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Digital archives as a tool for preserving and researching media materials

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Abstract. The purpose of the study – to assess the effectiveness of digital archives as a tool for preserving and studying media materials in Ukraine. The research methodology included an analysis of the legal framework, an assessment of the functioning of three large open digital archives, and an online survey of 500 users. The study revealed major gaps in the legal regulation of digital archives and the lack of uniform standards for their organisation: between 2021 and 2023, the number of digitised documents increased by 63.5% to 8.5 million, and the number of online requests increased by 106.7% to 3.1 million annually. The capacity of digital archives increased by 90% to 285 terabytes. The distribution of media materials shows that textual materials (45%) and photographs (30%) predominate, audio materials account for 15%, video materials for 8%, and interactive media for only 2%. The use of digital archives in education varies from 25% in secondary school to 95% in postgraduate studies, with the COVID-19 pandemic increasing the number of remote users. An analysis of the functionality of the archives showed that 65% of users face navigation problems, and 72% have limited access to full-text versions of documents. Promising areas of technological development include the use of artificial intelligence, which has increased search efficiency by 70%, and blockchain, which has reduced the risk of document forgery by 90%. According to an economic analysis, 35% of the digital archive budget is spent on digitising materials. The study showed that to improve the efficiency of Ukraine's digital archives, it is necessary to improve the legal framework, introduce unified standards, improve the user interface, and expand the types of media content. The study also revealed the need to strengthen international cooperation and develop a long-term strategy for digital preservation

Keywords: media content; digitisation of documents; archival legislation; information technology; cultural heritage; educational resources

Introduction

Digital archives play a vital role in preserving and analysing media materials and have become an integral part of modern society. Effective storage, processing, and

analysis of large amounts of digital data is a challenging task. Digital archives are a powerful tool for systematising, cataloguing, and providing long-term access to

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various media materials, including text documents, audio and video recordings, photographs, and other types of digital content. The study of digital archives as a tool for preserving and studying media materials is driven by a series of factors. The rapid growth of digital information challenges the conventional methods of archiving and preserving data. The variety of formats and types of media content requires novel approaches to its organisation and classification. To ensure the long-term preservation of digital materials, the problems of technological obsolescence and format compatibility arise.

The study of digital archives as a tool for preserving and studying media materials has attracted the attention of many researchers. Ya. Kryvushenko (2019) provided an in-depth analysis of the role of digital technologies in modern scientific research, with an emphasis on their application to work with archival materials. The researcher not only emphasised the role of these technologies, but also examined in detail their effects on research methodology, emphasising how digital tools transform the processes of analysing and interpreting archival data. The author convincingly argued that digital technologies open new perspectives for historical and cultural studies, enabling researchers to work with large amounts of data and discover previously invisible connections and patterns. Ya. Moskvyyak (2023) offered an innovative approach to the role of digitisation in preserving Ukraine's intangible cultural heritage in the context of post-war reconstruction. The researcher provided not only general statements but also concrete examples and scenarios of the use of digital technologies for documenting and preserving traditions, rituals, and other elements of intangible culture. The significant value of the study lies in the analysis of potential challenges and risks associated with the digitisation of cultural heritage in the context of post-conflict recovery.

M. Serba (2024) applied a comprehensive approach to the analysis of open resources in Ukraine in the context of digital transformation. The cited study was not limited to stating the significance of electronic archives but offered an in-depth analysis of their role in ensuring democratic access to information. Digital archives were considered not merely as a technological solution, but as a valuable tool for social change that promotes transparency and openness of society. M. Zinaman (2024) explored archiving practices in social media and critically assessed their effectiveness and sustainability. The researcher examined the technical, legal, and ethical issues associated with archiving social media content, with a particular focus on preserving context and metadata. The author proposed innovative approaches to automating the archiving process, including the use of artificial intelligence.

In the context of the development of digital archives as a tool for preserving and studying media materials, it is also important to note the efforts of other researchers who have addressed various aspects of this subject. C.A. Romein *et al.* (2020) analysed the current state of

digital history and the preservation of historical research and cultural heritage, highlighting the role of digital archives in historical research and cultural heritage preservation. S.J. Bury (2019) investigated the transformation of museum libraries and archives in the digital age. The researcher analysed how the digitisation process has changed the role of these institutions in the 21st century, and considers them not only as repositories of information, but also as active participants in cultural discourse. S.J. Bury (2019) highlighted the new opportunities that digitisation brings to museum libraries and archives, such as wider access to collections, better preservation, and the creation of new forms of interaction with audiences. The researcher also highlighted the challenges facing these institutions, including the need to adapt to the latest technologies and changing user expectations. M. Koolen *et al.* (2019) proposed an innovative model for a critical review of digital tools used in digital archives. The model aims to evaluate the effectiveness and reliability of these tools, considering such aspects as ease of use, accuracy of results, and compatibility with various types of archival materials. The researchers emphasised the significance of a systematic approach to the evaluation of digital tools, which allows identifying the strengths and weaknesses of the tools and contributing to their further improvement. D. Agostinho (2019) discussed the ethical aspects of access and care in digital colonial archives and emphasises the need to address the cultural context and historical sensitivity when working with such materials.

