https://doi.org/10.15407/scine21.02.064

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ONLINE ENCYCLOPEDIAS AND GENERATIVE ARTIFICIAL INTELLIGENCE: CHALLENGES AND OPPORTUNITIES (CASE OF THE ENCYCLOPEDIA OF MODERN UKRAINE)

Introduction. *Generative artificial intelligence (AI) has rapidly transformed numerous fields, presenting both opportunities and challenges. For the encyclopedia industry, this shift not only raises questions about potential applications but also necessitates adaptation to societal changes accompanying its widespread adoption.*

Problem Statement. *Online encyclopedias primarily depend on search engines, such as Google, for traffic. Recent announcements from Google LLC regarding the integration of generative AI into its search capabilities suggest significant changes in how users access information. These advancements may decrease website traffic, as users could find answers directly within search results without visiting the original sources.*

Purpose. *To identify and analyze the challenges confronting the encyclopedia industry in the era of generative AI.*

Materials and Methods. *The study has utilized quick experiments to evaluate the capacity of generative AI (e.g., ChatGPT) to perform tasks typical of encyclopedia editorial workflows. It has also analyzed traffic data from the academic Encyclopedia of Modern Ukraine website. Additionally, descriptive methods and statistical analyses have been employed.*

Results. *Generative AI has demonstrated its ability to automate various editorial tasks and enhance the quality of encyclopedia articles. However, the integration of AI-generated answers within global search engines has presented a critical challenge: as generative AI becomes more prominent, reliance on expert-authored encyclopedic content may diminish, potentially reducing the audience for traditional encyclopedic resources.*

Conclusions. *Generative AI represents an essential tool for the future of the encyclopedia industry. However, the integration of AI-driven search capabilities, particularly by platforms like Google, poses a risk to online encyclopedia traffic and the broader reliance on expert-generated content. Strategic adaptations will be necessary to address these emerging challenges.*

Keywords: encyclopedias, encyclopedic content, search engines, Google search engine, artificial intelligence, ChatGPT, large language models.

Citation: Zhelezniak, M. H., and Ishchenko, O. S. (2025). Online Encyclopedias and Generative Artificial Intelligence: Challenges and Opportunities (case of the Encyclopedia of Modern Ukraine). *Sci. innov.*, 21(2), 64—72. https://doi.org/10.15407/scine21.02.064

The development of the IT sector continually introduces new technologies, particularly in information and communication, which humanity directs toward optimizing and enhancing socio-economic processes and relationships. Ultimately, this facilitates improving social and economic well-being. This evolution has been driven by the widespread adoption of digital technologies across nearly all sectors of public and private life [1]. Currently, one of the most significant and transformative areas within IT is artificial intelligence (AI). As highlighted in recent studies, "Digital transformation has become the hallmark of contemporary technical progress, marked by the integration of digital technologies into all facets of social life and economic relations" [2]. AI technologies have already established themselves in numerous industries, delivering notable advancements in productivity, introducing new products, and automating repetitive, routine tasks. For instance, AI enhances the efficiency of government institutions, particularly in policymaking to promote citizen welfare [3].

Among the various AI technologies, **generative AI** — notably generative pre-trained transformers (GPT) — has emerged as a groundbreaking innovation with immense potential for future applications. Generative AI tools, such as ChatGPT, DALL-E, and GitHub Copilot, have combined deep learning with advanced text-generation capabilities [5]. These advancements have significantly improved natural language processing (NLP), enabling complex human-computer interactions. As a result, generative AI is often associated with **large language models (LLMs)**, which are trained on vast datasets and capable of generating human-like text, answering questions, and conducting meaningful dialogues [6].

However, despite these accomplishments, the deployment of large language models continues to face numerous challenges and limitations. Furthermore, the integration of these technologies raises critical questions and risks for various societal domains, including the encyclopedia industry.

Research has demonstrated that LLMs have already influenced fields such as education (M. Ayanwale et al. [7]), medicine (A. Ahuja et al. [8]), journalism (P. Breazu & N. Katson [9]), scholarly publishing (G. Kaebnick et al. [10]), and politics (S. Feldstein [11]). While these studies highlight both the potential and the risks of generative AI, the specific challenges it poses to encyclopedics remain underexplored.

