educational, scientific, information and communication, technological, institutional, and security-related aspects. The methodology is aimed at examining information governance not merely as a process of digitalizing individual procedures, but as an integrated cycle of data formation, verification, integration, analytical processing, and use for making governance decisions in the fields of education and science, through the application of the following methods:

1) system analysis – identifying the interrelationship between the quality of primary information, the compatibility of information systems, the validity of governance decisions, and the effectiveness of innovation-driven development;

2) institutional analysis – analyzing mechanisms for data formation, exchange, verification, and use, with particular attention to problems of institutional coordination and the allocation of responsibility for data quality;

3) comparative analysis – comparing global, European, and Ukrainian trends in the digitalization of education and science, which made it possible to identify benchmarks for improving information governance in Ukraine;

4) statistical series method – processing quantitative indicators for 2023–2025, making it possible to identify their dynamics and determine their managerial significance;

5) analytical-synthetic method – processing and synthesizing individual statistical, strategic, and analytical materials, which made it possible to form a comprehensive understanding of the current state of information governance;

6) content analysis – studying international and national strategies, reports, recommendations, statistical datasets, and analytical documents in terms of their content, with particular attention paid to source reliability, the period of data collection, the methodology used to calculate indicators, their comparability, and the consistency of the formulated conclusions with the content of the primary sources;

7) modelling – the development of an original information governance model comprising four interconnected circuits: data, analytics, decisions, and results, which reflects the sequence through which primary data are transformed into analytical conclusions, governance decisions, and measurable outcomes.

The combination of these methods made it possible to comprehensively examine integrated and evidence-based information governance as a mechanism for enhancing human capital and innovation development by identifying the key problems of data fragmentation, insufficient interoperability of information systems, unequal digital access, cyber threats, and the formalization of performance indicators.

6. Research results

Information governance is a system of principles, procedures, digital tools, organizational roles, and analytical practices aimed at ensuring the complete life cycle of data and knowledge for informed governance decision-making. It concerns the management not so much of technical information flows as of data quality, legal status, ethical use, security, accessibility, interoperability, and the capacity of data to support strategic objectives [9, p. 146].

In the traditional administrative framework, information was often perceived primarily as a reporting instrument. In the contemporary model, however, it performs at least six interrelated functions. The preparation of reports requires an assessment of the actual state of the system in terms of access to education, learners' educational outcomes, the provision of favorable workplace conditions for employees, the financing of scientific and innovative activities undertaken by business entities, staff productivity, and infrastructure losses (diagnostic function). Alongside this, modelling risks and the actual needs of staff and service recipients requires forecasting future developments (predictive function). The establishment of planned indicators involves public authorities, educational and research institutions, local communities, donors, businesses, and international partners. Effective cooperation among these stakeholders requires an appropriate distribution of responsibilities for implementing the developed plans (coordination function), together with adherence to the principles of accountability, quality, integrity, and timely implementation (control function). Such a systemic approach contributes to building stakeholders' trust in the decisions adopted (communication function) and ultimately transforms data into new educational and research products that can serve as an information basis for further study and improvement (innovation function) [7, p. 67–69].

Information technologies influence the quality of education not only as a means of delivering learning content but also as tools for planning, skills development, access, inclusion, learning-system governance, and the creation of a sociocultural context. Accordingly, digital technologies acquire governance significance only when integrated into an innovation policy aimed at establishing a regulatory framework for training academic and teaching staff and implementing advanced systems for assessing learners' outcomes [9, p. 36–37].

The development of education and science is taking place amid the simultaneous expansion of digital opportunities and the deepening of inequalities in access, funding, and institutional capacity. In Ukraine, these trends are further complicated by the war, infrastructure destruction, the forced transition to distance learning, and the need for rapid integration with European data governance practices (Table 1).

