

ELECTRONIC DATABASES IN THE EDUCATION SYSTEM OF UKRAINE: LEGAL AND ECONOMIC COMPONENTS OF PROTECTION

Igor Magdalina¹, Stanislava Myroniuk², Yevhen Zelenskyi³

Abstract. The article examines the legal and economic components of the protection of electronic databases in the education system of Ukraine. As a result of the study, it was established that the state policy of Ukraine on the digitalization of education is aimed at creating a single, secure and transparent digital ecosystem, which is implemented by: ensuring the functioning of the main information systems in the field of education, ensuring secure access to them and creating a system for their protection. It was found that the implementation of the state policy on the digitalization of education in Ukraine is hampered by a lack of funding and security challenges of wartime. It is proved that the public administration of electronic databases in the education system of Ukraine as a complex concept should include the following components: 1) electronic databases in the education system; 2) legal norms that regulate their public administration; 3) competence (limits of authority) of public authorities regarding their proper administration; 4) the procedure for forming databases; 5) the procedure for providing access to databases; 6) protection of information resources containing databases. It has been determined that electronic databases in the education system of Ukraine include: 1) the Unified State Electronic Database on Education (UEDEBO), which includes the following separate information resources: the register of subjects of educational activity, the register of education applicants, the register of education documents, the register of external independent assessment certificates, the register of student (student) tickets, the register of pedagogical, scientific and pedagogical workers, the register of certificates of pedagogical workers; 2) the Automated Information Complex of Educational Management (AICOM), as an integrated information resource in the field of education; 3) internal information bases in educational institutions – web pages, electronic journals, summary information on learning success, electronic databases on which educational materials and documents regulating the educational process are placed; 4) scientometric databases (for example, Scopus, Web of Science), which help track the citation of scientific articles, which is important for academic development; 5) distance education platforms to ensure distance learning. The shortcomings of the legal support for the functioning of electronic databases in the education system of Ukraine are identified, and areas for its improvement are proposed, in particular: the need for their integration with the "Diya" portal; the introduction of transparent data protection procedures; ensuring the interaction of educational databases with other state registers and the e-government system (a single infrastructure of interdepartmental interaction); the introduction of persuasion methods and clear administrative rules (permits, regulations) for the use of databases, which improves the quality of management processes; expanding the functionality, where the basis is the Unified State Web Portal of Electronic Services "Diya Portal" and the citizen's office; creating mechanisms for automated control over the reliability of data and ensuring the transparency of the activities of public administration bodies in the field of education. The economic components that affect the functioning and protection of educational databases are identified, namely: optimization of expenses and increasing efficiency; investments in data security; consideration of financial risks and cyber threats and their elimination; quality and training of personnel. Directions for improving the economic component of the functioning and protection of electronic databases in the education system of Ukraine are proposed, in particular: 1) cost optimization and cloud technologies, namely, the abandonment of own servers and the complete transition of educational institutions

¹ Dnipro State University of Internal Affairs, Ukraine

ORCID: <https://orcid.org/0000-0002-1550-9083>

² Dnipro State University of Internal Affairs, Ukraine (*corresponding author*)

E-mail: stanislava.myroniuk@dduvs.edu.ua

ORCID: <https://orcid.org/0000-0001-6462-2173>

³ Dnipro State University of Internal Affairs, Ukraine

ORCID: <https://orcid.org/0000-0002-5345-1513>



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from maintaining expensive local data centers to using cloud services, conducting centralized tenders through the Prozorro system for the purchase of licenses for database management systems (DBMS) and antivirus software at the regional or state level (for example, for EDEB); 2) attracting grant and international assistance through the use of targeted loan and grant programs from international donors (such as the World Bank initiative) to develop a secure digital educational environment; 3) establishing a public-private partnership, which involves involving leading Ukrainian and international IT companies in the creation and protection of educational databases on the terms of corporate social responsibility or partnership, creating educational hubs on the basis of universities, where students of specialized specialties (cybersecurity, IT) under the guidance of practitioners will conduct an audit of school and university databases, which will reduce the cost of third-party contractor services; 4) implementation of a risk-based security audit – a transition from chaotic spending of funds to conducting regular IT audits, which allows investing only in those protection systems that meet current cyber threats, implementing automated data backup to the cloud, introducing regulatory and financial autonomy, which consists in providing higher education institutions with the opportunity to independently redistribute special funds (funds from contract training) for priority purchases of cloud solutions and information security services.

Keywords: electronic resources, electronic registers, electronic databases in the education system of Ukraine, protection of electronic databases, legal support for the functioning of electronic databases, economic components of the protection of electronic databases of education.

