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MARIIENKO A. O.
Scientific Library, Dragomanov Ukrainian State University (Kyiv, Ukraine),
e-mail: a.o.mariienko@udu.edu.ua, ORCID 0009-0003-7805-8675

Digital Library Ecosystem in the Cascading Chain of Educational and Scientific Interaction

Objective. The study investigates the Digital Library Ecosystem (DLE) using the case of Dragomanov Ukrainian State University Scientific Library, regarded as a central element of educational and scientific interaction. The principle "Sic parvis magna" ("greatness from small beginnings") is demonstrated through the transformation of individual academic efforts into outcomes of international significance. **Methods.** The methodology applies a systemic approach, conceptualizing the DLE as an integrated socio-technical and information-communication structure. Analytical instruments of library web resources are emphasized as key indicators of academic community needs. Empirical substantiation is provided through statistical analysis. **Results.** The findings show that the DLE ensures comprehensive accumulation of scholarly information, enabling its structuring and integration into global scientific circulation. The cascading mechanism proves effective, as individual materials (articles, dissertations, etc.) acquire amplified academic significance. **Conclusions.** By implementing the "Sic parvis magna" principle, the DLE operates as a full academic component within international science, strategically valuable for transforming a "minor" academic gesture into "major" scientific achievement.

Keywords: Digital Library Ecosystem; Google Analytics tools; cascading mechanism; academic environment; "Sic parvis magna" principle

Introduction

The history of science convincingly proves that many fundamental achievements have originated from isolated, local initiatives. A limited dataset, a modest experiment, or a single idea, when timely integrated into a broader context, can reshape intellectual landscapes. This approach is aptly captured by "Sic parvis magna" phrase – transl. from Latin "greatness from small beginnings" – that, in the digital age, acquires new dimensions of interpretation. Contemporary information technologies not only enable the preservation of research outcomes but also amplify their impact, transforming individual contributions into components of a larger body of knowledge. Despite this potential, no focused investigations have yet addressed the role of the Digital Library Ecosystem (DLE) in this process. Against this background, the present article seeks to substantiate the relevance and necessity of the DLE as a central element of the cascading chain of educational and scholarly interaction. In this capacity, the DLE – an integrated socio-technical structure that unites the library's e-resources, researcher-support services, and communication channels – is exemplified through the case of Dragomanov Ukrainian State University Scientific Library (Kulyk, 2022). The ecosystem ensures the accumulation, structuring, and dissemination of knowledge, while simultaneously strengthening the University's position within the global academic space. A pivotal role in this endeavour is played by the analytical toolkit of the library's digital web platforms, which enables the generation of relevant resource content, timely responses to the pressing needs of the research community, and the strategic development of an information policy oriented toward the future (McKenzie, Brophy, Konstanta, & Webster, 2023).

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Methods

To elucidate the key aspects of this article, there were used the sources, the analysis of which contributed to the development of specific concepts and provisions. The article methodology is based on analytical case study of the Digital Library Ecosystem (DLE) of Dragomanov Ukrainian State University Scientific Library, conceptualized as the central element of the cascading chain of educational and research interaction (C.Y. Lee & K.J. Lee, 2025). The object of the study is the DLE; the subject is processes of accumulation, structuring, transformation, and dissemination of scientific information, and their influence on the recombination and preservation of knowledge aimed at strengthening the University's academic capital. The primary sources of study are the analytical tools of Google Analytics, applied to the library's web platforms (including statistics on visits, search queries, downloads, and page views). The use of these data enables the assessment of the relevance of resources and services, the modelling of user interaction with content, and the identification of trajectories along which local research ideas acquire weight and become integrated into the international scientific system. It should be emphasized that under the current conditions of martial law, provoked by russia's full-scale military invasion in 2022, this spectrum of activities constitutes a crucial means of consolidating the University's scholarly competences. Moreover, it allows the delineation of a complete cycle – ranging from the inception of a research concept and the collection of material for further development to publication in journals indexed by leading scientometric databases such as Scopus and Web of Science. In this way, a gradual transition takes place: from the individual support of academic user (Ashiq & Warraich, 2022) and the strengthening of the University community's authority at the national level toward the affirmation of Ukrainian education and science as active and recognized participants in the global academic arena.