The encyclopedia industry, especially online encyclopedias that serve as extensive knowledge repositories, is beginning to attract attention in discussions about the impact of AI. Although focused research on this topic is limited, the implications of AI and LLMs on encyclopedics have been discussed in various forums. For example, the 2024 European Encyclopedia Conference in Oslo featured presentations such as **"The Effect of AI and Language Models on Encyclopedias"** (B. Kalsnes) and **"Language Models and Copyright"** (A. Vestbø)[1], underscoring the need for deeper exploration of AI's role in this field.

Encyclopedics is a discipline that deals with the systematization, dissemination, and popularization of scientific knowledge through the creation and distribution of encyclopedic content. Encyclopedias empower individuals to master the "art of knowing about everything" [12]. However, in today's information-saturated environment, encyclopedias are less frequently encountered by the general public. This is largely due to the overwhelming abundance of information sources, many of which contain questionable data, misinformation, or outright falsehoods. As scholars have rightly noted, this sheer volume of information sources has created a trust deficit — individuals are often unsure which sources are reliable and which are not [13]. Conversely, some people tend to accept any information at face value, posing an equally significant risk. Under such circumstances, the creation and promotion of reliable knowledge sources — such as national encyclopedias — becomes crucial [14]. These resources are indispensable not only for enhancing knowledge but

[1] European Encyclopedia Conference website: https://encyclopedias.eu/conference/2024

also for verifying facts and fostering critical thinking in an era where information flows from countless channels. This constitutes the overarching scientific value of such social and humanitarian studies. In the context of Russia's intensified anti-Ukrainian propaganda, fueled by its ongoing war, the academic study of reliable information sources, including encyclopedias, gains even greater relevance.

This research focuses on analyzing statistical data on visits to the website of the *Encyclopedia of Modern Ukraine* (EMU) and reflecting on media reports concerning the prospects of the information and communication channels through which society accesses encyclopedic content.

The EMU is an academic encyclopedia offering authoritative reference knowledge about Ukraine and the Ukrainian people since the early 20th century, presented in the Ukrainian language. It is currently the largest Ukrainian multi-volume encyclopedia, consisting of 24 volumes. Its electronic version contains approximately 75,000 original articles and serves as a significant example of digital humanities development in Ukraine [15]. The authors chose the EMU as the subject of this study not only due to its academic importance but also because of access to relevant statistical data on this resource, obtained via Google Analytics and Google Search Console. In addition to the EMU, other reliable sources of Ukrainian studies available online include the *Encyclopedia of the History of Ukraine* and the *Internet Encyclopedia of Ukraine*. Wikipedia in the Ukrainian language also plays a critical role in disseminating knowledge. Notably, EMU authors are recognized as a specific category on Wikipedia, and many Wikipedia articles cite the EMU as a primary information source. Moreover, the inclusion of an entry in the EMU is often sufficient grounds for creating a corresponding Wikipedia article with the same title. Similar comprehensive national or universal encyclopedias are available online in other countries, fulfilling analogous functions. These include the *Britannica Encyclopedia* (United States and United Kingdom), *Brockhaus Enzyklopädie* (Germany), *Store Norske Leksikon* (Norway), *Den Store Danske* (Denmark), *Nacionālā enciklopēdija* (Latvia), and *Beliana* (Slovakia), among others.

The primary research method employed in this study is descriptive-analytical. Additionally, experimental and data analysis methods have been utilized, including the calculation of absolute and average traffic indicators for the *Encyclopedia of Modern Ukraine* website, such as visitor numbers and page views.