JEL Classification: R38, K23, O47

1. Introduction

As stated in the Law of Ukraine “On Education”, “education is the basis of the intellectual, spiritual, physical and cultural development of the individual, his successful socialization, economic well-being, the key to the development of a society united by common values and culture, and the state” (On Education, 2017). That is why there is an urgent need for a balanced, reasonable, far-sighted, transparent and responsible state policy in the field of education in Ukraine, which largely depends on both its perfect and effective legal support and the economic basis of its development.

Legal support for the implementation of the educational function of the state is an important component of the general legal support for the implementation of the fundamental functions of the state and takes place today in extremely difficult conditions of external and internal political instability of the state, associated with external military aggression on the territory of Ukraine, the need to integrate domestic education into the European and world educational spaces, and this requires constant improvement of administrative and legal regulation, taking into account all positive and negative factors and trends in the development of the educational sector in order to ensure, in the process of such regulation, the formation and implementation of an effective state educational policy for the progressive development of the individual, society, nation and state, and the protection of the national interests of Ukraine.

One of the areas of good governance in the field of education is the creation of a proper economic basis for the functioning and protection of electronic databases

in the education system of Ukraine, which requires scientific analysis, which will be carried out within the framework of this article.

Research on administrative and legal support or regulation in the field of education in the field of domestic legal science was carried out by such scientists as: Kurko M.N., Shapoval R.V., Guberska N.L., Savishchenko V.M., Shchokina R.G., Lehenkyi M.I., Lytvyn I.I. and others. Partially, the issues of using information resources in the education system at the monographic level were given attention in the works of the following authors: Lehenkyi M.I. – as a factor in ensuring the quality of educational services (Lehenkyi, 2017: 360); Shchokin R.G. – as a component of public administration in the field of education (Schokin, 2018:448); Guberska N.L. – as a tool of administration in the field of higher education (Guberska, 2015: 508).

In turn, the issue of creating an appropriate economic basis for the functioning and protection of electronic databases in the education system of Ukraine was the subject of research by such researchers as: Kraus K.M., Kraus N.M., Ishchenko I.S., Leonov S.V., Kryklii O.A. and others (Kraus, Kraus, Ishchenko, 2023: 208; Leonov, Kryklii, 2022; 204).

At the same time, a systematic study of the use of information resources in the education system, including the administration of information databases, has not been carried out, which makes the need to study the legal and economic support for the functioning of electronic databases in the education system of Ukraine relevant.

The purpose of the article is to study the legal and economic support for the functioning of electronic databases in the education system of Ukraine, the means and mechanisms of their implementation.

Materials and methods of research. Based on the subject of the study, a comprehensive approach to the application of scientific research methods was chosen. The methodological basis of the study is the dialectical method, the application of which allowed us to comprehensively reveal the nature of the concept of "protection of information databases in the field of education" as a set of legal, organizational and technical measures aimed at preventing illegal processing, leakage, modification or loss of data. The technical method was used to analyze the mechanisms for forming a system for protecting information databases in the field of education under martial law. The application of the economic method became the basis for clarifying the essence and content of the economic component of the functioning and protection of educational databases. The system analysis method was used to determine the prospects for improving the economic component of the functioning and protection of electronic databases in the education system of Ukraine.

2. State Policy of Ukraine on Digitalization of Data in the Field of Education and Access to It

The creation and development of electronic educational resources, unified information systems, such as EDEB and Mriya, are regulated by the Strategy for Digital Development, Digital Transformations and Digitalization (Strategy for Digital Development of Innovative Activity of Ukraine, 2024) and orders of the Ministry of Education and Science of Ukraine, for example, the Regulations on the Registers of the Unified State Electronic Database on Education (Regulations on the Registers of the Unified State Electronic Database on Education, 2021).

The State Policy of Ukraine on the Digitalization of Education is aimed at creating a unified, secure and transparent digital ecosystem, it ensures the transition from paper document flow to electronic registers, guaranteeing citizens equal access to educational data and services in real time. The main tools and principles of digitalization in the field of education are as follows:

1. The functioning of the main information systems, which include: YEDEBO (Single State Electronic Database on Education) – a central register that collects, verifies and stores data on educational institutions, applicants, students, teachers and issued diplomas; the information system "Mriya" – a National Educational Ecosystem Portal, created for convenient interaction of students, parents and teachers; the platform "Diya. Digital Education" – a state portal that develops digital skills and media literacy for both students and teachers.

2. Access to data and compliance with the principle of transparency are ensured: openness of information – citizens and employers can publicly verify the authenticity of diplomas, certificates or diplomas;

control for students – individuals have full access to information about themselves, full-time students can independently generate an electronic certificate with a unique QR code to confirm their status; personal data protection – all information processing is carried out in accordance with the legislation of Ukraine on information protection.