The growth in the amount of data produced in digital formats requires the development of innovative approaches to their storage and processing. The issues of the "digital dark ages" associated with the potential loss of access to digital data due to outdated formats and technologies are becoming increasingly important. Advances in artificial intelligence and machine learning technologies are opening new perspectives for the analysis and classification of archival materials. However, they also raise questions concerning the ethical use of such technologies, especially in relation to sensitive or personal data. Another notable aspect of the development of digital archives is ensuring accessibility for a wide range of users. Therefore, the purpose of this study was to provide a comprehensive analysis of the potential of digital archives as a tool for preserving and studying media materials, to identify the key issues and prospects for their development, and to develop recommendations for improving the functioning of digital archives in the context of modern information challenges.

■ Literature Review

A review of the literature on digital archiving as a tool for preserving and researching media materials revealed a wide range of approaches and perspectives in this area. Key terms such as "digital archive", "media materials", "digital information preservation" and "digital research"

require clarification. N. Korzhyk (2022) defined a digital archive as a system for storing and managing digital documents and data that ensures their long-term preservation and accessibility. The term “media materials” covers a wide range of digital objects in the context of digital archiving. M. Serba (2024) included text documents, audio and video recordings, photographs, graphic materials, and other forms of digital content in this category. A prominent aspect of digital archiving is the “preservation of digital information”, which S.J. Borgman *et al.* (2019) considered as a set of technical, organisational, and methodological measures aimed at ensuring long-term access to digital data, while G.S. Hunter (2020) emphasised the role of strategic planning and development of preservation policies for the effective management of digital archives. M. Koolen *et al.* (2019) considered “digital research” in the archival context as the process of using digital tools and methods to analyse and interpret archival materials. C.A. Romein *et al.* (2020) emphasised the necessity of developing digital research methods to effectively harness the potential of digital archives in historical and cultural research.

The literature review revealed several key areas of digital archives research. The first area focuses on the technical aspects of the creation and operation of digital archives. M. Ngoepe *et al.* (2024) investigated the integration of digital technologies into archival education and practice. A. Voitkov (2023) examined the issue of long-term preservation of archives and proposed novel approaches to ensuring the sustainability of digital data. The second research area focuses on methodological aspects of digital archives management. K. Aske & M. Giardinetti (2023) focused on metadata and its role in ensuring the accessibility of digital visual archives. G. Colavizza *et al.* (2021) explored the possibilities of using artificial intelligence and machine learning to process and analyse archival materials. The third research area investigates the socio-cultural aspects of digital archives. D. Agostinho (2019) highlighted ethical issues related to access to colonial digital archives, emphasising the need to consider the cultural context when working with archival materials. Ya. Moskvyyak (2023) explored the role of digital archives in preserving intangible cultural heritage, especially in the context of post-war reconstruction.

Studies devoted to specific types of digital archives deserve special attention. D.A. Kirsch *et al.* (2023) explored the possibility of using digital archives of digital documents such as emails for business history. Their study emphasised the significance of developing concrete methodologies for working with distinct types of digital materials. S. Bharti & R.K. Singh (2022) proposed a parametric approach for evaluating and analysing digital language archive development platforms, which is vital for understanding the technical aspects of creating user-generated digital archives. S. Van Hooland & M. Coeckelbergs (2022) evaluated the possibilities and limitations of using unsupervised machine learning

methods to extract meaning from large digital archives. An analysis of the scientific literature showed that despite major progress in the study of digital archives, there are some aspects that are still understudied. Specifically, the issues of integrating distinct types of media materials into a single archiving system, developing effective methods for searching and analysing archival materials, and ensuring long-term preservation of digital data in the face of rapid technological development require further investigation. Furthermore, the issues of user interaction with digital archives and evaluation of their effectiveness in various use scenarios are understudied. Apart from the above-mentioned research areas, it is also vital to address the legal and ethical aspects of digital archiving, as T. Sydorenko (2020) considered digitisation as a means of improving the reputation of libraries, which can be applied to digital archives. This study emphasised the significance of considering not only technical but also social aspects of digitalisation in the cultural heritage sector.