Generative artificial intelligence (AI) can serve as a valuable tool for encyclopedic publishing by optimizing various processes through its API integration into web products. Integrating generative AI into the technical infrastructure of the encyclopedic field could automate functions characteristic of online encyclopedias, particularly content creation and maintenance. For instance, generative AI could potentially address the issue of decoding abbreviated terms, which is a common feature of encyclopedias in the post-Soviet space. The tradition of abbreviating words in encyclopedic texts originated as a space-saving measure in printed publications. Although this practice persists in some modern online encyclopedias derived from printed editions, it is no longer necessary in digital formats. The EMU is among such publications. To evaluate this hypothesis, a mini-experiment was conducted. Using ChatGPT[2] (specifically the GPT-4 version on July 1, 2024), a task was assigned to the AI to decode abbreviations in the article "Vitamins" [16]. This article, which no longer contains abbreviations due to the editorial team's ongoing work to eliminate them, was copied from the EMU website and submitted in its entirety to the chatbot interface. Overall, the AI performed well: all abbreviations were correctly decoded. However, the article includes a table describing vitamins and their effects on the human body. While the table initially contained no abbreviations, it was included as part of the task since the entire article was processed. Surprisingly, the AI partially altered the

[2] Chat bot website: https://chatgpt.com

descriptions of the clinical activities of the vitamins in the table. For example:

- **Original:** Antixerophthalmic. Protects epithelial tissues, activates differentiation of rapidly proliferating cells. Absolutely essential for the normal growth and development of young organisms. **AI Output:** Antixerophthalmic. Protects epithelial tissues, activates epithelial differentiation (keratinization). Essential for normal growth, development, and reproductive function.
- **Original:** Anti-anemic. Stimulates erythropoiesis. Participates in the synthesis of amino acids, nucleic acids, purines, and pyrimidines, and choline metabolism. **AI Output:** Anti-anemic. Involved in erythropoiesis, cell growth, and the metabolism of nucleic acids, purines, and pyrimidines. Normalizes carbohydrate and protein metabolism.

While ChatGPT successfully decoded abbreviations, these unexpected changes in the text reveal unanticipated risks. The AI not only fulfilled the direct request but also made unintended modifications to the content. This highlights the importance of precise query formulation — not only specifying what the AI should perform but also clarifying what it must not do. Even then, there is no guarantee against undesired alterations in encyclopedic text. This mini-experiment underscores potential risks when employing ChatGPT for automated tasks that involve direct text intervention, particularly for editing or modifying encyclopedic articles.

Generative AI could be applied to other tasks related to encyclopedias in a safer and more productive manner. For instance, some studies suggest that AI is capable of generating summaries for academic articles [17]. Similarly, generating concise information blocks containing key phrases about a person, phenomenon, object, or process on online encyclopedia pages would likely benefit readers and help popularize the encyclopedic genre. While creating such elements manually through editors is a labor-intensive and time-consuming process, especially for a large body of articles, generative AI could prove to be a highly effective tool for this purpose. In addition to this, AI can be used in other capacities. These include enhancing hyperlink systems, which are integral to encyclopedic publications; identifying discrepancies in articles for subsequent standardization; analyzing statistical data; and, importantly, identifying entities such as institutions or geographical locations that have been renamed as part of Ukraine's ongoing decommunization and derussification processes.

Undoubtedly, the active implementation of AI in encyclopedic practice would mark a significant technological advancement for the field, especially if it enables automatic updates to outdated information. However, if AI were to replace authors in the preparation of articles, this could be detrimental to the integrity of the encyclopedic tradition. Currently, not everyone fully understands the potential of generative AI, as it requires both a theoretical understanding of AI and technical expertise to implement it effectively. Research indicates that individuals with higher levels of AI awareness are more likely to recognize its utility compared to those with limited knowledge, who may perceive AI as something negative or even threatening [18]. That said, legitimate concerns and challenges exist regarding the widespread application of AI in encyclopedic work. These challenges are not limited to individual encyclopedias but apply to any online resource. Below, we explain what we mean.

One primary issue is how users access online encyclopedias. Most traffic to these sites comes via search engines such as Google. For example, data from *Google Analytics* on the *Encyclopedia of Modern Ukraine* (EMU) indicates that 90% of page views originate from search engine queries, while only 6.5% come from direct visits — where users access the website through its web address and navigate articles using its internal search interface. An additional 2.3% of traffic comes from social media referrals.