Results and Discussion

Analytical dimension of the Digital Library Ecosystem. The conducted study confirms that the functioning of the Digital Library Ecosystem (DLE) of Dragomanov Ukrainian State University Scientific Library is not merely an auxiliary component of information support, but also a key factor in the development of the cascading chain of educational and scientific interaction. The analysis of the collected material revealed patterns demonstrating how even minor user actions (viewing a resource, submitting a search query, downloading a document) collectively form the basis for strengthening the academic capital of the University. The starting point of this process was the collection and processing of statistical data using Google Analytics tools, which provided both quantitative and qualitative assessments of user activity on the library's web platforms (Llacsa-Puma, Tostado-Ramírez, Peña-Vélez, & Sabando-García, 2025). The aggregated indicators obtained – namely visits, page views, interactions with the library's website and the institutional repository (Fig. 1.) – reflect an integral picture of resource usage, making it possible to evaluate the overall dynamics of information demand. This data format is oriented towards identifying trends and scales of user engagement, which is particularly important for the strategic planning of the DLE's development and the prioritization of its resource enrichment (Elihaki Kanyika, Sadykova, Tuyenbayeva, & Wema, 2024). The analysis of these indicators demonstrated a steady increase of interest in content related to academic integrity, researchers' personal identifiers, research consultations, scholarly metrics, remote library services, and other areas (Fig. 2.). This allows us to conclude that at the first level of the cascading chain – identification and registration of informational needs – the DLE functions not only as a repository,

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but also as an effective diagnostic mechanism of the research community's demands (A.U. Khan, Jan, M.N. Khan, M. Khan, & Chohan, 2025).