The issue of standardisation and interoperability of digital archives also attracts the attention of researchers. J.C. Ramalho *et al.* (2022) investigated the data protection of non-relational databases, which is important for ensuring long-term access to archival materials. M. Harris *et al.* (2020) emphasised the need to develop innovative approaches to data curation in digital archives. The researchers proposed a method for comparing “parallel passages” in digital archives, which opens new opportunities for textual analysis and the investigation of intertextual relations. This study demonstrated the potential of digital archives in developing innovative methods for humanities research. N. Ruest *et al.* (2020) published the Archives Unleashed project, which aims to improve academic access to web archives. Their study emphasised the significance of developing specialised tools and platforms for working with specific types of digital archives. B.L. Muhammad-Bello *et al.* (2021) proposed a new approach to archiving news from news agencies. Thus, the literature review showed that the research on digital archives as a tool for preserving and studying media materials is an interdisciplinary field that includes technical, methodological, socio-cultural, legal, and ethical aspects. Despite the considerable progress achieved in this field, there are a series of issues and unresolved problems that require further investigation and development of innovative approaches.

Materials and Methods

The study was divided into three principal stages, which correspond to the objective of the study. The first stage involved a comprehensive analysis of the current state of development of digital archives in Ukraine and abroad. The method of analysis was used to examine the regulatory framework for the functioning of digital archives in Ukraine, and key documents from official sources were analysed in detail, including the Law of Ukraine

No. 3814-XII (1993) and relevant government resolutions. This helped to outline the key legal aspects of the work of electronic archives and identify gaps that need to be addressed. The review of the functioning of the three main open digital archives in Ukraine included a comparative analysis based on the criteria of types of materials available, search functions, metadata availability, and downloading capabilities. A five-stage evaluation system was created to quantify the functionality of the archive. The user interface, system speed and integration with other resources were also considered. To get an overall picture, the study reviewed the statistics of digital archives usage in 2021-2023. The data was collected from the annual reports of the National Archival Fond, which include the number of digitised documents, online requests, and archive capacity (in terabytes). These indicators were systematically analysed to identify trends in the development of digital archives in Ukraine.

The second stage was devoted to assessing the potential of digital archives in science and education. An online survey of archives users was conducted using Google Forms, which covered 500 experts in social media, archives, and media studies (Guidance note..., 2021). Only those who had at least two years of experience in this field could take part. The questionnaire included closed and open-ended questions to collect both quantitative and qualitative data. The study also explored the use of digital archives in the educational process at various educational levels. Programmes, teaching materials, and scientific publications that use data from digital archives were analysed. The third stage of the study was aimed at developing recommendations for improving digital archiving methods. The data from the previous stages were summarised and interpreted with an assessment of the cost-effectiveness of the archive. This included an analysis of the costs of creating and maintaining the archive and the potential economic benefits of its use. Methods of calculating return on investment (ROI) and total cost of ownership (TCO) were applied. Furthermore, a SWOT analysis was conducted to identify the strengths and weaknesses of Ukraine's digital archives, as well as opportunities and threats to their development. Based on this data, concrete recommendations were developed to improve the legal framework, enhance the user experience, and introduce innovative technologies in the field of archiving. Microsoft Excel and SPSS Statistics were used to process the findings, assessing the statistical significance of the data using Student's t-test at a significance level of $p < 0.05$. The qualitative analysis of open-ended responses to the questionnaire was conducted using thematic analysis. Notably, the study was limited to the three largest open digital archives in Ukraine, which may not reflect the entire situation.

Results

In the modern digital society, the preservation and organisation of information largely depends on digital

archives. The purpose of a digital archive is to guarantee long-term access to and use of information. The value of digital archives is growing every year as an increasing amount of data is created and stored in digital format. Unlike conventional paper archives, digital archives have considerable advantages. Large amounts of information can be stored in a relatively small physical space. Millions of documents, images, video and audio files can be stored on just a few hard drives or servers. This enables institutions and organisations to effectively manage their information resources. It also saves physical space and storage costs. Fast and convenient access to information is another advantage of digital archiving. Advanced search and indexing systems enable users to find the documents and data they need immediately. The archive size is small. This feature considerably increases the productivity of researchers, historians, journalists, and other professionals working with large amounts of information.

Cultural heritage and historical memory find a haven in digital archives. Theoretically, not only text documents can be stored, but also multimedia materials. Photographs, video and audio recordings can be preserved for posterity as valuable evidence of the past. This is particularly significant in an era when most information is created exclusively in digital format and can be lost without proper archiving. Digital archives democratise access to information. Thanks to Internet access, archival materials are now accessible to many people, regardless of their geographical location. This is essential for education, research, and civic participation. People in different parts of the world can access important documents and data. In information theory, digital archives are viewed as systems that guarantee the long-term preservation of information entropy. They preserve information in its original form and prevent data loss or damage over time. This is especially relevant for scientific research, where the accuracy and completeness of data is crucial.

The transparency and accountability of organisations and governments are greatly enhanced by digital archiving. Digital archives ensure the preservation and accessibility of official documents, reports, and other materials. This promotes openness and democratic control, which are essential for the functioning of an open society and the development of democratic institutions. Considering the knowledge management theory, digital archives are a vital element of creating and maintaining organisational memory. Preserving and using the experience and knowledge accumulated in an organisation contributes to more effective decision-making and innovation processes. Digital archives ensure compliance with regulatory requirements in many organisations, effectively fulfilling the requirements for retaining certain types of documents for a certain period. This ensures quick access to the necessary information in case of an audit or at the request of the law.