Table 1. Comparative trends in digital access and R&D funding indicators

No.	Indicator	Year	World	EU	Ukraine
1	Internet use, %	2023	69.2	91.0	82.4
		2024	71.0	93.0	82.5
		2025	74.0	94.0	–
2	Population not using the Internet, %	2023	30.8	9.0	17.6
		2024	29.0	7.0	17.5
		2025	26.0	6.0	–
3	R&D expenditure as a share of GDP, %	2023	1.92	2.26	0.32
		2024	–	2.24	0.37
4	R&D expenditure in business sector, %		–	66.5	59.9
5	R&D expenditure in public sector, %		–	10.7	33.4
6	R&D expenditure in higher education sector, %		–	21.4	6.7
7	R&D expenditure in private non-profit sector		–	1.3	–

Source: compiled by the author based on [2; 3; 4; 12; 15; 16]

The data presented indicate uneven development across two interconnected components of the information environment: digital accessibility and the capacity to generate new scientific knowledge. Internet use is expanding both globally and in the EU; however, the pace of change and the levels achieved differ substantially. The share of internet users worldwide increased from 69.2% in 2023 to 74.0% in 2025, representing a rise of 4.8 percentage points. In the EU, the corresponding indicator grew from 91.0% to 94.0%, an increase of 3 percentage points. The smaller absolute increase in the EU can be explained by its proximity to digital saturation, at which point further population uptake proceeds more slowly because digital exclusion is increasingly concentrated among the most vulnerable social and age groups. The ITU (2025, November 17) confirms that the global share of internet users reached 74% in 2025 [4], while Eurostat (2024, December 17) recorded internet usage rates of 91% in the EU in 2023 and 93% in 2024 [2].

In 2023–2024, Ukraine maintained a relatively high level of internet use, ranging from 82.4% to 82.5%. On the one hand, this indicator exceeded the global average by 13.2 percentage points in 2023 and by 11.5 percentage points in 2024. On the other hand, the gap between Ukraine and the EU widened from 8.6 to 10.5 percentage points. The global environment is gradually approaching Ukraine's level, whereas Ukraine is not demonstrating a comparable convergence with the EU. The almost unchanged value over the two-year period may indicate that a certain quantitative plateau has been reached, beyond which further development depends not only on connecting new users but also on connection quality, reliability, service affordability, access to devices, and digital competencies. The latest value published by the World Bank Group (2024a) for Ukraine is approximately 82% and refers to 2024 [15].

The dynamics of the share of the population not using the internet mirror changes in digital coverage. Globally, this indicator declined from 30.8% in 2023 to 26.0% in 2025, while in the EU it decreased from 9.0% to 6.0%. In Ukraine, it remained virtually unchanged in 2023–2024, at 17.6–17.5%. Consequently, the level of digital exclusion in Ukraine was almost twice as high as that of the EU in 2023 and 2.5 times higher in 2024. At the same time, it remained considerably below the global level. This indicates that Ukraine has a sufficiently broad digital base; however, the country has not yet achieved the near-universal level of access characteristic of the EU.

Simultaneously, the internet usage rate should not be equated with full digital access to education and science. Formal connectivity does not reflect connection speed and continuity, access to a personal computer, the ability to work during power outages, the availability of specialized educational platforms, or users' capacity to apply digital tools effectively. Therefore, governance analysis should move beyond measuring the mere fact of internet use toward assessing meaningful digital accessibility, which encompasses technical quality, affordability, digital skills, security, and the effectiveness of technology use.

European Commission's (2025, March 28) detailed data on the digital transformation of education confirm that Ukraine is actively addressing infrastructural and social constraints. Since 2022, more than 260,000 digital devices have been distributed to students and educators, over 300 digital learning centers have been established, and the number of registered users of the All-Ukrainian Online School has approached 900,000. More than 300,000 educators have received digital literacy training. These indicators demonstrate the considerable scale of digital support, while also confirming the importance of complementing internet access with appropriate equipment, educational content, professional training, and education data management systems [1].

UNESCO (2025) further demonstrates the targeted nature of this support: 50,528 devices were provided to teachers, while 8,534 were distributed to students who were unable to attend in-person classes. More than 77,400 educators registered for a digital skills training course; however, the certification rate was only 42% [10, p. 12–13]. The gap between registration and course completion indicates that the quantitative reach of such programmes does not yet guarantee the development of sustainable digital competencies. From an information governance perspective, it is important to monitor not only the number of devices distributed or participants registered, but also training completion rates, the practical application of acquired skills, and the impact of digital training on students' learning outcomes.

