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THE DIGITAL LIBRARY AS A PLATFORM FOR RESEARCH-BASED LEARNING FOR FUTURE SPECIALISTS IN LIBRARY, INFORMATION, AND ARCHIVAL SCIENCE IN TECHNICAL HIGHER EDUCATION INSTITUTIONS

The article substantiates the transformative role of digital libraries, which are evolving from passive repositories to dynamic platforms for research-based learning. It analyzes the specifics of integrating digital libraries into the professional training of specialists in library, information, and archival science at technical higher education institutions. The methodology combines a competency-based approach with digital humanities, viewing digital libraries not only as a resource but simultaneously as a source, environment, tool, and object of analysis and professional modeling. Given the focus on practical application in technical higher education institutions, digital libraries become a "bridge" between foundational theory and applied engineering approaches. The study demonstrates that integration goes beyond simple access, requiring the active involvement of students in research-based learning. Digital libraries serve as a platform where students acquire operational skills: working with metadata systems (Dublin Core, MARC), modeling archival search situations, verifying digital traces, and mastering digital restoration and conservation. A key element of research-based learning is the transformation of students into active knowledge builders. The experience of the Kharkiv Aviation Institute illustrates how students are involved in project work: creating digital collections, developing interfaces, testing library services, and implementing their own creative initiatives (such as chatbots and mobile applications). Digital libraries function as laboratories for developing analytical thinking, where students study user behavior and conduct bibliometric and altmetric analysis. The article explores the role of digital libraries in shaping digital ethics, academic integrity, and critical analysis skills. Particular attention is paid to the importance of digital libraries as a stabilizing resource for ensuring academic continuity and supporting students under martial law. The study concludes that digital libraries in technical higher education institutions are not merely an auxiliary service, but the core of the educational space, and that their integration is an objective necessity and a new educational paradigm.

Keywords: *digital library, research-based learning, library, information and archival science, technical higher education institutions, professional training, competency-based approach, future specialists.*

Шленьова М. Г. Цифрова бібліотека як платформа для дослідницько-орієнтованого навчання майбутніх фахівців із бібліотечної, інформаційної та архівної справи у закладах вищої технічної освіти. *Стаття обґрунтовує трансформаційну роль цифрових бібліотек, що еволюціонують від пасивних сховищ до динамічних платформ для реалізації дослідницько-орієнтованого навчання. Проаналізовано специфіку інтеграції цифрових бібліотек у професійну підготовку фахівців з бібліотечної, інформаційної та архівної справи у технічних ЗВО. Методологія поєднує компетентнісний підхід та цифрову гуманітаристику, розглядаючи цифрові бібліотеки не лише як ресурс, але водночас як джерело, середовище, інструмент та об'єкт аналізу й професійного моделювання.*

В умовах технічних ЗВО, з їх орієнтацією на практичну доцільність, цифрові бібліотеки стають «містком» між теоретичною основою та прикладними інженерними підходами. Доведено, що інтеграція виходить за межі простого доступу, вимагаючи активного залучення студентів до дослідницько-орієнтованого навчання. Цифрові бібліотеки виступають як платформа, де студенти набувають операційних навичок: практична робота з системами метаданих (Dublin Core, MARC), моделювання ситуацій архівного пошуку, верифікація цифрових слідів, опанування цифрової реставрації та консервації. Ключовим елементом дослідницько-орієнтованого навчання є перетворення студента на активного конструктора знання. На досвіді ХАІ показано, як студенти залучаються до проєктної роботи: створення цифрових колекцій, розробка інтерфейсів, тестування бібліотечних сервісів та реалізація власних креативних ініціатив (чат-ботів, мобільних застосунків).

Цифрові бібліотеки стають лабораторією для розвитку аналітичного мислення, де студенти вивчають поведінку користувачів, проводять бібліометричний та альтметричний аналіз. Розкрито роль цифрових бібліотек у формуванні цифрової етики, академічної доброчесності та навичок критичного аналізу джерел. Окрему увагу приділено значенню цифрових бібліотек як стабілізаційного ресурсу для забезпечення академічної тяглості та підтримки студентів в умовах воєнного стану. Зроблено висновок, що цифрові бібліотеки у технічному ЗВО є не допоміжним сервісом, а ядром освітнього простору, а їх інтеграція є об'єктивною необхідністю та новою освітньою парадигмою.