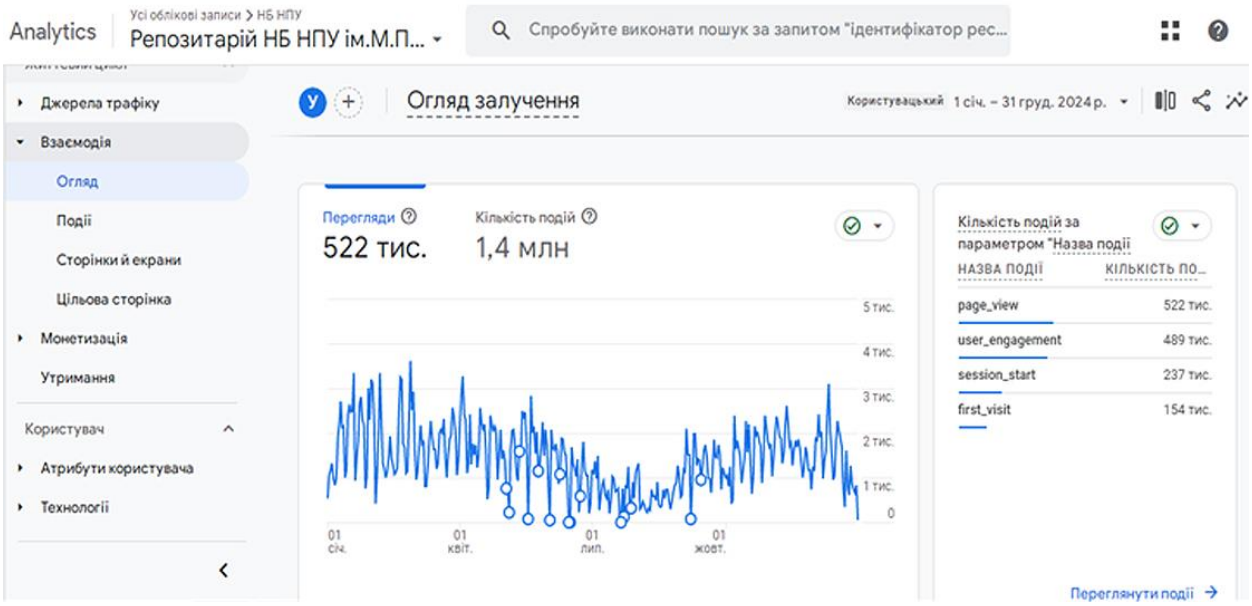
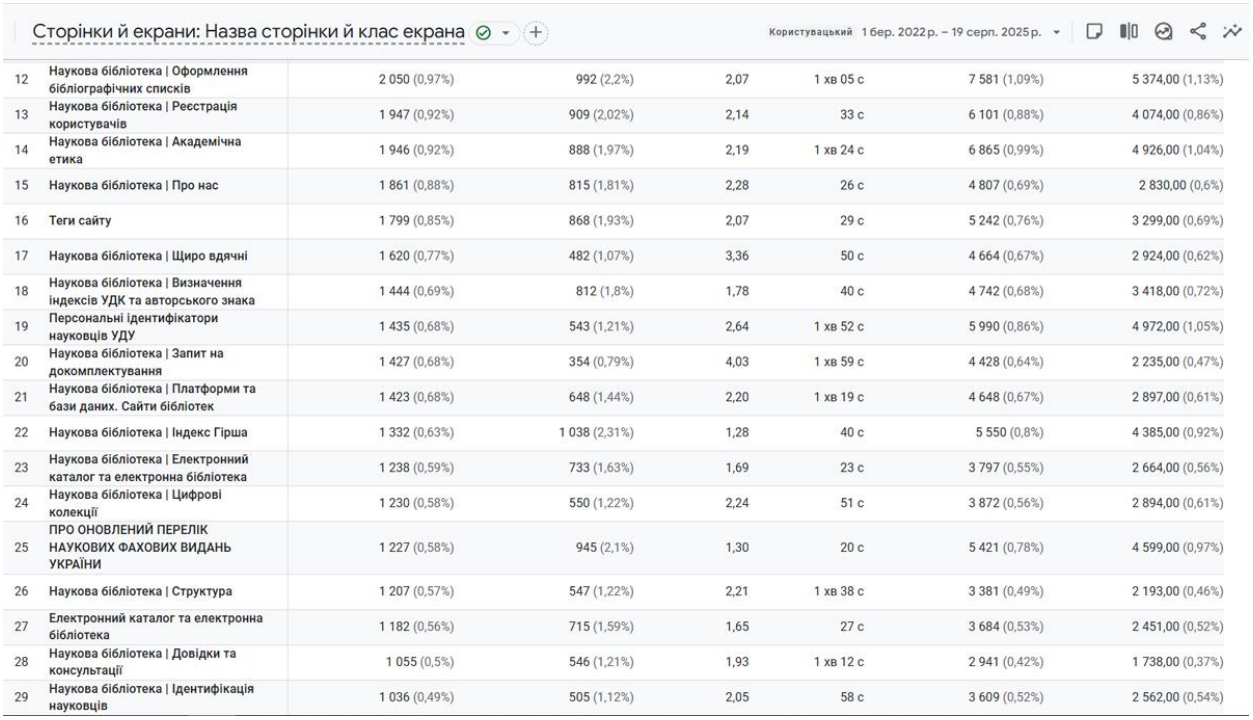


Fig. 1.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Користувацький 1 бер. 2022 р. – 19 серп. 2025 р.