As for World Bank Group (2025, March 25), this issue is particularly significant given the destruction of infrastructure caused by the war. As of the end of 2024, 3,373 educational institutions in Ukraine had been damaged, of which 385 had been completely destroyed. A total of 741,000 children were studying in a blended learning format, while a further 443,000 were receiving education entirely remotely [13]. Thus, a high overall level of internet use coexists with extensive territorial, security-related, and infrastructural constraints. Under such conditions, digital access becomes not only an indicator of technological development but also a component of educational system resilience and learning continuity.

Even more pronounced disparities can be observed in R&D funding. In 2023, global expenditure on R&D amounted to 1.92% of GDP, compared with 2.26% in the EU and only 0.32% in Ukraine. Thus, Ukraine's R&D intensity was six times lower than the global level and approximately 7.1 times lower than that of the EU. The gap amounted to 1.60 percentage points relative to the global figure and 1.94 percentage points relative to the EU. This lag reflects not only limited financial resources but also the insufficient capacity of the national system to transform scientific ideas into research, development, patents, technologies, and innovations.

In 2024, Ukraine's R&D expenditure increased to 0.37% of GDP, representing a rise of 0.05 percentage points. In the EU, the indicator declined slightly from 2.26% to 2.24%. Nevertheless, even after Ukraine's notable increase, the EU's R&D intensity remained approximately 6.1 times higher, while the absolute gap amounted to 1.87 percentage points. Therefore, Ukraine's positive dynamics do not yet indicate structural convergence with the EU, as the relatively substantial growth is primarily attributable to the country's very low initial base.

As can be seen, combining indicators of digital access and research funding reveals a key structural asymmetry. Ukraine has a relatively high level of access to digital communication channels, yet it lags significantly behind global and European levels in terms of the resources allocated to the creation of new knowledge. In other words, a relatively extensive infrastructure has been established for the consumption, dissemination, and exchange of information, while the financial capacity to generate scientific outputs and technological innovations remains limited. This creates a risk of

dependence on imported technologies, external digital platforms, and foreign scientific developments. In this context, information governance should integrate data on digital access with indicators of funding, human resources, research infrastructure, and the actual performance of the science and research system. It is insufficient to record the share of internet users or the volume of R&D expenditure in isolation. Instead, the entire causal chain should be traced: access to infrastructure – use of digital tools – development of competencies – research funding – production of scientific outputs – their practical implementation – societal and economic impact.

The example of the LEARN programme demonstrates the possibility of transitioning to a results-oriented model in which funding is linked to verified indicators of teacher training, the provision of textbooks and transportation, and the establishment of safe learning spaces. The programme's total funding reached USD 737 million, and more than 240,000 teachers had received training and over 779,000 students had been provided with textbooks [6]. This approach could also be extended to the research sector, where resource allocation should be linked to research quality, data openness, international cooperation, patenting, technology transfer, and the implementation of research results.

Thus, Ukraine's main challenge lies not so much in its lower level of digital coverage compared with the EU as in the insufficient transformation of its existing digital potential into higher-quality education, greater research productivity, and innovation-driven development. Further growth in the share of internet users should be accompanied by a reduction in territorial and social inequalities through the development of digital competencies, the restoration of safe infrastructure, and increased R&D funding, alongside the integration of resource data with indicators of actual outcomes. First, digital access has already become widespread, but not universal: even globally, more than two billion people remain offline, while the quality of access varies according to income, place of residence, and level of digital skills. Second, the digitalization of education does not automatically guarantee improvements in quality: the OECD (2026, January 19) emphasizes that generative artificial intelligence can support learning only when accompanied by appropriate pedagogical guidance; without such support, it often improves task performance without producing a genuine learning effect [9, p. 119]. Third, in Ukraine, information governance also has a security dimension, since data on damaged educational institutions, shelters, transportation, remote access, digital devices, and psychosocial support directly affect the ability to ensure the right to education.