3. Formation of the main priorities of state policy in this area: end-to-end digitalization – providing educational institutions (schools, universities) with modern gadgets, high-speed Internet and a secure digital environment; lifelong education – creating convenient conditions for distance or blended learning and advanced training of teachers; adaptability – providing access to electronic textbooks and interactive materials, checking your status, finding an educational institution or verifying a document can be done on the official resources of EDEBO. A full list of educational services and courses to improve digital literacy is available on the portal Action. Education.

The development of information and communication technologies has led to significant changes in the formation of new approaches to the creation, storage and use of databases, in particular in education and educational research. The website of the Ministry of Education and Science of Ukraine (Digital Transformation of Education and Science: MES website) offers various areas of digital transformation in the field of education and science, which we have conventionally combined into several large groups depending on the goals of their creation and functioning:

- 1) organizational – digital tools for organizing education in educational institutions (State e-journal for ZZSO, Interdepartmental platform for the admission of foreigners, Digital platforms of informal education);

- 2) methodological and content – electronic tools for implementing the content of education at different levels (All-Ukrainian Online School, the "Mriya" application, Digital platforms of informal education);

- 3) management – remote tools for accounting for education seekers and ensuring document flow (e-Out-of-School, E-Reporting, E-Administration, licensing, Ordering education documents, European-style supplements to higher education documents, EMIS management system for vocational education);

- 4) monitoring – online tools for assessing the effectiveness of educational activities and checking the level of competences of education seekers (SELFIE, Introductory campaigns for obtaining professional pre-higher and higher education, as well as vocational (vocational and technical) education, multi-subject test for obtaining junior bachelor's and bachelor's degrees, monitoring of graduate employment);

- 5) accumulative – electronic databases in the field of education (EDEBO as the Unified State Electronic Database on Education), Data exchange of EDEBO with external systems of the National Agency for Higher

Education and State Medical Service, Connection of third-party educational information systems to PAK "AICOM", Pre-university training of foreigners, National electronic scientific information system URIS).

The implementation of the state policy on the digitalization of education in Ukraine is hampered by a lack of funding and security challenges of wartime, and its proper implementation is affected by a number of factors, including: 1) destruction or damage to educational infrastructure – many educational institutions have been destroyed or damaged, which diverts the lion's share of state funding to the reconstruction of physical premises (for example, the construction of underground schools) instead of investing in digital technologies; 2) problems with electricity and energy supply – emergency and planned power outages make full-fledged online learning impossible in many regions; 3) the presence of infrastructural inequality – there is a striking contrast between access to technology in large cities and remote or front-line rural communities; 4) outdated equipment – many schools and universities do not have a sufficient number of modern laptops, interactive whiteboards, or stable Wi-Fi coverage; 5) personnel and psychological problems – despite advanced training courses, a significant part of teachers needs in-depth training to work with new digital tools, platforms (such as the "Mriya" ecosystem) or artificial intelligence algorithms; 6) professional burnout – the forced transition to distance learning has led to overloading of teachers and a decrease in the quality of live communication between students and teachers; 7) lack of electronic materials – there is a shortage of interactive textbooks, virtual laboratories and adapted digital content, which requires large resources of time and money for their development; 8) regulatory and administrative difficulties, which consist in the fact that school and university management often does not have sufficient financial or managerial freedom to independently purchase the necessary software or equipment, despite the fact that the state is gradually transitioning to electronic document management and digital journals, the process of abandoning paper reporting is progressing slowly due to the inertia of the system and outdated instructions.

3. Electronic Databases in the Education System of Ukraine and the Legal Principles of Their Administration

Taking into account our own scientific developments, as well as the analysis of scientific works of other scientists, and considering the subject of the study within the framework of this article, we will make an assumption that the administrative and legal support for the functioning of electronic databases in the

education system of Ukraine as a complex concept should include the following components: 1) electronic databases in the education system; 2) legal norms that regulate their public administration; 3) competence (limits of authority) of public authorities regarding their proper administration; 4) the procedure for forming databases; 5) the procedure for providing access to databases; 6) mechanisms for protecting information resources that contain databases. Thus, below it is worth analyzing these elements of the administrative and legal support for the functioning of electronic databases in the education system of Ukraine.