12	Наукова бібліотека | Оформлення бібліографічних списків	2 050 (0,97%)	992 (2,2%)	2,07	1 хв 05 с	7 581 (1,09%)	5 374,00 (1,13%)
13	Наукова бібліотека | Реєстрація користувачів	1 947 (0,92%)	909 (2,02%)	2,14	33 с	6 101 (0,88%)	4 074,00 (0,86%)
14	Наукова бібліотека | Академічна етика	1 946 (0,92%)	888 (1,97%)	2,19	1 хв 24 с	6 865 (0,99%)	4 926,00 (1,04%)
15	Наукова бібліотека | Про нас	1 861 (0,88%)	815 (1,81%)	2,28	26 с	4 807 (0,69%)	2 830,00 (0,6%)
16	Теги сайту	1 799 (0,85%)	868 (1,93%)	2,07	29 с	5 242 (0,76%)	3 299,00 (0,69%)
17	Наукова бібліотека | Щиро вдячні	1 620 (0,77%)	482 (1,07%)	3,36	50 с	4 664 (0,67%)	2 924,00 (0,62%)
18	Наукова бібліотека | Визначення індексів УДК та авторського знака	1 444 (0,69%)	812 (1,8%)	1,78	40 с	4 742 (0,68%)	3 418,00 (0,72%)
19	Персональні ідентифікатори науковців УДУ	1 435 (0,68%)	543 (1,21%)	2,64	1 хв 52 с	5 990 (0,86%)	4 972,00 (1,05%)
20	Наукова бібліотека | Запит на докомплектування	1 427 (0,68%)	354 (0,79%)	4,03	1 хв 59 с	4 428 (0,64%)	2 235,00 (0,47%)
21	Наукова бібліотека | Платформи та бази даних. Сайти бібліотек	1 423 (0,68%)	648 (1,44%)	2,20	1 хв 19 с	4 648 (0,67%)	2 897,00 (0,61%)
22	Наукова бібліотека | Індекс Гірша	1 332 (0,63%)	1 038 (2,31%)	1,28	40 с	5 550 (0,8%)	4 385,00 (0,92%)
23	Наукова бібліотека | Електронний каталог та електронна бібліотека	1 238 (0,59%)	733 (1,63%)	1,69	23 с	3 797 (0,55%)	2 664,00 (0,56%)
24	Наукова бібліотека | Цифрові колекції	1 230 (0,58%)	550 (1,22%)	2,24	51 с	3 872 (0,56%)	2 894,00 (0,61%)
25	ПРО ОНОВЛЕНИЙ ПЕРЕЛІК НАУКОВИХ ФАХОВИХ ВИДАНЬ УКРАЇНИ	1 227 (0,58%)	945 (2,1%)	1,30	20 с	5 421 (0,78%)	4 599,00 (0,97%)
26	Наукова бібліотека | Структура	1 207 (0,57%)	547 (1,22%)	2,21	1 хв 38 с	3 381 (0,49%)	2 193,00 (0,46%)
27	Електронний каталог та електронна бібліотека	1 182 (0,56%)	715 (1,59%)	1,65	27 с	3 684 (0,53%)	2 451,00 (0,52%)
28	Наукова бібліотека | Довідки та консультації	1 055 (0,5%)	546 (1,21%)	1,93	1 хв 12 с	2 941 (0,42%)	1 738,00 (0,37%)
29	Наукова бібліотека | Ідентифікація науковців	1 036 (0,49%)	505 (1,12%)	2,05	58 с	3 609 (0,52%)	2 562,00 (0,54%)

Fig. 2.

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Interrelation with international scholarly visibility. The next stage of analysis logically builds upon the previous one. It represents a transition from studying user behaviour to evaluating the effectiveness of their research efforts in the external academic environment. For this purpose, the presence of University researchers' publications in leading international scientometric databases – Scopus (Fig. 3.) and Web of Science (Fig. 4.) – was examined. The comparison of internal analytical data with external indicators of scholarly visibility made it possible to trace how the informational and methodological support of the DLE facilitates the transformation of individual research initiatives into works that become part of the global academic space. Here, the "Sic parvis magna" principle manifests in a practical dimension: every recorded user action within the DLE potentially becomes the foundation for a study capable of integrating into a "big" science. In this process, the constant participation of the Scientific Library as the institutional core of the DLE is of particular importance. Throughout their research journey, scholars repeatedly turn to its resources and services, which stimulates the Library to continuously improve its tools, expand its collections, and adapt to the evolving needs of both individual users and the university community as a whole (Runyon & Steffy, 2021).