The Strategic Plan of the Ministry of Education and Science of Ukraine through 2027 (2024) identifies the transformation of education and science in the context of war, European integration, and the Sustainable Development Goals as one of the key frameworks of public policy. The plan outlines nine ministerial priorities and five areas of transformation structured around the interaction between content and meaning, teachers and researchers, systems and networks, physical spaces and governance capacities [5]. Governance capacities constitute the principal entry point for information governance, since without high-quality data it is impossible to optimize the institutional network, plan reconstruction, or evaluate reform outcomes.

Eurydice (2025, March 28) characterizes the digitalization of education in Ukraine as a strategic priority for resilience and innovation. In 2025, the key practices identified included the development of digital learning environments, the strengthening of digital infrastructure, the automation of data collection and analysis, the enhancement of digital literacy, the operation of the AICEM, the Unified State Electronic Database on Education (EDEBO), and the Automated System for Inclusive Resource Centers (AS IRC), as well as the use of the Mriia and Diia.Osvita applications [1]. This indicates that Ukraine has established key elements of an information ecosystem; however, the principal challenge lies in integrating these elements, standardizing data, and transitioning from electronic service provision to data-driven governance.

A positive example is the use of results-based financing under the LEARN programme. The Ministry of Education and Science of Ukraine (2026, June 26) announced an additional USD 286 million in financing from the World Bank, with support from Japan, to be disbursed upon the achievement of specified results: training 60,000 Grade 9 teachers to implement the New Ukrainian School standards; providing textbooks to 300,000 Grade 9 students and 300,000 Grade 4 students;

expanding the free school transportation programme to cover approximately 50,000 students; and updating the criteria for allocating subventions for shelters and school buses [6]. This approach demonstrates that effective information governance can directly influence resource mobilization and accountability in the use of funds.

The research sector faces distinct information-related challenges. In 2026, the State Statistics Service of Ukraine (2026, June 10) published datasets on the performance of R&D activities, including R&D expenditure, the share of intramural R&D expenditure in GDP, the number of personnel, researchers, and research institutions [8]. However, effective strategic governance of the research sector requires not only the availability of statistical indicators but also their linkage to outcomes, including publications, patents, grants, commercialization, international cooperation, the implementation of research outputs, open datasets, and the impact of research on policymaking.

Despite notable progress in digitalization, information governance in Ukraine's education and research sectors faces a number of systemic challenges:

1) data fragmentation: data are frequently collected by different systems using different methodologies, which complicates comparison, integration, and analysis; this results in duplicated reporting, an incomplete understanding of existing needs, and delays in decision-making;

2) insufficient metadata quality: the absence of clear descriptions of indicators, units of measurement, sources, update frequencies, and responsible parties causes data to rapidly lose their value for governance and decision-making;

3) inequality in digital access: differences in connection speed and reliability, access to devices, and digital skills affect the quality of distance learning and access to scholarly communication, even when the overall proportion of internet users is high;

4) war-related risks and infrastructure losses: information governance must take into account not only academic performance but also the safety of educational institutions, the availability of shelters, transportation routes, energy resilience, the loss of instructional time, and the provision of psychological support;

5) threats to academic integrity: generative artificial intelligence, commercial academic-writing services, predatory journals, and manipulative metrics create a risk that genuine knowledge will be replaced by formal performance indicators;

6) insufficient linkage between R&D data and performance management: given the low level of R&D intensity, there is a need not only to increase funding but also to introduce portfolio-based management of research priorities, outputs, international grants, patents, technology transfer, and the implementation of R&D results.

7. Prospects for further research development

Drawing on contemporary governance practices, a model of information governance for education and research is proposed, comprising four interconnected domains: data, analytics, decisions, and outcomes. Its underlying logic is that data have no independent governance value unless they are verified and interpreted and are supported by clearly defined organizational responsibility and mechanisms for influencing decision-making (Table 2).