In accordance with Article 74 of the Law "On Education", an integrated information system operates in the education system – the Unified State Electronic Database on Education (hereinafter – EDEB). EDEBO includes the following separate information resources: 1) Register of subjects of educational activity; 2) Register of education seekers; 3) Register of documents on education; 4) Register of certificates of external independent evaluation; 5) Register of student (pupil) tickets; 6) Register of pedagogical, scientific and pedagogical workers; 7) Register of certificates of pedagogical workers. All of them are interpreted under the name "public electronic registers in the field of education" (On Education, 2017). For example, the Register of subjects of educational activity is a separate e-resource in the EDEBO system, which includes a list of: higher education institutions, institutions of professional pre-higher education, institutions of professional vocational and technical education, institutions of general secondary education, scientific institutes (institutions), institutions of postgraduate education. The Register of Educational Activity Entities contains systematized information about all educational institutions (from schools to universities), their licenses, educational programs, and is actually an official state "passport" of each institution. The key features of maintaining and filling out this register are regulated by the special Regulations on the Register of Educational Activity Entities (Register of Educational Activity Entities of the Unified State Electronic Database on Education, 2021), which are as follows: 1) provides individuals and legal entities with reliable information about the network of institutions, which excludes fraud and confirms the legality of the provision of educational services; 2) includes the full name, EDRPOU code, location, type of institution, head, and most importantly – information about licenses for educational activities and certification; 3) entering, changing and confirming information is carried out through the institution's electronic office or education management bodies with the mandatory imposition of a qualified electronic signature (QES); 4) The register is directly linked to other modules of the EDEBO, such as the Register of Education Documents and the Register of NMT/ZNO Certificates, which allows you

to automatically generate electronic student cards and check diplomas; 5) the register data is open for public inspection, that is, any person can check the status of an institution or find out which specialties are licensed in it using the open module Register of Educational Activity Subjects (EDEBO); 6) education management bodies verify (confirm) information about institutions subordinate to them (for example, the education department of city councils for schools).

Information databases in education provide centralized storage, quick search and updating of large volumes of data about students, teachers, curricula and assessments. They are the foundation for creating state-level documents, accounting for student tickets, automating the educational process and monitoring the quality of education. The importance of databases in the educational system is as follows: 1) data management is ensured in a centralized manner by storing data, avoiding duplication, and ensuring consistency of information; 2) EDEB is used to produce documents on education, licenses, accreditation certificates and student tickets; 3) in addition to EDEB, there are internal information bases in educational institutions – electronic journals, diaries, summary information on academic performance, electronic databases on which educational materials and documents regulating the educational process are placed; 4) in the scientific field related to education, there are such information bases as scientometric bases (for example, Scopus, Web of Science), which help track the citation of scientific articles, which is important for academic development; databases of professional publications.

A separate integrated information resource in the field of education is the automated information complex of educational management (hereinafter – AICOM), which was introduced to ensure proper digital interaction in the education system between state authorities, local governments, educational institutions and institutions, their structural divisions, participants in the educational process and other legal and physical persons in Ukraine. AICOM is a state integrated information system, the tasks of which are: collection, accumulation, processing, protection of information in the field of education, granting it official recognition (in the case of creation, storage and use of information in the field of education in AICOM); combination of electronic information resources and/or public electronic registers in the field of education, ensuring their internal and external information interaction, in particular on issues of distribution and redistribution of inter-budgetary transfers from state to local budgets, ordering textbooks, documents on education, on professional development of employees of educational institutions and institutions, enrollment, expulsion, transfer of students, organization of the educational process, etc.; ensuring electronic maintenance of business documentation and reporting by educational

institutions, accounting of preschool and school-age children (including children not covered by education), participants in the educational process and subjects of educational activity; interaction on issues of receiving, transmitting, recording, verifying and processing information in the field of education with the information systems of the Unified State Demographic Register, the Unified State Register of Legal Entities, Individual Entrepreneurs and Public Organizations, the State Register of Civil Status Acts of Citizens, the State Register of Compulsory State Social Insurance, the State Register of Individual Taxpayers, the Unified State Register of Conscripts, Military Conscripts and Reservists, the Electronic Health System, the Unified Information System of the Social Sphere, the Unified State Web Portal of Electronic Services, registers of territorial communities, the information and production system of information and documentary support of institutions and citizens of Ukraine in the field of education and with other automated systems and information resources of the AICOM holder and other legal entities to the extent and in cases specified by law. The AICOM holder is the central executive body in the field of education and science (On Education, 2017). Since 2024, the Ministry of Education and Science has launched the functioning of the National Electronic Scientific and Information System and approved the Procedure for its work, which determines the procedure for ensuring the collection, formation, processing, storage, use of data and information on the sphere of scientific and scientific and technical activity of Ukraine, ensuring the implementation of the functions of the subjects of the National Electronic Scientific and Information System (hereinafter referred to as the system), information support and support for their activities (Procedure for the work of the National Electronic Scientific and Information System, 2024).