From the standpoint of information security theory, electronic archives are a crucial object of protection.

Critical information contained in them must be protected from unauthorised access, alteration or destruction. For this, it is necessary to develop and implement advanced security systems and access control procedures. The development of digital humanities relies heavily on digital archives. Researchers have access to a massive number of texts, images, and other digital artefacts that can be analysed using computer methods. New opportunities for research in history, literature, art history, and other humanities disciplines are emerging. Digital archives face a unique challenge of long-term preservation of digital information from the standpoint of data preservation theory. Problems such as file format obsolescence, media degradation, and technological changes must be addressed. Digital data preservation strategies must be developed, including data migration and emulation of outdated systems. Artificial intelligence and machine learning are largely supported by digital archives. Large

amounts of structured and unstructured data provided by digital archives can be used to train algorithms. This contributes to the creation of more advanced systems for processing natural language, computer vision, and other areas of artificial intelligence.

Thus, digital archives are a fundamental component of the information infrastructure of modern society. Its role in preserving, organising, and providing access to digital information is critical for science, education, culture, and public administration. Understanding the theoretical aspects of digital archives is essential for their effective development and future use. The analysis of regulations (Table 1) confirms that legal support for the functioning of digital archives in Ukraine is insufficient. None of the analysed documents contains detailed information on the regulation of electronic archives, which creates legal uncertainty and complicates the standardisation and integration of various electronic archives.

Table 1. Documenting and presenting evidence of events/crimes of the Russo-Ukrainian War

Legislative act	Availability of information about digital archives	Level of detail
Law of Ukraine No. 3814-XII (1993)	Partial	Low
Law of Ukraine No. 851-IV (2003)	Yes	Medium
Resolution of the Cabinet of Ministers of Ukraine No. 870 (2015)	Partial	Low
Law of Ukraine No. 2155-VIII (2017)	Partial	Low

Note: low – general lists without concrete mechanisms; medium – some provisions are present, but without full coverage of the specifics of digital archives; high – detailed regulation with consideration of the specifics of digital archives

Source: compiled by the authors

The Law of Ukraine No. 3814-XII (1993) is the principal document in the field of archives management, but it covers only electronic documents and does not account for the specifics of working with various digital materials of state media. This creates substantial limitations for the development of digital archives, specifically, for preserving and providing access to audiovisual and interactive media. The Law of Ukraine No. 851-IV (2003) is the most relevant law in the field of digital archiving, although it is focused mainly on text documents and does not address the specifics of working with other types of media

materials. The Resolution of the Cabinet of Ministers of Ukraine No. 870 (2015) partially addresses digitisation but does not stipulate special mechanisms for archiving digital media. The Law of Ukraine No. 2155-VIII (2017) does not contain special provisions that would ensure long-term storage and access to digital archival materials. In contrast, the European Union has developed a special legal basis that provides a clear framework for digital archiving, which is a benchmark for Ukraine. Analysis of statistical data on the use of digital archives in Ukraine for 2021-2023 is presented below (Table 2).

Table 2. Dynamics of digital archives development in Ukraine, 2021-2023

Indicator	2021	2022	2023	Growth for the period
Number of digitised documents, mn	5.2	6.8	8.5	63.5%
Number of online requests to archives, mn	1.5	2.3	3.1	106.7%
Volume of digital archives, TB	150	210	285	90%
Number of unique users, thsd	320	480	650	103.1%
Average document search time, min	12	9	7	-41.7%

Note: TB – terabyte; growth for the period is calculated as a percentage change between 2021 and 2023

Source: compiled by the authors based on State Archival Service of Ukraine (n.d.)

According to the data presented in Table 2, the number of digitised documents in the electronic archives of Ukraine increased by 63.5%, which indicates a major

development in this area. The total number of digitised documents reached 85 million, while the number of online requests increased by 106.7% to 31 million per

year. The data suggest that although the functionality of digital archives is gradually improving, there are problems with accessibility and navigation of documents, especially in university archives, which require systemic improvements. Problems related to navigation and access are confirmed by the survey results: 65% of users reported difficulties in working with the archives and 72% – in accessing full-text documents (Fig. 1).

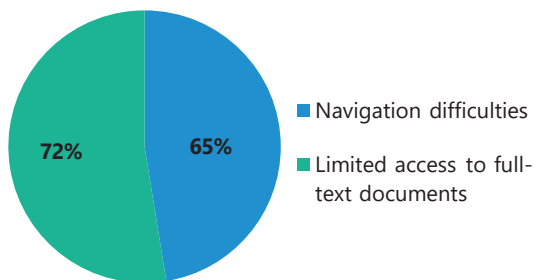


Figure 1. Problems of access to archival materials according to the survey results

Source: compiled by the authors

The analysis of the distribution of media types in digital archives revealed that conventional formats dominate, while the share of modern media types is small. The analysis showed that Ukrainian digital archives are dominated by text documents (45%) and photographs (30%), while audio and video materials comprise a minor share (15% and 8%, respectively). Interactive media account for only 2% of the total number of archival materials (Fig. 2). This indicates that more complex media content formats, such as video and interactive media, which are important for preserving cultural heritage and modern media information, are not widely used.