Ключові слова: цифрова бібліотека, *дослідницько-орієнтоване навчання, бібліотечна, інформаційна, та архівна справа, технічні заклади вищої освіти, професійна підготовка, компетентнісний підхід, майбутні фахівці.*

Introduction. The digital transformation of the educational space has become a defining vector for the development of higher education, especially in the context of professional training in areas directly related to information technology, knowledge management, preservation of documentary heritage, and institutionalization of access to sources. The training of future specialists in library, information, and archival science in technical higher education institutions is increasingly being implemented

within the context of the integration of digital tools. In this paradigm, digital libraries function not just as key centers for the storage, processing, management, and representation of knowledge, but fundamentally as core instruments for research-based education.

Thus, within technical universities, digital libraries emerge as active platforms and laboratories that enable students to go beyond mere consumption of information to model research activities, design individualized learning trajectories, and acquire the essential competencies for searching, critically analyzing, and interpreting information in the digital environment. The integration of digital libraries into the curriculum reflects an educational philosophy that views knowledge as a dynamic and technologically mediated construct, making them indispensable for fostering independent research skills and critical thinking.

The purpose of this article is to theoretically substantiate the role of digital libraries in transforming the educational environment of technical higher education institutions, and to analyze their integration into the professional training of future specialists in library, information, and archival science. Special emphasis is placed on the use of digital libraries to support research-based learning, reconceptualizing library infrastructure as an active factor in developing digital competencies, information culture, academic mobility, and independent research skills.

Aim and tasks. The study aims to theoretically substantiate the role of digital libraries in transforming the educational environment of technical higher education institutions, and to analyze their integration into the professional training of future specialists in library, information, and archival science. Special emphasis is placed on the use of digital libraries to support research-based learning, reconceptualizing library infrastructure as an active factor in developing digital competencies, information culture, academic mobility, and independent research skills.

Research methods. The study theoretically substantiate the role of digital libraries. It uses literature review and analytical models to examine how digital libraries integrate and function. The research involves a conceptual rethinking of library infrastructure. By focusing on research-based education, the study analytically determines how digital libraries serve as active platforms for modeling research activities, critical evaluation, and performing bibliometric and altmetric analyses.

Review of the recent studies and publications. Digital libraries are “electronic institutions” that provide access to collections that are organized, managed, and presented in an electronic environment. Their functioning is based on a set of information interaction models, among which repository, institutional, and hybrid access formats are the most important. In the context of training specialists in the information sphere, it is digital libraries that play the role of moderators between students, teachers, and knowledge.

It should be emphasized that, unlike traditional libraries, digital resources not only provide content but also contribute to the formation of a new paradigm of interaction with knowledge (interactive, personalized, and analytical). Analysis of research. According to research by M. Maliuga (2019), digital libraries are platforms that allow students not only to find the materials they need, but also to construct their own learning trajectories based on a competency-based approach. This is extremely important for future information specialists, who must possess the skills to search for, process, analyze, and interpret information in a digital environment.

A digital library is not just an electronic form of a traditional library, but a multi-level knowledge management system that includes the functions of an information aggregator, a learning environment, a means of academic communication, and even a mechanism for inter-institutional interaction. As C. M. Owusu-Ansah et al. (2018) points out, digital libraries should be seen as a critical component of distance learning, providing contextualized access to knowledge, personalizing the educational experience, and supporting educational continuity even in challenging conditions of mobility or crisis.

In the professional training of library specialists, it is important to take into account the functional polyvalence of digital libraries. They can serve as educational spaces, laboratories, archives, knowledge management systems, and tools for academic mobility. Van der Walt et al. (2019), considering integration models, distinguishes between “functionally linear” and “environmentally integrated” approaches, where the former is dominated by the provision of electronic access to resources, and the latter by the creation of shared educational and information environments involving digital libraries.

Professional training in technical higher education institutions requires consideration of multi-vector interaction: technical tools, methodological models, and content guidelines. Digital libraries can act as an integrating link within this interaction. They not only provide access to high-quality sources, but also contribute to the formation of digital culture, academic integrity, and critical thinking, which are key characteristics of a modern specialist.

In the study by M. Shlenova (2024), soft skills such as critical thinking and adaptability are identified as crucial for navigating uncertainty in the information sector. This validates our concept of digital libraries as Research-Based Learning platforms, confirming that technical knowledge must be integrated with non-technical competencies. Thus, the digital library acts as the practical environment where these essential analytical and communicative skills are actively developed.

The strategic dimension of the use of digital libraries is also essential. According to Y. Horban & N. Gaisynuik (2023), it is necessary to implement institutional strategies for integrating digital libraries into courses, develop e-learning modules

with an emphasis on library digital services, and train teachers in the use of digital resources in blended teaching formats. This is entirely consistent with the needs of technical education, where STEM disciplines dominate and the need for information support from libraries is extremely high.