It is also worth paying attention to such electronic databases in education as distance education platforms, in particular: iLearn – online courses in the main subjects of the external assessment, webinars with the best tutors, tests, podcasts, materials for self-training; Moodle – a free educational platform, a full-featured system for organizing distance learning and creating electronic courses; My Class – an electronic educational platform that offers a wide range of materials for distance learning – tasks, theory and tests in school subjects; Classtime – a platform for creating interactive educational applications that allows you to conduct analytics of the educational process and implement strategies for an individual approach; Google Classroom – a free web service created by Google for educational institutions to simplify the creation, distribution and classification of tasks in a paperless way; Zoom – a service for conducting video conferences and online meetings; Google Meet – a service for conducting video conferences and online meetings, etc.

Regulatory and legal regulation of public administration of information databases in education is provided by the following legal acts: 1) The Law of Ukraine "On Education" in Section IX "Infrastructure of Education", which regulates the procedure for the functioning of the Unified State Electronic Database on Education (UEDEBO) and the Automated Information Complex of Educational Management (AICOM) (Law on Education, 2017); 2) The Law of Ukraine "On Information Protection in Information and Communication Systems" dated July 5, 1994 No. 80/94-VR (Law on Information Protection in Information and Communication Systems, 1994) – regulates relations in the field of information protection in information, electronic communication and information and communication systems, including those formed in the field of education; 3) The Law of Ukraine "On Public Electronic Registries" dated November 18, 2021 No. 1907-IX (Law on Public Electronic Registries, 2021) – establishes the legal, organizational and financial principles for the creation and functioning of public electronic registries in order to protect the rights and interests of individuals and legal entities during the creation, storage, processing and use of information in public electronic registers; 4) The Regulation on the Unified State Electronic Database on Education, approved by the Resolution of the Cabinet of Ministers of Ukraine dated July 15, 2025 No. 872 (Regulations on the Unified State Electronic Database, 2025) – defines the mechanism for the functioning of the Unified State Electronic Database in the field of education as an integrated information system that ensures the collection, creation, registration, accumulation, storage, modification, use, dissemination and protection of information about subjects of educational activity, applicants to educational institutions, education seekers, documents on education (academic degree), pedagogical, scientific-pedagogical and scientific workers in order to meet the needs of individuals and legal entities, the procedure for its maintenance; 5) The Regulation on the software and hardware complex "Automated Information Complex of Educational Management", approved by the Resolution of the Cabinet of Ministers of Ukraine dated December 2, 2021 No. 1255 (Regulations on AICOM, 2021) – defines the main tasks, purposes and issues of functioning of this software and hardware complex.

4. The Mechanism of Administration of Electronic Databases in the Education System of Ukraine

The mechanism of administration of electronic databases in the education system of Ukraine as a complex concept should include the following components: 1) the competence (limits of authority) of public authorities regarding their

proper administration; 2) the procedure for forming databases; 3) the procedure for providing access to databases; 4) mechanisms for protecting information resources that contain databases.

The competence (complex and limits of authority) of public authorities regarding their proper administration and the procedure for forming information databases in the field of education determines the legal status of these bodies, which include: the Ministry of Education and Science (MES), the State Enterprise "Inforesurs", the State Education Quality Service, the National Agency for Higher Education Quality Assurance, ministries and other central executive bodies that have educational institutions under their control, local governments, as well as educational institutions and their separate divisions that conduct educational activities at the level of professional (vocational and technical), professional pre-higher education, higher education and adult education, in particular postgraduate education, regardless of the form of ownership and area of management, the Ukrainian Center for Education Quality Assessment, the State Scientific Institution "Institute of Educational Analytics".

In particular, the administrator of the EDEBO is the State Enterprise "Inforesurs", which belongs to the sphere of management of the Ministry of Education and Science, which, within its powers: carries out measures to create and maintain the software of the Electronic Base; is responsible for the technical and technological support of the Electronic Base, storage and protection of information (data) contained in the Electronic Base; ensures the provision and cancellation of access to the Electronic Base; conducts training for working with the Electronic Base. In turn, the owner of the Automated Information Complex of Educational Management and the owner of the information processed in it is the state represented by the Ministry of Education and Science, which, in accordance with its competence: provides regulatory and legal regulation regarding the functioning of the automated management complex; determines the procedure for access to information in the central database; determines instructions for using the automated management complex; determines technical requirements for educational information systems; determines the procedure for exchanging information with the EDEBO and other state electronic information resources; provides methodological and methodological support for the functioning of the automated management complex; monitors and analyzes the effectiveness of the functioning of the automated management complex; organizes the interaction of state electronic information resources and the automated management complex. At the same time, the technical administrator of the automated management complex is the state scientific institution "Institute of Educational Analytics", which belongs to

the sphere of management of the Ministry of Education and Science.