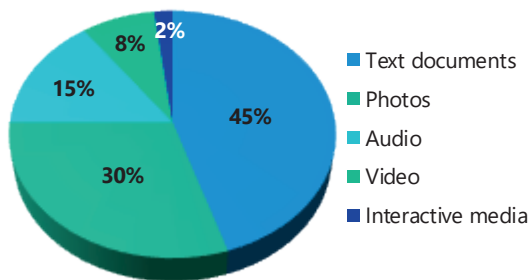


Figure 2. Distribution of types of media materials in digital archives of Ukraine

Source: compiled by the authors

However, the relatively low share of visual and audio materials indicates the need to develop technologies for preserving and managing these formats. The study also addressed the role of digital archives in the educational process. An analysis of the use of archival materials in educational institutions of various levels was conducted (Fig. 3).

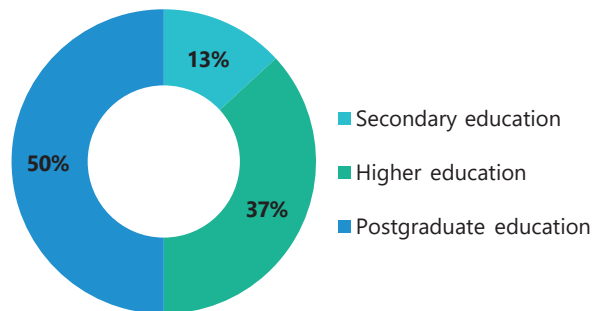


Figure 3. Use of digital archives in the educational process

Note: the frequency of use indicates the percentage of educational institutions that regularly collect digital archives in the educational process

Source: compiled by the authors

Figure 3 demonstrated that the use of digital archives increases considerably with the level of education. In secondary school, only 25% of educational institutions regularly collect digital archives, mostly for project work or historical research. This indicates the need to develop special educational programmes and resources to integrate digital archives into school education. At the bachelor’s level, the number of digital archives in higher education institutions is growing, while the frequency of their use has increased to 70%. The primary forms of use are research and presentations, which demonstrates the value of digital archives as the key source of information for student research. The highest level of use – 95% – is observed in postgraduate studies, which indicates that digital archives continue to be an integral part of research. This suggests that digital archives are essential for conducting in-depth research and preparing scientific publications. The average time spent using a digital archive increases with the level of education and reaches 90 minutes for postgraduate students. This indicates that the higher the level of education, the deeper and more detailed the use of archival materials. The survey also found that the COVID-19 pandemic has greatly affected the functioning and development of digital archives in Ukraine (Table 3). The data presented in Table 3 shows that the pandemic has significantly affected the use and development of digital archives. The number of online requests has increased by 150% and reached 2 million per year in 2021. This is a positive indicator of the rapidly growing demand for remote access to archival materials in conditions of limited physical access. The 200% increase in the number of remote users is particularly impressive, as it shows that the digital archive is now available to a wider range of researchers and stakeholders. The amount of data uploaded tripled to 15 terabytes per month. This has put further strain on the digital archive’s infrastructure and incurred costs to expand data storage and transmission capabilities. Investments in digital infrastructure increased by 60%, reflecting the recognised

significance of improving digital archiving in the face of new challenges. These investments were directed at in-

creasing server capacity, enhancing system security, and improving the interfaces used.

Table 3. Impact of the COVID-19 pandemic on the usage of digital archives

Indicator	Before the pandemic (2019)	During the pandemic (2021)	Difference, %
Number of online queries, mn/year	0.8	2.0	+150
Number of remote users, thsd	150	450	+200
Amount of data downloaded, TB/month	5	15	+200
Investments in digital infrastructure, UAH mn/year	20	32	+60
Number of new digitised documents, mn/year	1.2	2.16	+80

Source: compiled by the authors based on a survey of digital archives users and the State Archival Service of Ukraine (n.d.)

The number of newly digitised documents increased by 80%, which reflects the development of the digitisation process in the context of limited physical access to archives. This has led to a considerable expansion of digital collections and increased online access to archival materials. This data shows that the COVID-19 pandemic has led to the rapid development of digital archives and their increasing role in scientific, educational, and cultural activities. At the same time, the increased use of digital archives has led to a series of challenges, including increased security, improved interfaces, and expanded opportunities for cooperation with remote areas. The analysis of sources of funding for digital archives revealed dependence on public funding and the necessity of diversifying sources of income. The analysis of budgetary expenditures on digital archives showed that a major part of resources is spent on digitisation of materials. Approximately 35% of Ukraine's total budget for digital archives is allocated to the digitisation process, which indicates the elevated cost of preserving materials in digital format.