Table 2. Information governance model for education and research

No.	Model domain	Content	Key instruments	Expected effect
1	Data domain	Collection, standardization, verification, and protection of primary education and research data	Unified reference systems, unique identifiers, APIs, metadata, data quality audits, and personal data protection policies	Reduced duplication of reporting and increased reliability and interoperability of information

Continuation of Table 2

2	Analytics domain	Transformation of data into indicators, forecasts, risk profiles, and scenarios	Business intelligence dashboards, geospatial analytics, education indicators, research metrics, workforce demand forecasting, and analysis of learning losses	Early identification of problems and evidence-based prioritization of resources
3	Decision-making domain	Use of analytics for budgeting, institutional network planning, accreditation, research funding, and quality management	Results-based financing, key performance indicators, project portfolios, and digital decision-making protocols	Increased transparency, accountability, and governance efficiency
4	Outcomes domain	Monitoring the impact of decisions on access, quality, safety, innovation, integrity, and international integration	Policy evaluation, public dashboards, open data, and feedback from institutions, students, and researchers	Adjustment of policies on the basis of actual outcomes rather than formal reporting

Source: systematized by the author based on [7; 9; 11; 14]

The application of the proposed information governance model requires a transition from fragmented information systems to a data architecture that clearly defines data owners, data exchange rules, levels of data access, quality standards for data processing and dissemination, accountability for errors, updating mechanisms, and principles for the ethical use of data. Particular importance should be attached to interoperability among the systems of general secondary, vocational, professional pre-higher, and higher education, as well as those related to inclusive education, research, statistics, budgeting, and international reporting. This model can be applied by public authorities, educational and research institutions, local government bodies, and international partners to design information systems, develop dashboards, train administrators to work with data, formulate open science policies, and implement responsible artificial intelligence.

According to the proposed model, enhancing the quality of education and research development requires the implementation of information governance as a comprehensive policy that integrates legal, organizational, technological, human resource, and analytical components (Table 3).

Table 3. Practical areas for improving information governance

No.	Area	Practical measures	Performance indicators
1	Unified education and research data architecture	Development of a harmonized data model for education and research; metadata standards; API-based data exchange among key systems; unique identifiers for institutions, programmes, projects, researchers, and research outputs.	1) share of integrated systems; 2) reduction in duplicated reporting; 3) number of automatically updated indicators.
2	Analytical dashboards for decision-making	National and regional dashboards covering access, quality, shelters, learning losses, workforce needs, R&D funding, publications, patents, and international projects.	1) data update time; 2) number of decisions made on the basis of analytics; 3) public availability of aggregated indicators.

Continuation of Table 3

3	Open science and FAIR data	Development of repositories, open-access policies, research data management plans, licensing arrangements, DOI and ORCID adoption, and national guidelines on the FAIR principles.	1) share of open-access publications; 2) number of datasets deposited in repositories; 3) share of grants accompanied by a data management plan.
4	Data literacy for administrators, educators, and researchers	Training institutional leaders, administrators, teachers, lecturers, and researchers in data management, digital ethics, cyber hygiene, the use of artificial intelligence, and the interpretation of indicators.	1) number of certified participants; 2) error rate in reporting; 3) share of institutions using analytics in planning.
5	Responsible use of artificial intelligence	Policies governing generative artificial intelligence, labelling of AI-assisted work, personal data protection rules, algorithmic transparency, non-discrimination, and risk audits.	1) availability of AI policies; 2) number of audits conducted; 3) reduction in academic integrity violations.
6	Cyber resilience and data protection	Data backup, access control, data segmentation, incident response, staff training, and regular cybersecurity audits.	1) number of incidents; 2) service recovery time; 3) share of critical systems with backup and redundancy arrangements.

Source: systematized by the author based on [7; 10; 11; 14]

The above confirms the need for governance to focus on high-quality data rather than being limited exclusively to quantitative indicators. In education, such data should capture students' learning progress in relation to educational expenditure, learner motivation, and well-being within educational institutions. Educators will implement inclusive teaching practices focused on learners' individual characteristics and educational needs rather than standardized requirements. This approach will help ensure students' safety and well-being within educational institutions, while educators' competencies will be aligned with digital monitoring of learning outcomes and the assessment of students' digital behavior. Alongside this, in the research sector, data on research quality become an important object of governance, particularly data concerning studies conducted in accordance with the principles of reproducibility, openness, and interdisciplinarity within international collaborations, as well as their impact on innovation policy and technology transfer. Without such an expansion of the information base, governance risks remaining merely formal.