In a technical university, students majoring in B13 must not only master the basic skills of cataloguing, classification and archiving, but also understand the digital infrastructure in which modern information circulates. Digital libraries play the role not only of a source of information, but also of an environment for the formation of information culture. According to research by S. Chukanova & M. Golubev (2012) for modern students, flexible access to high-quality electronic resources in a digital library environment is a prerequisite for in-depth learning, independent work, and scientific research.

Information literacy requires critical analysis, not just technical skills, making the digital library both a resource and an object of study. In technical universities, libraries must function as foundational educational platforms rather than mere support services. Effective integration requires strategic implementation beyond simple access. This should follow van der Walt's four models: institutional **100 %** (centralized structural integration), programmatic (embedding resources into disciplines), pedagogical (transforming teaching methods), and technological (ensuring service compatibility).

The importance of digital libraries as environments for digital identity is particularly relevant in the context of Ukrainian technical higher education institutions, which, in conditions of war, unstable access to resources, temporary migration of students abroad, etc., must ensure sustainable access to knowledge. In this context, digital libraries become a kind of stabilizing resource that allows maintaining academic continuity, supporting students in asynchronous learning mode, and using mobile technologies to engage them in the educational process. As T. Kostyrko (2022) rightly points out, digital libraries in a centralized education system are a flexible stabilizer of academic interaction that prevents the fragmentation of educational experience.

One of the key components of a digital library is its interoperability—the ability to interact with other systems, open archives, educational platforms, and databases. In a study by O. V. Ivashkevych (2021) it was determined that a successful digital library is one that provides not only access but also dynamic interaction between users, sources, and content, supports navigation, registration, personalization of experience, and usage analytics. For students of information specialties, this is an important component of professional socialization, since it is through digital libraries that they learn to work in an environment of real information flow.

It is worth noting that a digital library not only represents academic knowledge, but is also a field for the development of creative thinking and new forms of scientific communication, in particular through the possibility of creating digital exhibitions, annotated collections, and digital storytelling, which are increasingly used in information practice. Teachers at technical higher education institutions that train specialists in archival science can use digital libraries to model real-life situations of archival search, electronic document preservation, dynamic metadata processing, digital trace verification, etc.

Results. The integration of digital libraries into the training of future specialists involves not only the use of ready-made platforms, but also the participation of students in the development of information policies, access standards, and open access policies, which are part of the global trend of democratization of knowledge. Digital libraries should not remain passive tools, they should become a platform for engaging student initiative, testing new services, integrating artificial intelligence, and automating text analysis processes.

Training information specialists requires shifting from mere usage to the active creation of digital collections. In technical universities, students should engage in digitization, interface development, and metadata systematization, effectively merging theoretical study with practical engineering tasks. Effective integration relies on teachers mastering digital pedagogy, bibliometric systems, and international interfaces. To ensure sustainability, institutions must support continuous professional development and foster interdepartmental collaboration for content creation.In the research dimension, digital libraries provide access to diverse scientific and legal materials. This fosters academic integrity, citation skills, and scientific culture. Thus, the library functions as an arena for academic personal development rather than a simple access tool.

Improving the quality of professional training is only possible if digital libraries are included in curricula as a full-fledged educational tool, rather than a secondary source. This involves the creation of new disciplines such as “Digital Libraries in the Information Environment,” “Metadata and Digital Preservation,” “Digital Collection Management,” and “Open Access Repositories,” which will allow for the combination of fundamental library education with technological innovations characteristic of technical higher education institutions.

Integrating digital libraries into technical universities requires aligning with their specific culture, which prioritizes practical expediency and technological efficiency over the humanities. Consequently, implementation must focus on functionality: optimizing training and delivering practice-oriented results that address industry challenges. Developing user autonomy, defined as independent navigation and source management, requires integrating digital libraries across the entire curriculum, from introductory courses to

final theses. Comprehensive implementation, such as creating individual information portfolios, fosters academic responsibility and helps students construct their professional profile.

Strategic approaches to the integration of digital libraries deserve separate consideration, in particular those related to blended learning, micro-educational modules, open educational resources, and MOOC platforms. In our opinion, digital libraries in this context should not be just a supplement, but the core of the course, around which the entire logic of interaction between the student and knowledge is built. This means the need for changes in the structure of disciplines, the inclusion of tasks based on working with digital libraries, the development of case studies and situational tasks, where information search, source processing, and digital content creation play a key role.