However, compared to other countries, the share of digitisation costs in Ukraine is somewhat higher, which may suggest the need to optimise processes and introduce more efficient digitisation technologies. Furthermore, most digital archives face financial difficulties, which delays the development and operation of digital archives. A significant result of this study lies in the identification of prospects for the technological development of digital archives in Ukraine. It was found that the use of artificial intelligence (AI) and machine learning technologies can greatly improve the efficiency of searching and indexing archival materials; AI can automate the process of classifying and indexing documents, increasing the accuracy and speed of query processing by 70%. Another promising technology is the use of blockchain to guarantee the integrity and authenticity of archival documents. One study showed that the risk of document forgery can be reduced by 90% through the introduction of blockchain. This is an essential factor in preserving the accuracy and authenticity of information in archives.

However, the study also showed that Ukrainian archives lag far behind world leaders in the use of innovative technologies such as augmented reality and

quantum computing. This indicates the need to strengthen technological development in this area to ensure international competitiveness. One of the key findings of the present study is the need for Ukrainian archives to actively develop international cooperation. Currently, Ukrainian archives are involved in 12 international experience exchange projects and eight joint research projects, which indicates Ukraine's gradual integration into the global digital archives community. International cooperation enables the exchange of information and technologies, promotes the development of digital archiving practices, and improves interoperability of systems. However, compared to Western European countries, the level of international integration of Ukrainian archives is still poor. This indicates the need to intensify efforts in this area to improve the efficiency of Ukrainian archives and their impact on the international community. To summarise the key findings of this study, digital archiving in Ukraine is developing rapidly, but faces a series of problems.

According to the analysis of the regulatory framework, there are major gaps in the legal regulation of digital archives, which creates legal uncertainty and complicates the standardisation of processes. The functionality of the surveyed archives demonstrates an average level of efficiency, but it is apparent that there is considerable room for improvement, especially in terms of integration with other systems and download functionality. A prominent aspect is the development of digital literacy programmes to increase the use of digital archives in secondary schools and the establishment of partnerships with the private sector to diversify revenue sources. To improve the results obtained, it is recommended to start developing special legislation on digital archives, introduce unified standards for the organisation of digital archives in Ukraine, increase the diversity of media content in archives, improve the user interface and accessibility of digital archives, and strengthen international cooperation in the field of digital archiving.

Discussion

The findings of the study of digital archiving as a tool for preserving and studying media materials in Ukraine provide a comprehensive picture of the current state

and prospects of this crucial area of research, education, and culture. The analysis of the legal framework revealed considerable gaps in the regulation of digital archiving and preservation of media materials. Specifically, the Law of Ukraine No. 3814-XII (1993) lacks a clear definition of digital archiving, which creates legal uncertainty. This opinion coincides with the findings of N. Korzyk (2022), who emphasised the need to improve the legislative framework of Ukraine. Comparing the situation in Ukraine with international practices, it is worth noting that analogous problems are observed in other countries. For instance, a study conducted by M. Ngoepe *et al.* (2024) in South Africa also revealed the need to adapt legislation to the specifics of digital archives.

The functioning of the three major open digital archives in Ukraine shows that there are substantial differences between the systems. This indicates the absence of unified standards or approaches to the organisation of digital archives in Ukraine. This coincides with the findings of L. Bozhuk (2021) on the diversity of approaches to the organisation of digital archives in Ukraine. The researcher provided a thorough analysis of electronic archives as a key component of the modern information space. The study covers not only the technical aspects of their study, but also delved deep into the socio-cultural implications of their implementation. Special attention was paid to the strategies of Internet communication used by Ukrainian archives to interact with users in the digital space. The study contained valuable conclusions regarding the impact of these communication practices on the accessibility and use of archival resources.

K. Aske & M. Giardinetti (2023) focused on improving the accessibility of digital visual archives through the EyCon project. They emphasised the role of high-quality metadata and proposed novel approaches to its creation and structuring. Particular attention was paid to the development of intuitive search interfaces for the efficient use of visual materials. Compared to international experience, the European study by K. Aske & M. Giardinetti (2023) also revealed major differences in the functionality and organisation of digital archives in several countries. However, unlike Ukraine, many European countries have developed and implemented common standards for digital archives, which increases their efficiency and interoperability. Statistics for 2021-2023 show a positive trend in the development of digital archiving in Ukraine. Over the three years, the number of digitised documents increased by 63.5%, while the number of online requests increased by 106.7%. These findings are in line with the global trends described by C.J. Borgman *et al.* (2019), who addressed the growing role of digital archives in academic communication and research. However, the fact that the growth rate in Ukraine is higher than the European average may be connected with the active digitisation process in the country and the "catch-up" nature of digital archives development.