Access to electronic databases in the education system is carried out through: 1) official websites of the EDEB holder and the EDEB administrator; 2) Unified State Web Portal of Electronic Services.

Access to electronic databases (EDEB, scientific databases) in education in Ukraine is carried out mainly through official web portals (for example, <https://info.edbo.gov.ua/>), using a KEP (electronic signature) for personal data or through requests from institutions, or through the Unified State Web Portal of Electronic Services. The main access methods are: 1) to EDEB – individuals have full free access to information about themselves (diplomas, certificates) through the official website, forming a request with the imposition of a KEP; 2) to the Register of Educational Activity Subjects – open access to view information about educational institutions, licenses and educational programs <https://registry.edbo.gov.ua/>; 3) to electronic scientific databases – educational institutions receive access upon application, through competitive selection or orders of the Ministry of Education and Science (for example, to Scopus, Web of Science). Information that is not confidential is posted on the official websites of the Ministry of Education and Science and the Unified Educational System for free use. To check documents (diplomas) or search for information about themselves, users usually go to the Unified Educational System portal and use specialized modules, for example, check-person.

It is worth distinguishing between access to electronic databases in the education system for the purpose of checking information and obtaining confirming information, including in the form of an electronic document, and access to the Unified Electronic Database for the purpose of entering information into it as a certified user. For example, the Unified Educational System administrator provides (organizes and supports) access to the electronic database to users on the basis of: an order of the Ministry of Education – to users from the Ministry of Education; an order (order) of the administrator – to users from the administrator; application of the subject of maintenance, which necessarily contains information about it or its separate subdivision, data of its user (users), who (who) is granted access to the Unified Electronic Database. Access to the Unified Electronic Database is provided to users from automated workplaces (workstations, local computer networks, information and communication systems), in which decisions on information protection agreed with the administrator are implemented, from the date determined by the administrator by creating an account, the user receives the right to access after authorization and authentication. It should be noted that at the regulatory level, the issue of access to electronic databases in the education system is sufficiently fully

regulated in the Regulation on the Unified State Electronic Database on Education.

Separately, it is worth noting such an element of the mechanism for administering electronic databases in the education system of Ukraine as the protection of information resources that contain databases. The protection of electronic databases in education (EDEBO, AICOM) is ensured by strict compliance with the Law "On Personal Data Protection", is controlled by the Educational Ombudsman of Ukraine, as an official who protects the rights of students, teachers and scientists, promotes the accessibility of education and monitors compliance with the law and provides for the use of multi-level authentication, encryption, corporate mail and regular backups to prevent unauthorized access to student and teacher data. The main aspects of data protection in educational systems are as follows: 1) legal regulation of the procedure for processing data in EDEBO and AICOM, which is mandatory for the functioning of education; 2) multi-factor authentication (MFA) – the use of several steps to log in to the system; 3) encryption of mail messages and data; 4) use of secure Wi-Fi and VPN; 5) regular creation of copies of data to avoid their loss; 6) use only official mailboxes for work communication; 7) creation of separate accounts for work and personal needs; 8) establishment of access rights to information depending on job responsibilities. As some researchers rightly point out, "ensuring the confidentiality and integrity of databases can be achieved through encryption and cryptographic methods, which will guarantee the reliability of information during transmission and storage; the use of blockchain technology and a consensus mechanism will allow maintaining the consistency and immutability of data, which is important for state registers; tools for preventing information leakage and loss, such as network shielding and DLP systems, which will help minimize the risks of cyber threats and unauthorized access to data; additional power sources will contribute to the uninterrupted operation of servers and other critical equipment, which will avoid data loss due to power outages; communication access control systems, including electronic identification, authentication and biometric verification, will ensure accurate identification of users and reduce the risks of unauthorized access" (Zadereiko, 2025: 59).

5. Economic Components of the Functioning and Protection of Electronic Databases in the Education System of Ukraine

The economic efficiency of electronic databases in education in Ukraine consists in optimizing budget expenses for administration, digitalization of services and increasing transparency. At the same time, the protection of these systems requires investments in cybersecurity to prevent information

leaks and minimize financial losses. The main economic aspects of the functioning and protection of educational databases can be divided into several key components:

1. Optimization of expenses and increasing efficiency, which involves: reducing administrative costs – the transition from paper document flow (folders, journals, personal files) to electronic (systems such as EDEBO or electronic journals) reduces costs for paper, printing, logistics and physical storage of archives; automation of processes – centralized data management allows you to generate statistical reports faster, distribute state orders and automatically calculate academic scholarships or funding for institutions; time saving – automation of the work of admissions committees and personnel departments frees up the working time of specialists to perform other tasks.