Digital libraries serve as strategic marketing assets, showcasing the university's scientific potential and building its international brand. Engaging students in these activities fosters a sense of academic belonging, contributes to heritage preservation, and strengthens the institutional image. Integration faces barriers such as technical limitations, funding shortages, and low digital literacy. Overcoming these requires implementing digital support programs, training, software compatibility, and institutional monitoring systems. Integration demands systematic scientific reflection through empirical research on user experience and learning outcomes. Involving students in this process, via surveys and diaries, encourages their active engagement in academic dialogue.

Integrating digital libraries represents a new educational paradigm that transforms professional training. In technical universities, they serve as a vital bridge connecting theoretical knowledge with applied engineering activities. One important element is for students to study metadata systems, taxonomies, and formats for presenting digital documents, such as Dublin Core, MARC, METS, MODS, etc. Working with digital libraries in this context is not just about consuming information, but about acquiring professional skills, forming indexes, processing electronic records, and creating interfaces for accessing collections. As a result, future specialists gain knowledge that has both theoretical and operational value.

The experience of the Kharkiv Aviation Institute demonstrates the effectiveness of a model in which the digital library is not simply included in the educational process, but is an integral part of it. This is achieved through the joint development of training programs between departments and library units, the organization of hackathons, project work with digital collections, and competitions for the best infographics or scientific visualization based on library sources.

It is necessary to pay attention to the potential of digital libraries as a platform for institutional representation of academic results. Professional training of students

in the information field should include an understanding of how university electronic archives are formed, how licensing takes place, which Creative Commons licenses apply to electronic documents, and how the long-term preservation of digital information is ensured. This is part of their readiness to work in the information society.

In the context of rapid change and new challenges (in particular, the development of generative AI, changes in content management paradigms, and copyright issues in the digital age), the role of digital libraries is changing significantly. They are becoming not only a source of information, but also a platform for modeling professional activities, research, and testing new tools. The use of analytical modules in digital libraries allows students to study user behavior, conduct bibliometric and altmetric analysis, build information access chains, and predict user interests.

Digital libraries facilitate intercultural communication, which is crucial for the internationalization of higher education and academic mobility. By integrating international resources like Europeana and ArXiv, they serve as platforms for knowledge exchange, allowing students to critically compare global experiences with the Ukrainian academic environment. Digital libraries foster social inclusion by providing essential access for students with disabilities through adaptive formats. In technical universities, engaging students in the design of these inclusive interfaces transforms their technical training into a socially significant mission.

In archival science, digital libraries preserve retrospective documents, enabling students to master digital restoration and metadata description. This protection of digital memory is critical during hybrid warfare, transforming professional responsibility into a mission to safeguard documents as carriers of truth. Students must develop a reflective attitude, viewing digital access as a creative resource that highlights the librarian's role as a societal mediator. Essential digital competencies now include critical analysis, identifying fake information, and mastering bibliographic managers like Zotero and Mendeley.

Digital libraries foster academic integrity by integrating anti-plagiarism and citation tools, while serving as repositories for validating student authorship in project-based technical environments. Additionally, training involves active participation in creating digital collections, developing structures and metadata, which facilitates interdisciplinary cooperation between information science, computer science, and design faculties. Digital libraries are evolving into environments for modeling new publishing activities and forming personalized scientific ecosystems that demand both technical and humanities skills. Their adaptability enables adaptive educational paths, allowing students to curate individual source pools. Consequently,

the teacher's role transforms into that of a navigator and facilitator, which strengthens student motivation and improves learning outcomes.

In the context of distance or blended learning, digital libraries are becoming a basic tool for building course content. They provide access to electronic textbooks, multimedia resources, video lectures, interactive materials, test assignments, and automated bibliographic services. According to the models described in van der Walt's work, effective integration of a library into a distance learning environment requires its full synchronization with the learning management system (LMS), accessibility on mobile devices, integration with external APIs, and compliance with international interface standards.

Digital libraries act as instruments of social responsibility, enabling regional technical universities to preserve local history and enterprise archives. This engages students in digital humanities projects that strengthen community ties and preserve cultural memory. Additionally, they are vital for ensuring academic mobility and educational continuity, specifically under martial law in Ukraine. By facilitating universal access, libraries support international cooperation and often function as the primary communication channel for remote learning.

Another strategic aspect is the role of digital libraries in shaping digital ethics and culture. Working with open educational resources, applying copyright, citing correctly, respecting intellectual property, these are all skills that cannot be developed without practical application, which is provided through library services. Studying issues of academic ethics, the differences between open and commercial access, and the advantages and disadvantages of open science are all included in the context of professional training focused on the digital environment.