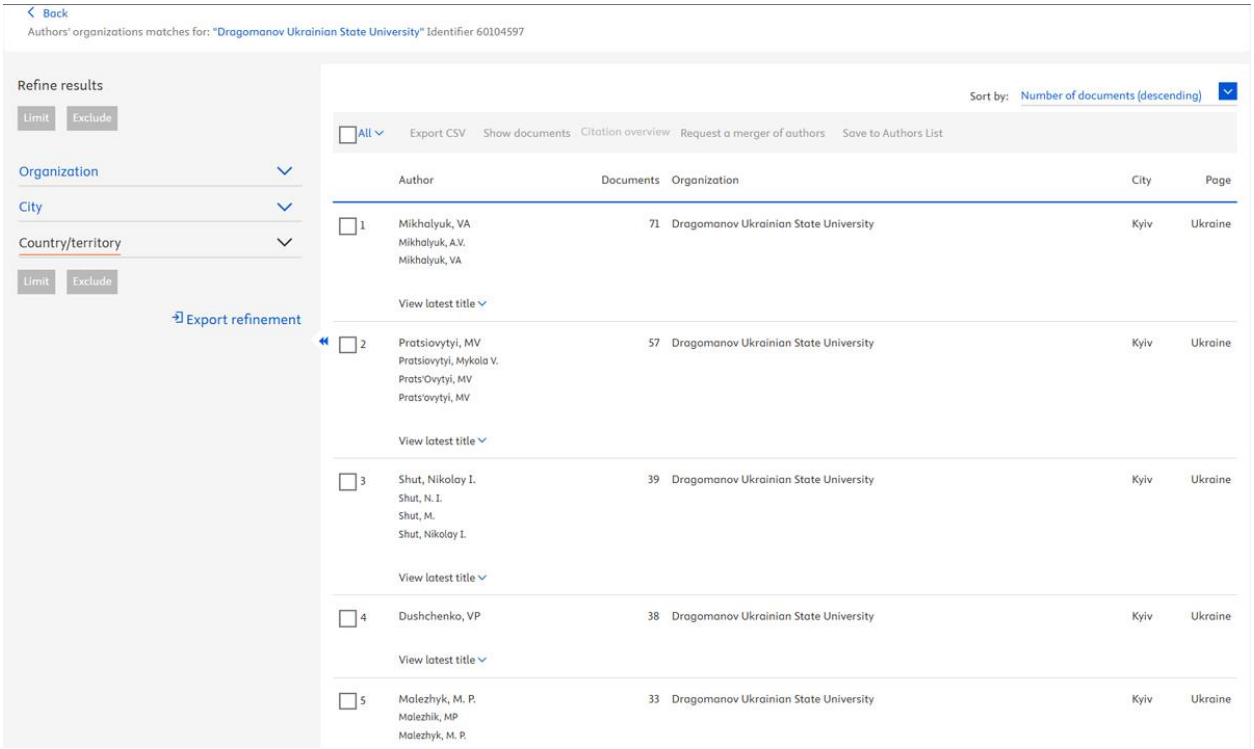

Fig. 3.

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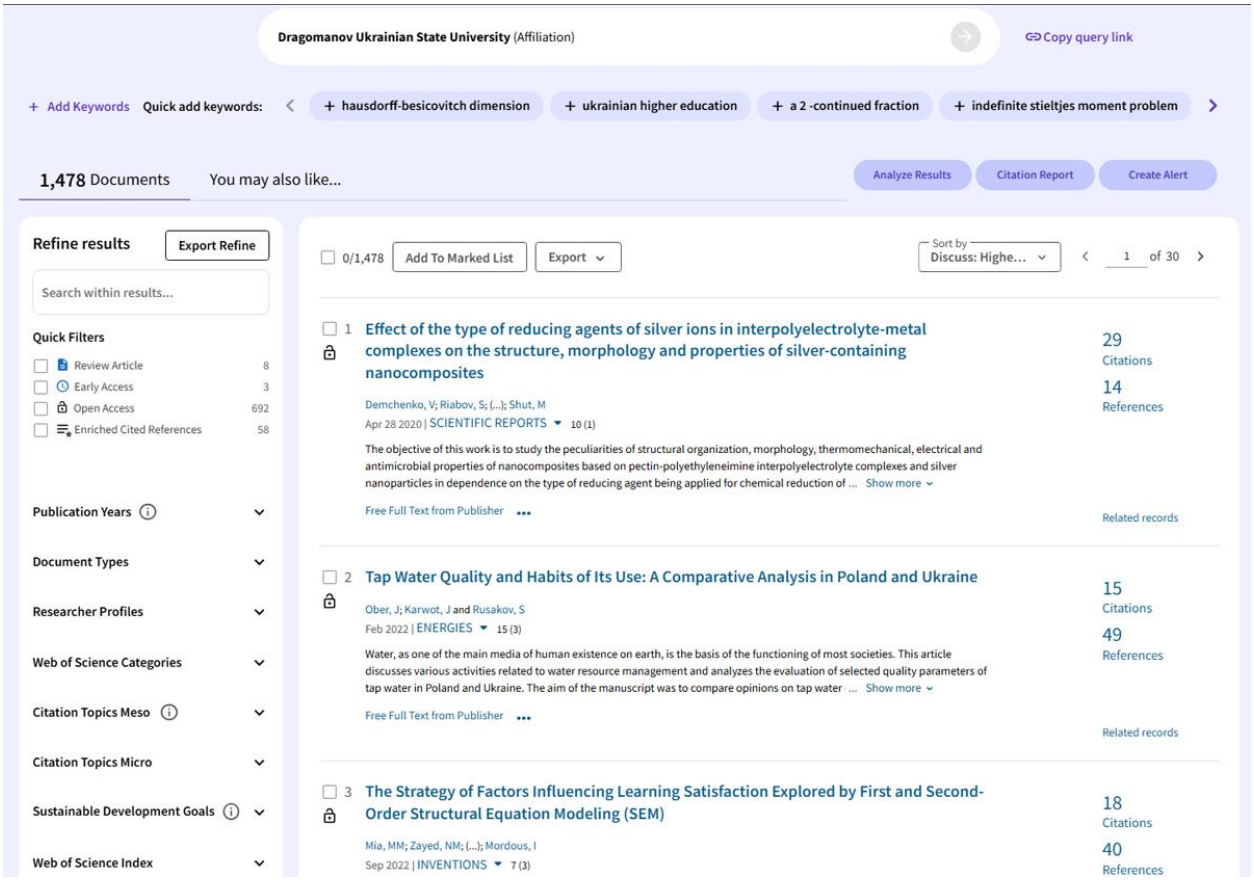