Currently, Google rates the *Encyclopedia of Modern Ukraine* (EMU) website quite highly, ac-

tively indexing its pages (99% of all site pages are indexed). As a result, EMU articles often appear prominently in user query results. To illustrate this, we conducted the following mini-experiment. Using Google, we entered three queries that the EMU articles could address:

1. "адміністративно-територіальний поділ України" (administrative-territorial division of Ukraine);
2. "Павло Мовчан" (Pavlo Movchan);
3. "консервативна політична ідеологія" (conservative political ideology).

These queries differ in their relationship to the EMU articles, potentially influencing the search results:

- The first query matches the article title "Адміністративно-територіальний поділ України" exactly, suggesting the highest likelihood of the relevant article appearing in the search results.
- The second query partially matches the title "Мовчан Павло Михайлович," differing in word order and omitting the patronymic.
- The third query correlates only with thematic keywords found within several articles, such as "Консерватизм," rather than matching any specific article title.

Despite these differences, Google positioned the relevant EMU articles prominently for all three queries, ranking them third — immediately after the Ukrainian and Russian versions of Wikipedia. (These queries were performed in Cyrillic from Ukraine on July 1, 2024). According to *Google Search Console*, EMU articles have an average position of 8th in search results over the past 15 months.

Recently, media reports have highlighted Google's plans to fundamentally change its search algorithms. According to one observer, significant changes have already occurred as over the last two years, a series of updates to Google Search amount to a dramatic upheaval to the Internet's most powerful tool, complete with an unprecedented AI feature. Will Google save the web, or destroy it? [19]. The author suggests that Google is now shifting its focus from qualitative metrics, such as content uniqueness and originality — historically the foundation for site evaluation and positioning — to quantitative factors. As a result, small websites with high-quality content are increasingly overshadowed or ignored in favor of large brand sites, regardless of the quality of their information. The article also quotes Google's CEO, who outlines future plans, including the integration of generative AI into search: "Going forward, Google Search would provide its own AI-generated answers to many of your questions" [19]. According to Google's CEO, these developments aim to ensure users encounter high-quality, useful content.

Thus, there are grounds to state that Google is evolving from a classical search engine, which provides a list of websites with information relevant to a query, toward a platform that generates its own answers to user queries. For now, we will set aside a series of questions that arise regarding the quality, reliability, and trustworthiness of such generated information, as well as issues of ethics and copyright compliance. It is important to note that generating these answers requires training artificial intelligence on large datasets, which likely include online encyclopedias whose content is typically protected by copyright.

The primary concern in this scenario is that websites — especially online encyclopedias, currently regarded as "reliable, trustworthy sources" [20, p. 17] — will lose a portion of their Google search traffic. In other words, high-quality encyclopedic content, created by leading experts in their respective fields, reviewed and approved by editorial teams, will become less visible to users due to the AI-generated content.

It is worth noting that the aforementioned changes to Google's algorithms, which have already begun, correlate with the traffic trends of the EMU website. According to *Google Analytics*, from 2018 onwards, the site experienced an annual average growth of 44% in visitors and 37% in page views. However, this trend shifted in 2023, when, for the first time, the site's yearly traffic declined: the number of visits dropped by 8%, and page views decreased by 10% compared to 2022 (Fig. 1).