Digital libraries can also be used as a tool for developing analytical thinking. The use of visualisations of bibliometric indicators, tools for assessing the impact of scientific publications, and the compilation of scientific citation maps allows students to understand the logic of scientific communication, identify the most influential authors, and analyse scientific trends. This is especially important for training future information analysts who will be able to apply such knowledge in scientometrics, patent law, expert activities, etc.

In technical universities driven by engineering and management strategies, digital libraries have shifted from auxiliary additions to the core of the educational space. Their integration reflects a mature educational philosophy that views knowledge as a dynamic, networked product requiring new forms of moderation, analysis, and communication, rather than just technical development.

The formation of educational programmes in which digital libraries perform not only a supporting but also a structuring function allows for the creation of complex learning environments. In such environments, three main components interact: digital

resources (library), educational context (programme, discipline) and learning subjects (students, teachers, researchers). This corresponds to the concepts of constructivism and connectivism, according to which knowledge is constructed through interaction in the information space.

It is important to implement a multi-strategic approach to digital libraries, combining technological infrastructure, pedagogical support and administrative coordination. For example, creating a multimedia digital library at a university, combined with the Mentor, LMS Canvas or Google Classroom learning platform, makes it possible to automate the process of accessing sources, manage academic routes, and create your own training courses with built-in library components.

For students preparing to work in the field of archiving, digital libraries are tools for testing skills in digital restoration, digitisation, cataloguing, and building digital ontologies. They allow you to simulate work situations in an electronic archive, ensure digital identification of documents, and uphold the principles of electronic authenticity and legal significance. This is especially relevant in the field of digital archives of government agencies, judicial institutions, and enterprises, where accuracy, preservation, and authenticity are critical factors.

Digital libraries also open the way to studying global academic discourse. In an environment where knowledge is increasingly disseminated in open access mode, students must be able to work with English-language, multilingual, and localised metadata sources. This shapes a new quality of academic thinking — metacognitive, cross-cultural, adaptive. In our opinion, a digital library is an ‘arena of hybrid intelligence’ that combines the artificial intelligence of search algorithms and the critical thinking of the user.

It is equally important to consider digital libraries in the context of sustainable development. Universities that strive to meet the Sustainable Development Goals (SDGs), especially SDG 4 (quality education) and SDG 9 (innovation and infrastructure), must ensure free access to quality educational resources, including through digital libraries. Thus, libraries are not only an element of educational policy, but also a component of environmental responsibility - minimising printing, preserving paper collections, and transitioning to digital content.

The integration of digital libraries into technical higher education institutions should also contribute to the development of a digital communication culture. Libraries are increasingly becoming not only repositories, but also platforms for scientific discussion, digital storytelling, educational blogging, scientific videos, and podcasts. Students can participate in creating their own content: preparing video reviews of books, recording podcasts on digital literacy, creating educational infographics, electronic reference books, or glossaries. This allows for the training of

specialists capable of working at the intersection of librarianship, journalism, digital pedagogy, and communications.

In addition, digital libraries contribute to the development of project management skills. Their resources can serve as a basis for student start-ups, creative initiatives, and information campaigns. For example, a digital library can be used to implement interactive maps of local archives, mobile applications for searching scientific sources, chatbots with source recommendations, and virtual tours of electronic exhibitions. This allows not only to develop digital skills, but also to train competitive specialists.

Conclusions. In the field of document science and information management, digital libraries play another important role is management. Students learn to understand the principles of information policy, access rights management, the creation of usage regulations, user activity analysis, and the implementation of KPIs for evaluating resource effectiveness. Thus, a digital library is not only a technological but also an organisational phenomenon that combines technology, management, educational practice, and information law.

Therefore, it should be emphasised that the successful integration of digital libraries into the professional training of students majoring in 'Information, Library and Archival Studies' at technical higher education institutions is impossible without systematic support from the university administration, state policy and international cooperation. It requires investment, modernisation of IT infrastructure, openness to innovation, an interdisciplinary approach to education and, most importantly, a philosophical rethinking of the library as an institution of the future.

The integration of digital libraries into the professional training of library, information, and archival science specialists within technical higher education institutions constitutes an objective necessity rather than a transient trend. This multifaceted paradigm shift entails a systemic transformation of the educational environment, the advancement of digital competencies among all stakeholders, and the reconceptualization of the library as a knowledge institution. Ultimately, this process cultivates a new professional identity defined by adaptability, innovation, and technological proficiency.

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