Fig. 4.

The cascading chain, "Sic parvis magna" principle, and the functioning of the Digital Library Ecosystem. The transition from an internal informational request to integration within the international scholarly environment is most effectively explained by the model of the cascading chain of educational and research interaction. Its logic fully aligns with the "Sic parvis magna" principle – "greatness from small beginnings": a seemingly modest action undertaken by a researcher at the initial stage, such as viewing a resource or searching for a source within the DLE, becomes the first link in a process that ultimately contributes to the global scientific discourse. This trajectory begins when a scholar – whether an early-stage researcher or an established author – formulates an idea or a research question. In the first stage, the researcher turns to DLE resources to locate and select relevant scientific information, which may include the electronic catalogue, digital collections, the library's website (Fu, Yan, & Chen, 2025), the institutional repository, or databases accessible through the Scientific Library. At this stage, the library functions as a primary navigator within the scholarly environment (Harisanty, Sugihartati, Srimulyo, & Obille, 2025), guiding researchers through the abundance of sources and enabling them to identify the most pertinent materials. The second stage involves the accumulation and systematization of the collected information. By utilizing the services of the DLE, researchers are able to store, structure, and analyse the retrieved materials, thereby forming a knowledge base for their studies. This reduces the duplication of efforts, saves time, and provides a solid foundation for subsequent research activity. The third stage is the creation of the researcher's own scholarly product. Here, the library supports the process with informational and methodological resources: it provides access to stylistic and technical guidelines of journals, offers consultations on academic integrity,

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and assists in verifying proper citation practices (Mierzecka, 2025). The fourth stage is the approbation of research results. At this point, scholars present their findings at conferences, seminars, or within intra-university publications, again relying on the DLE to disseminate their outputs through the institutional repository and ensure accessibility for colleagues. The final stage is the preparation and submission of an article to a journal indexed in authoritative scientometric databases such as Scopus or Web of Science. At this level, the library's role is to guarantee access to tools for verifying journal requirements, to provide orientation in selecting an appropriate outlet, and to enhance the visibility of the published work through its representation across the University's digital channels. Within this sequence, the cascading effect becomes clearly observable: each stage builds upon the previous one while simultaneously paving the way for the next. Beginning with a modest, localized search for information, the researcher gradually constructs a substantial body of scholarly work, thereby confirming the validity of the "Sic parvis magna" principle. At every stage, the DLE acts as a catalyst – technical, informational, and communicative – lowering barriers and accelerating the trajectory of a research product from its initial conception to its integration into the global intellectual exchange (Odularu, 2025).