Moreover, information governance should be integrated into the budget cycle, in which the financing of education and research programmes is linked to data on stakeholder needs – including those of investors, recipients, and consumers – the risks associated with service use and investment, investment outcomes, and institutional performance. Results-based financing, as exemplified by the LEARN programme, demonstrates the potential to combine international support, national priorities, and verifiable performance indicators. In the research sector, a similar approach could be implemented through portfolios of priority research areas, competitive grant programmes with transparent impact metrics, project life-cycle monitoring, and evaluation of the implementation of research outcomes. It is also important to avoid reducing information governance to rankings and formal key performance indicators. Indicators should serve as tools for organizational learning rather than mechanisms of bureaucratic pressure. Excessive emphasis on the number of publications, scores, ranking positions, or formal reports may encourage performative and imitative practices. Therefore,

the indicator system should combine quantitative and qualitative criteria, take contextual factors into account, allow for expert interpretation, and include mechanisms to prevent manipulation.

8. Conclusions

Information governance is an integrated mechanism for the development of education and research that combines digital infrastructure, data governance, open science, evidence-based decision-making, cyber resilience, and the responsible use of artificial intelligence. Unlike approaches that view digitalization primarily as the conversion of processes into electronic form, information governance involves a management cycle focused on achieving tangible outcomes and strengthening public trust. In other words, information governance is a key prerequisite for advancing education and research, as it enables a transition from intuitive or fragmented governance to evidence-based planning, monitoring, and adjustment of investment, innovation, and information policies.

Digital transformation creates significant opportunities for education and research; however, it simultaneously intensifies the risks of unequal access, data fragmentation, cyber threats, academic misconduct, and the excessive formalization of performance indicators. Ukraine has already established important elements of an information ecosystem for education, including digital learning environments, educational registers containing electronic data, modern online learning systems, inclusive education services, and internationally supported programmes. However, these elements need to be integrated into a unified data architecture governed by clear rules for data quality, security, and analytical use. Along with this, the research sector needs to strengthen the linkages among R&D statistics, open science, research funding, and research performance, as well as between international cooperation and the implementation of innovations. Ukraine's low R&D intensity further increases the need for more precise governance of research priorities and resources. In this context, the proposed four-domain information governance model – comprising data, analytics, decisions, and outcomes – could provide a foundation for building a modern education and research governance system focused on innovation and human capital and guided by the principles of quality, transparency, and resilience.

The implementation of above-mentioned model requires the development of a national framework for governing education and research data. This framework should define applicable standards, data owners, rules governing access to information, data exchange and protection, as well as data storage and reuse. In this context, it is critically important to establish an integrated system of analytical dashboards for the Ministry of Education and Science of Ukraine, local communities, educational institutions, and research institutions. These dashboards should include indicators of access to information, data quality and security, education and research funding, the effectiveness of research commercialization, and the risks associated with the subsequent application of research results. The establishment of such a system should also include mandatory research data management plans for publicly funded research grants and the gradual institutionalization of a national FAIR data and open science policy.

Under these conditions, it is particularly important to develop a professional development programme for education and research leaders focused on data literacy, digital ethics, cybersecurity, and the responsible use of artificial intelligence. As part of this programme, budget planning should be linked to data on learning outcomes, the need to improve the digital and financial literacy of academic and teaching staff, and the risks associated with the improper application of the knowledge, abilities, and skills they acquire. Funding for education and research should increasingly be based on evidence-based indicators rather than solely on historical budget estimates. Accordingly, to ensure the effective implementation of the programme, it is advisable to develop unified guidelines for the use of generative artificial intelligence in education and research. These guidelines should establish rules concerning academic integrity for educators and students, personal data protection, algorithmic transparency, non-discriminatory use, and pedagogical appropriateness. Their implementation should

be supported by regular independent audits of data quality and the cyber resilience of critical education and research information systems.

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