2. Investments in data security, because the protection of databases containing personal data of pupils, students and teachers requires constant financial investments, its components are: hardware – purchase of secure servers, backup systems and equipment for creating backup data centers; software solutions – licensed antivirus software, data encryption systems (SSL/TLS), firewalls and intrusion prevention systems (IDS/IPS), cloud technologies – use of certified cloud services in compliance with the requirements of a comprehensive information protection system (CIS).

3. Financial risks and cyber threats, which include: economic losses from negligence or cyberattacks, which can be critical because violation of laws on the protection of personal data entails legal and financial liability; data and system recovery – eliminating the consequences of hacker attacks (for example, encryption viruses), restoring damaged or lost databases requires significant financial and time resources; reputational losses – data leaks undermine trust in the education system, which can lead to a decrease in the number of entrants to contract education or an outflow of users.

4. Quality and training of personnel, because cybersecurity depends on user awareness. Educational institutions bear the costs of organizing training for teachers and administrators on digital hygiene and recognizing phishing attacks. Attracting highly qualified cybersecurity engineers and database administrators requires competitive salaries, which is a significant expense for educational institutions and the state as a whole. Information on the state of digitalization and data protection in Ukrainian education is based on state programs of the Ministry of Education and Science of Ukraine on the implementation of EDEBO, education management automation systems (COURSE: Education, Human, My Class, etc.) and the laws of Ukraine on information protection in information and telecommunication systems.

Economic indicators of the functioning and protection of electronic databases in the education

system of Ukraine are based on minimizing risks, optimizing budget financing and taking into account direct losses from cyberattacks. The integration of economic effect and security ensures the continuity of management of educational processes. The main components of the system of financing electronic databases in the education system include: 1) capital and current expenses – financing of protection and support of databases (such as EDEBO or AICOM) is covered from the state and local budgets, these funds are used to rent server capacities, purchase licensed antivirus and cryptographic software, as well as services of cloud providers; 2) administration and audit – mandatory assessment of compliance of Comprehensive Information Protection Systems (CIPS) requires significant funds for attracting certified specialists and regular updating of hardware complexes; 3) economic indicators of protection against cyberattacks – in the event of a successful attack on databases of educational institutions or ministries (for example, DDoS attacks or wiper attacks), economic losses include direct costs for restoring the operability of systems and backups, loss of confidentiality (fines and reputational losses); blocking of admission campaigns, which directly affects the labor market and university admissions.

In modern conditions, the cost of security tools is considered not as an expense, but as a minimization of business risks. The cost of preventive measures (implementation of multi-factor authentication, encryption, cloud backup) is $\frac{1}{10}$ – $\frac{1}{100}$ times less than the potential losses from data leakage or shutdown of educational infrastructure. The economic effect of digitalization – resource optimization – centralized data storage in the educational network reduces the need for paper document flow, reduces the time for processing and checking documents (for example, diplomas or NMT results). Big Data analytics – electronic registers allow the Ministry of Education and Science to conduct a predictive analysis of the development of the industry, optimally distribute subsidies between regions and predict the need for educational services. In addition, any electronic education system in Ukraine is obliged to function in accordance with the legislation on information protection in information and communication systems. Responsibility for organizing protection measures lies with database managers and state authorities in accordance with the Law of Ukraine on the Basic Principles of Ensuring Cybersecurity of Ukraine (On the Basic Principles of Ensuring Cybersecurity, 2017).

The areas for improving the economic component of the functioning and protection of electronic databases in the education system of Ukraine include:

1. Cost optimization and cloud technologies, which involves:

- abandonment of own servers – a complete transition of educational institutions from maintaining expensive local data centers to using cloud services (AWS, Microsoft Azure, Google Cloud), which reduces capital expenditures (CapEx) for equipment and translates them into more flexible operating expenses (OpEx);

- centralization of procurement – conducting centralized tenders through the Prozorro system for purchasing licenses for database management systems (DBMS) and antivirus software at the regional or state level (for example, for YEDEBO);

- implementation of Open Source – more active use of free open source software (for example, PostgreSQL for data storage), which significantly reduces licensing costs for educational institutions.

2. Attracting grant and international assistance, in particular:

- participation in international projects – use of targeted loan and grant programs from international donors (such as the World Bank initiative) to build a secure digital educational environment;

- investments in the digitalization of vocational education – raising funds (such as under the Financial Agreement with the EIB) for the purchase of secure equipment and the construction of local educational networks.