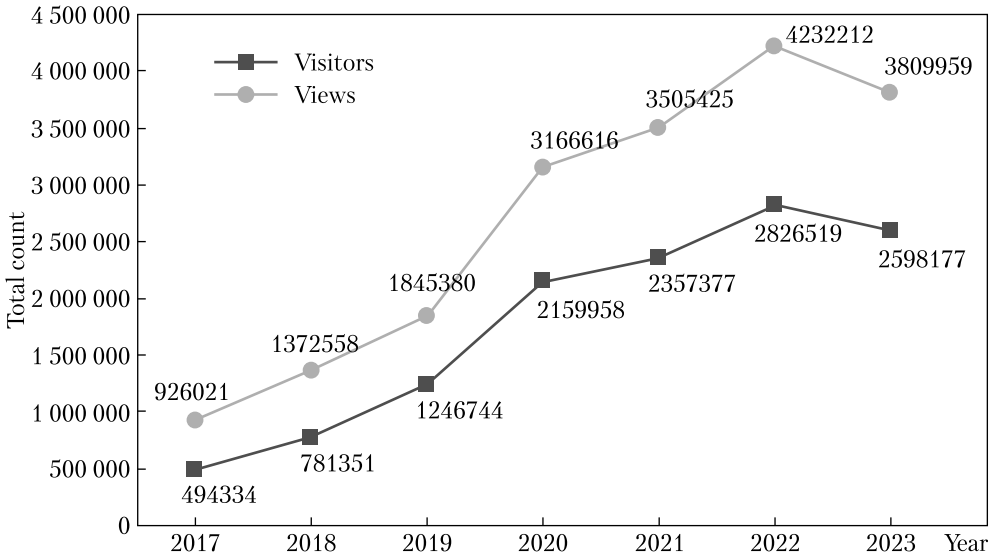

Fig. 1. EMU website traffic dynamics

It is worth noting that the exact reasons for the sharp changes in site traffic in 2023, coinciding with changes in Google's algorithms, remain unknown. The assumption that these changes are caused by the search algorithm updates, rather than being a random correlation, is merely logical speculation. Starting in mid-May 2024, Ukraine experienced a significant electricity deficit due to the destruction of its energy infrastructure by Russian airstrikes. As a result, electricity supply for Ukrainian residents was interrupted for many hours daily, undoubtedly affecting the annual traffic of the encyclopedia's website, as approximately 85% of its traffic comes from Ukraine. However, this issue did not exist on such a scale in 2023. Notably, monthly traffic metrics have returned to 2022 levels since February 2024.

The traffic of any website (data on the number of visitors and page views) is a key indicator of its effectiveness. For encyclopedic websites, it depends on many factors, such as user-friendliness, aesthetic appeal, thematic relevance, content readability, and more. However, the primary factor is the positioning of their pages in major search engines like Google, as users typically reach encyclopedic content (e.g., Wikipedia, EMU) through search engine queries. If Google's developers genuinely aim to provide reliable, high-quality sources in their search results, they should focus not only on using AI to generate their own answers to user queries but also on improving the visibility of encyclopedic content. This approach would offer users the freedom of choice — one of the foundational principles of a free society.

We believe that the decline in EMU website traffic, hypothetically linked to changes in Google's search algorithms driven by AI technologies, has a critical implication: a smaller audience had access to a reliable Ukrainian-language source of knowledge. This audience consists primarily of Ukrainians living during Russia's war, enduring not only constant missile and other attacks by the Russian army but also the Kremlin's powerful propaganda machine. In this context, cultural and informational security is paramount. Reliable sources of information, especially those about Ukraine's history, serve as essential tools for countering anti-Ukrainian propaganda narratives. These sources enable users to verify claims such as when the terms *Ukraine* and *Ukrainians* first appeared, whether Ukraine was "invented" by Lenin, the differences between Ukrainians and Russians, why

the Russian people claim the history of Kyivan Rus as their own, why Stepan Bandera is a hero in Ukraine but demonized in Russia, and whether the Holodomor of 1932—1933 was an act of genocide by the Soviet leadership. In the case of EMU, its body of encyclopedic articles portrays Ukraine as a strong European country with a talented people, a rich culture, a developed economy, and abundant natural resources. This image serves as a robust cultural-historical foundation capable of resisting propaganda attacks.

Thus, the use of artificial intelligence in the field of encyclopedics (especially regarding online encyclopedias) is clearly essential for the continued development of the industry. However, major encyclopedias worldwide have not yet demonstrated through publications or ongoing projects the most important areas where AI has been successfully integrated. In this article, we have outlined several key tasks relevant to encyclopedics that AI could potentially address, while also pointing out that the implementation of artificial intelligence must be approached with caution. This is because granting AI access to make automated changes to encyclopedic article texts involves certain risks that must be recognized and mitigated.