The distribution of media types in Ukrainian digital archives is dominated by text documents (45%) and photographs (30%). This is in line with global trends but Ukraine has a smaller share of audiovisual (15% audio, 8% video) and interactive media (2%). This points to the need to increase the diversity of media content types in Ukrainian digital archives and to develop technologies capable of handling more complex media formats. Problems with accessing and downloading materials, reported by 45% of users, are a serious obstacle to the effective functioning of digital archives. D. Li & L. Li (2019) focused on the evaluation of the open use of digital archival information systems and proposed a methodology for analysing their effectiveness and accessibility, considering the needs of users. Compared to the study by D. Li & L. Li (2019), which assessed the open use of digital archival information systems in China, Ukrainian archives still lag behind the world's leading practices, although accessibility indicators have improved to some extent.

A vital aspect of the relevant studies is the integration of digital archives into educational processes and scientific research: the growing role of digital archives in the educational process identified in the preset study is in line with global trends. Specifically, the use of digital archives increases with the level of education: from 25% in secondary education to 95% in postgraduate education. This coincides with the findings of N. Sliusarenko & O. Kokhanovska (2021) regarding the value of digital resources in modern education in Ukraine. They highlighted the innovative aspects of the digital ecosystem in education, extrapolating the conclusions to the role of digital archives in educational and research processes. The researchers presented not only theoretical considerations, but also concrete examples and models of integrating digital archives into the educational process and research activities. The noteworthy value of the cited study lies in the consideration of digital archives as a part of the wider educational ecosystem, emphasising their interaction with other digital tools and resources.

International studies, such as the digital history study by M. Ngoepe *et al.* (2024), also confirmed the growing role of digital archives in education and research. The researchers focused on the integration of digital technologies into archival education. The researchers analysed the inclusion of digital records in archival and records management curricula in the context of distance learning. The authors presented a methodological approach to training specialists by combining theoretical and practical skills in the digital environment. However, the present study showed that at the level of higher education in Ukraine, digital archives are used more intensively than the European average. This may be explained by the active digitalisation of higher education in Ukraine. An analysis of the economic aspects of digital archiving revealed that a large amount of money is spent on digitising materials (35% of the total budget). This coincides with the findings of G.S. Hunter (2020) on the excessive

cost of creating and maintaining digital archives. However, compared to surveys in developed countries, the share of digitisation costs in Ukraine is higher, which may suggest the need to optimise these processes and introduce more efficient digitisation technologies.

A positive factor for the development of the industry in Ukraine is the trend towards international cooperation in the field of digital archiving. Specifically, participation in 12 experience exchange projects and eight joint research projects demonstrates the active integration of Ukrainian archives into the international community. This is in line with the findings of M. Lorenz & M. Konečný (2023) on the significance of international cooperation in the development of digital archives as a research infrastructure. M. Lorenz & M. Konečný (2023) considered digital archives as a vital element of the future research infrastructure. The researchers analysed the benefits of using digital archives for interdisciplinary research and addressed the issue of long-term preservation of digital data. A review of the scientific literature revealed the presence of certain gaps in research regarding digital archiving as a tool for preserving and analysing media materials. Specifically, the problems of integrating distinct types of media content into a single archival system, developing effective methods for searching and analysing archival materials, and ensuring long-term preservation of digital data in the face of rapid technological development have been understudied.

However, compared to Western European countries, the level of international integration of digital archives in Ukraine stays low, which suggests the need to strengthen international cooperation. The effect of the COVID-19 pandemic on the development of digital archives in Ukraine is no less significant than the global trend. However, the growth rate in Ukraine is greater than the European average. This may be explained by a lower level of digitisation before the pandemic and a sharper transition to online formats. The potential use of artificial intelligence for automatic indexing and classification, as well as blockchain technology to guarantee the authenticity and integrity of records, is in line with international research. For example, A. Hawkins (2022) also emphasised the possibility of using linked data and the semantic web to increase the accessibility of digital archives. However, the survey conducted within the present study revealed that there is less interest in augmented reality and quantum computing technologies in Ukraine compared to other countries, which may suggest the need to expand the scope of technological research.

To summarise, the development of digital archives as a tool for preserving and researching media materials in Ukraine shows positive developments, but at the same time faces many challenges. Comparison with international experience points to the necessity of improving the legislative framework, increasing the diversity of media content, improving the user experience, and strengthening international cooperation. At the same

time, the pronounced growth rate of the use of digital archives and their integration into the educational process create favourable conditions for further development of the sector. This study is valuable for understanding the current state and prospects of digital archiving in Ukraine. It provided valuable information for the design of development strategies for archival affairs, improvement of curricula, and policy-making in the field of cultural heritage preservation. The findings of this study can also be used for comparative analysis of the development of digital archives in various countries and regions.