3. Public-private partnership, which provides for:

- cooperation with the IT sector – involving leading Ukrainian and international IT companies (for example, EPAM, Google) in the creation and protection of educational databases under the terms of corporate social responsibility or PPP partnership;

- creation of educational hubs based on universities, where students of specialized specialties (cybersecurity, IT) under the guidance of practitioners will conduct an audit of school and university databases, which will reduce the cost of third-party contractors.

4. Introduction of economically justified protection mechanisms, namely:

- introduction of risk-based security audit – transition from chaotic spending of funds to conducting regular IT audits, which allows investing only in those protection systems that meet the current cyber threats of CERT-UA;

- backup – automated data backup to the cloud, which is the cheapest economic protection in case of information loss due to force majeure, cyberattacks or power outages.

- training of personnel as an investment – investment in regular advanced training of system administrators and educational managers, since most data leaks occur due to the human factor (phishing, weak passwords).

5. Introduction of regulatory and financial autonomy, which consists in providing higher education institutions with the opportunity to independently redistribute

special funds (funds from contract training) for priority purchases of cloud solutions and information security services.

6. Conclusions

As a result of the study, it was established that the state policy of Ukraine on the digitalization of education is aimed at creating a single, secure and transparent digital ecosystem, which is implemented by: ensuring the functioning of the main information systems in the field of education, ensuring secure access to them and creating a system for their protection. It was found that the implementation of the state policy on the digitalization of education in Ukraine is hampered by a lack of funding and security challenges of wartime.

Public administration of electronic databases in the education system of Ukraine as a complex concept should include the following components: 1) electronic databases in the education system; 2) legal norms that regulate their public administration; 3) competence (limits of authority) of public authorities regarding their proper administration; 4) the procedure for forming databases; 5) the procedure for providing access to databases; 6) protection of information resources that contain databases.

Electronic databases in the education system of Ukraine include: 1) The Unified State Electronic Database on Education (UEDB), which includes the following separate information resources: register of subjects of educational activity, register of education applicants, register of education documents, register of certificates of external independent assessment, register of student (pupil) tickets, register of pedagogical, scientific and pedagogical workers, register of certificates of pedagogical workers; 2) Automated Information Complex of Educational Management (AICOM), as an integrated information resource in the field of education; 3) internal information databases in educational institutions – web pages, electronic journals, summary information on learning success, electronic databases on which educational materials and documents regulating the educational process are placed; 4) scientometric databases (for example, Scopus, Web of Science), which help track the citation rate of scientific articles, which is important for academic development; 5) distance education platforms to provide distance learning.

The shortcomings of the legal support for the functioning of electronic databases in the education system of Ukraine are identified, and areas for its improvement are proposed, in particular: the need for their integration with the "Diya" portal; the introduction of transparent data protection procedures; ensuring the interaction of educational databases with other state registers and the e-government system (a single infrastructure of interdepartmental interaction); the introduction of persuasion methods

and clear administrative rules (permits, regulations) for the use of databases, which improves the quality of management processes; expanding the functionality, based on the Unified State Web Portal of Electronic Services "Diya Portal" and the citizen's office; creating mechanisms for automated control over the reliability of data and ensuring transparency of the activities of public administration bodies in the field of education.

The economic components that affect the functioning and protection of educational databases are identified, namely: optimization of expenditures and increasing efficiency; investments in data security; consideration of financial risks and cyber threats and their elimination; quality and training of personnel. Directions for improving the economic component of the functioning and protection of electronic databases in the education system of Ukraine are proposed, in particular: 1) cost optimization and cloud technologies, namely, the abandonment of own servers and the complete transition of educational institutions from maintaining expensive local data centers to using cloud services, conducting centralized tenders through the Prozorro system for the purchase of licenses for database management systems (DBMS) and antivirus software at the regional or state

level (for example, for EDEB); 2) attracting grant and international assistance through the use of targeted loan and grant programs from international donors (such as the World Bank initiative) to build a secure digital educational environment; 3) establishing a public-private partnership, which involves involving leading Ukrainian and international IT companies in the creation and protection of educational databases under the terms of corporate social responsibility or partnership, creating educational hubs at universities, where students of specialized specialties (cybersecurity, IT) under the guidance of practitioners will conduct an audit of school and university databases, which will reduce the cost of third-party contractors' services; 4) implementing a risk-based security audit – a transition from chaotic spending of funds to conducting regular IT audits, which allows investing only in those protection systems that meet current cyber threats, implementing automated data backup to the cloud, introducing regulatory and financial autonomy, which consists in providing higher education institutions with the opportunity to independently redistribute special funds (funds from contract training) for priority purchases of cloud solutions and information security services.

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Received on: 19th of April, 2026

Accepted on: 25th of June, 2026

Published on: 31th of July, 2026