At present, generative AI is actively being implemented by the largest internet services, including search engines like Google. Typically, users of the internet arrive at reference articles in Wikipedia and other general and national online encyclopedias — such as the Britannica Encyclopedia, Brockhaus Enzyklopädie, Store Norske Leksikon, and the Encyclopedia of Modern Ukraine — via search queries in Google. We believe that Google's development towards generating AI-driven answers to user queries will negatively impact traffic to encyclopedic websites. Since the authors of national encyclopedias are recognized experts in their fields, in such a scenario, their authored content will become less visible compared to that generated by artificial intelligence. This presents a challenge to the dissemination of encyclopedic knowledge in the information space, which is already flooded with low-quality, unchecked, and often pseudoscientific information, as well as dangerous misinformation.

In this research, using the example of the Encyclopedia of Modern Ukraine, we have shown that during a period when Google began implementing search algorithm innovations related to artificial intelligence, the traffic to the Ukrainian encyclopedic site noticeably decreased in 2023. Since the Encyclopedia of Modern Ukraine offers high-quality, verified knowledge about Ukraine, its history, prominent figures, and heroes (including those of the Russo-Ukrainian war), and counters the information assault of anti-Ukrainian Russian propaganda, the decrease in its site traffic in 2023 has suggested that Ukrainian society was somewhat less protected and more vulnerable to hostile narratives.

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Received 02.08.2024
Revised 28.08.2024
Accepted 28.08.2024

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ОНЛАЙН-ЕНЦИКЛОПЕДИСТИКА І ГЕНЕРАТИВНИЙ ШТУЧНИЙ ІНТЕЛЕКТ: ВИКЛИКИ ТА ПЕРСПЕКТИВИ (НА ПРИКЛАДІ ЕНЦИКЛОПЕДІЇ СУЧАСНОЇ УКРАЇНИ)

Вступ. Нині генеративний штучний інтелект (ШІ) набуває широкого використання у різних сферах діяльності. Для енциклопедистики він наразі лишається викликом не лише з точки зору розуміння потенціалу застосування, а й у контексті певних суспільних змін, що стануться після масового поширення ШІ.

Проблематика. До онлайн-енциклопедій читачі звертаються передусім завдяки *Google* чи подібним пошуковим системам. Нещодавно компанія *"Google LLC"* заявила про наміри вдосконалення своєї пошукової системи: суттєву роль відіграватиме генеративний ШІ у формуванні відповідей на запити користувачів інтернету. А це, ймовірно, спричинить зменшення трафіку сайтів, зокрема й енциклопедичних, оскільки через готові згенеровані відповіді у багатьох людей не буде потреби переходити на оригінальні сторінки інформаційних ресурсів.

Мета. Окреслити виклики для енциклопедичної галузі в контексті розвитку генеративного штучного інтелекту.

Матеріали й методи. Дослідження ґрунтується на експрес-експериментах щодо швидкої оцінки можливостей генеративного штучного інтелекту (*ChatGPT*) розв'язувати різні завдання, типові для енциклопедичних редакцій, та на аналізі статистичних даних про трафік сайту академічної *Енциклопедії Сучасної України*. Крім експерименту й статистичного аналізу, використано описовий метод.

Результати. ШІ уможливлює автоматизацію низки функцій, пов'язаних із дією енциклопедичних онлайн-ресурсів, вдосконалюючи контент енциклопедичних статей. Водночас впровадження генеративного ШІ у глобальних пошукових системах становить певні виклики перед енциклопедичною галуззю — чим популярнішими ставатимуть згенеровані ШІ відповіді-довідки на запити користувачів інтернету, тим рідше у фокусі їхньої уваги будуть авторські довідки, створені фахівцями.

Висновки. Впровадження ШІ в енциклопедистиці є необхідністю для її розвитку, водночас зміни в *Google*, зумовлені його впливом, можуть негативно вплинути на трафік онлайн-енциклопедій.

Ключові слова: енциклопедії, енциклопедичний контент, пошукові системи, пошукова система *Google*, штучний інтелект, *ChatGPT*, великі мовні моделі.