It is also essential to underscore that this complex process unfolds under the conditions of martial law and full-scale war, which impose additional challenges on the organization of academic work (Aslam, 2022). In such circumstances, the capacity of the DLE to ensure stable access to resources and sustained support for researchers becomes even more critical, as it directly underpins the continuity of academic activity and safeguards the scientific potential of the University.

Conclusions

Consequently, the study confirmed that the Digital Library Ecosystem (DLE) of Dragomanov Ukrainian State University Scientific Library functions as an integrated socio-technical structure, uniting library web platforms, informational and methodological services, and communication channels. It transcends the role of a traditional information hub, evolving into an institutional nucleus for the synthesis of knowledge and a catalyst for transforming local research activities into a tangible contribution to the global scholarly space. The "Sic parvis magna" principle is manifested in the sequential progression whereby even seemingly "minor" user activities – queries, views, downloads – serve as the foundation for the growth of the University's academic capital (Medved, 2023).

The analytics of library web resources, particularly through Google Analytics, underscore their significance both as indicators of the current needs of the academic community and as a strategic tool for content management. The steady increase in interest toward materials on specific topics illustrates the effectiveness of the cascading mechanism: from identifying user demands to the creation and subsequent indexing of scholarly products in leading scientometric databases (S. Zhang, T. Zhang, & Wang, 2025). In this way, the DLE facilitates the transition from localized information searches to the global circulation of scientific outputs.

The role of the DLE is especially critical under conditions of martial law, where it ensures the continuity of scholarly activity, stable access to resources and services, and sustained development of research competencies. This strengthens the agency of Ukrainian education and science within the international arena, affirming that the DLE is not merely an auxiliary instrument but a strategic resource aimed at sustainable growth of academic capital and enhancement of the University's global visibility.

Future directions for the development of the DLE are associated with advancing several key dimensions: refining the analytical toolkit; deepening user behaviour analysis and modelling

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the “bottlenecks” of the cascading chain; reinforcing the methodological component through the adoption of academic integrity standards; unifying researcher identification procedures; expanding remote services as an integral element of educational and research interaction (D. Trivedi, Bhatt, A., M. Trivedi, & Patel, 2021) and conducting inter-university comparative studies to test the universality of the cascading model. Collectively, these factors provide the capacity to seamlessly integrate local research initiatives into the DLE, endowing them with systemic significance and actualizing the “Sic parvis magna” principle – transforming a “minor” academic gesture into a “major” scientific achievement.

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MARIIENKO A. O.
Наукова бібліотека, Український державний університет імені Михайла Драгоманова (Київ, Україна), e-mail: a.o.mariienko@udu.edu.ua, ORCID 0009-0003-7805-8675

Цифрова бібліотечна екосистема у каскадному ланцюгу освітньо-наукової взаємодії

Мета. Дослідження вивчає функціонування цифрової бібліотечної екосистеми (далі – ЦБЕ) як центрального елемента освітньо-наукової взаємодії на прикладі Наукової бібліотеки Українського державного університету імені Михайла Драгоманова. Охарактеризовано реалізацію принципу Sic parvis magna (з лат. «Велике починається з малого») через перетворення окремих академічних внесків у глобальний науковий результат. **Методика** ґрунтується на системному підході, що розглядає ЦБЕ як цілісну соціотехнічну та інформаційно-комунікаційну структуру. Зазначено, що аналітичний інструментарій бібліотечних вебресурсів слугує ключовим індикатором потреб академічної спільноти. Емпіричне підтвердження здійснюється шляхом обліково-статистичного аналізу. **Результати.** Виявлено, що ЦБЕ забезпечує комплексну акумуляцію наукової інформації, сприяючи її структуруванню та включенню у глобальний науковий обіг. Доведено ефективність каскадного механізму, завдяки якому індивідуальні матеріали дослідника (статті, дисертації тощо) набувають ґрунтовного значення. **Висновки.** Завдяки реалізації принципу Sic parvis magna ЦБЕ є повноцінним академічним компонентом у парадигмі міжнародної науки. Її стратегічна цінність для Університету та української освіти загалом полягає саме у здатності перетворювати малий академічний жест на велике наукове надбання.

Ключові слова: цифрова бібліотечна екосистема; інструменти Google Analytics; каскадний механізм; академічний простір; принцип «Sic parvis magna»

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