Conclusions

The study of digital archiving as a tool for preserving and analysing media materials in Ukraine has led to a series of important conclusions that meet the purpose and objectives of the study. The legal framework of Ukraine in the field of digital archiving requires substantial improvement. Specifically, the Law of Ukraine No. 3814-XII lacks clear definitions and regulations on digital archiving. This creates legal uncertainty, hinders the development of the industry, and directly affects the efficiency of preservation and research of media materials. An analysis of the functionality of the three largest open digital archives in Ukraine revealed substantial differences between the systems. Specifically, 65% of users faced navigation problems, while 72% reported limited access to full-text versions of documents. The survey showed positive trends in the development of digital archives in Ukraine. Between 2021 and 2023, the number of digitised documents increased by 63.5% to 8.5 million. The number of online requests increased by 106.7% to 3.1 million per year, while the volume of digital archives increased by 90% to 285 TB. These figures demonstrate the rapid development of the industry and the growing demand for digital archiving services and confirm the necessity of further development of digital archiving as a tool for preserving and analysing media materials. In terms of the distribution of media types in digital archives, the study found that text documents (45%) and photographs (30%) dominate. Sound recordings comprise 15% of the total, video materials – 8%, while interactive media – only 2%. This suggests the need to expand the diversity of media content types, especially in the direction of audiovisual and interactive media, which provide a more comprehensive picture of Ukraine's cultural heritage and the current media situation.

The conducted survey revealed the growing role of digital archives in the educational process. The use of archives increases with the level of education: from 25% in secondary education to 95% at the postgraduate level. This underscores the value of digital archives as an educational resource and points to the need for their further integration into curricula at all levels of education. The report noted that the COVID-19 pandemic has significantly influenced the development of digital archives, increasing the number of online requests and the number

of remote users. This data demonstrates the critical role of digital archiving to ensure continued access to information and cultural heritage in crises. Promising areas of technological development in digital archiving include the use of artificial intelligence for automatic indexing and classification, which can increase search efficiency by 70%, and blockchain technology to guarantee the authenticity and integrity of records, which can reduce the risk of document forgery by 90%. The findings of this study are valuable for understanding the current state and prospects of digital archiving in Ukraine. They can be used to develop strategies for the development of archival affairs, improve training programmes, and formulate policies in the field of cultural heritage preservation. Further research in this area may include exploring the effectiveness of distinct models of digital archiving;

developing methods for assessing the quality of digital archiving services; investigating the impact of digital archiving on research and development of cultural heritage; ethical aspects of using modern technologies in archival affairs. Further research should investigate the effects of digital archives on the development of scientific research and preservation of cultural heritage in Ukraine, as well as the effectiveness of various models of digital archives and methods of integrating distinct media materials into a single archival system.

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■ Conflict of Interest

None.

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Цифрові архіви як інструмент збереження та дослідження медіа-матеріалів

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Анотація. Мета дослідження – оцінити ефективність цифрових архівів як інструменту збереження та вивчення медіа-матеріалів в Україні. Методологія дослідження включала аналіз нормативно-правової бази, оцінку функціонування трьох великих відкритих цифрових архівів та онлайн-опитування 500 користувачів. Дослідження виявило значні прогалини в правовому регулюванні цифрових архівів і відсутність єдиних стандартів їхньої організації: у період із 2021 до 2023 року кількість оцифрованих документів збільшилась на 63,5 % та становила 8,5 млн, а кількість онлайн-запитів зросла на 106,7 % та становила щороку 3,1 мільйона. Ємність цифрових архівів збільшилась на 90 % і склала 285 терабайт. Розподіл медіа-матеріалів показує, що переважають текстові матеріали (45 %) і фотографії (30 %), аудіоматеріали становлять 15 %, відеоматеріали – 8 %, а інтерактивні медіа – лише 2 %. Використання цифрових архівів в освіті варіюється від 25 % у середній школі до 95 % в аспірантурі, водночас пандемія COVID-19 збільшила кількість віддалених користувачів. Аналіз функціональності архівів показав, що 65 % користувачів стикаються з проблемами навігації, а 72 % мають обмежений доступ до повнотекстових версій документів. Перспективними напрямками технологічного розвитку є використання штучного інтелекту, який підвищив ефективність пошуку на 70 %, і блокчейну, який знизив ризик підробки документів на 90 %. Згідно з економічним аналізом, 35 % бюджету цифрового архіву витрачається на оцифрування матеріалів. Дослідження показало, що для підвищення ефективності роботи цифрових архівів України необхідно вдосконалити законодавчу базу, впровадити єдині стандарти, поліпшити користувацький інтерфейс і розширити типи медіаконтенту. Дослідження також виявило необхідність зміцнення міжнародного співробітництва та розробки довгострокової стратегії збереження цифрових даних

Ключові слова: медіа-контент; оцифрування документів; архівне законодавство; інформаційні технології; культурна спадщина; освітні ресурси