Artificial Intelligence in Digital Marketing: Bibliometric Analysis*

Tetiana Zavalii[1,*,†], Serhii Lehenchuk[1,†,*], Tetiana Ostapchuk[1,†], Oleh Vlasenko[1,†] and Mykhailo Medvediev[2,†]

[1] *Zhytomyr Polytechnic State University, 103 Chudnivska str., 10001 Zhytomyr, Ukraine*
[2] *ADA University, School of Information Technologies and Engineering, 61 Ahmadbay Agha-Oglu str., AZ1008 Baku, Azerbaijan*

Abstract
The impact of Industry 4.0 technologies on developing digital marketing practices has been analyzed. The decisive role of artificial intelligence in promoting the development of digital marketing to ensure the efficiency of enterprise activities and hyper-personalization has been substantiated. The article's purpose has been to conduct a bibliometric analysis of scientific publications related to the use of artificial intelligence in digital marketing. The methodological basis of the study has been a bibliometric analysis, which was carried out using the tools built into the Scopus scientometric database and the VOSviewer software. The object of the study has been scientific works from the Scopus scientometric database for 1985-2024, selected by the key phrases "digital marketing" and "artificial intelligence". The study's results of the study confirm the significance and increasingly significant role of integrating artificial intelligence into digital marketing as a key factor in formation a new marketing paradigm.

Keywords
digital marketing, artificial intelligence, bibliometric analysis, digital marketing paradigm, VOSviewer

1. Introduction

The transition to Industry 4.0 has led to revolutionary changes in the business environment through the introduction of breakthrough technologies (Internet of Things, Big Data, artificial intelligence, cloud computing, augmented reality, robotics, cybersecurity, etc.), which has become a catalyst for a fundamental transformation of the methodological and applied aspects of digital marketing as an integral component of modern business processes.

The introduction of Industry 4.0 technologies has made it possible to increase the level of efficiency of digital marketing practices, ensuring the success of the implementation of marketing strategies of the enterprise, making them more dynamic and personalized, and generally contributing to the achievement of sustainable development goals. Some researchers even note the formation of a new paradigm of digital marketing, which is the result of revolutionary transformations not only at the level of marketing practices, but also in the scientific field of marketing. Examples of such transformations are: (1) Creation of specialized scientific publications that highlight the features of the implementation of digital marketing practices and are dedicated to the analysis of the use of individual Industry 4.0 technologies in digital marketing; (2) Formation of scientific associations and communities of scientists (scientific associations, federations, public organizations, etc.) that are engaged in the study of digital marketing problems and forecasting its development in the future; (3) Including digital marketing directly, as well as other related disciplines ("Targeting", "Digital Communications in Marketing", "Social Media Marketing", "Content Marketing", etc.) in educational programs and

* *DECaT'2025: Digital Economy Concepts and Technologies, April 4, 2025, Kyiv, Ukraine*
* Corresponding author.
† These authors contributed equally.
zavaliitatyana@gmail.com (T. Zavalii); legenchyk2014@gmail.com (S. Lehenchuk); ostapchuk-a@ukr.net (T. Ostapchuk); oleg@ztu.edu.ua (O. Vlasenko); miserablewisdom@ukr.net (M. G. Medvediev)
0000-0002-6315-5646 (T. Zavalii); 0000-0002-3975-1210 (S. Lehenchuk); 0000-0001-9623-0481 (T. Ostapchuk); 0000-0001-6697-2150 (O. Vlasenko); 0000-0002-3884-1118 (M. G. Medvediev)

curricula for training marketers and other specialists in the fields of economic and management sciences; (4) Research into theoretical and practical problems of digital marketing development based on the use of various Industry 4.0 technologies has become one of the elements of "normal" marketing science (according to T.S. Kuhn), which are fully recognized and carried out by representatives of the community of marketing scientists.

One of the defining technologies of Industry 4.0, which plays a crucial role in the transformation of digital marketing, is artificial intelligence, the wide implementation of which in the activities of enterprises and marketing agencies has caused a real revolution in established digital marketing practices. The consequences of this transformation are traced both in the application of complex technological solutions for the implementation of marketing strategies in the digital space, and in the modification of organizational structures, which requires intensive collaboration of marketers with IT specialists and leads to the hybridization of the marketing profession. The rapid development of digital marketing based on the use of artificial intelligence tools is an example of taking into account the progress of technology and society in practice, which allows for increasing the role of marketing in ensuring the effective functioning of enterprises in general and qualitatively improving the processes of interaction with consumers through hyper-personalization in particular.

The formation of the digital marketing paradigm in the last decade is a consequence of the revolutionary impact of Industry 4.0 technologies on digital marketing practices and on the scientific field of marketing, as noted by Bădică & Mitucă [1], Okorie et al. [2], and Paatlan & Ranga [3]. Artificial intelligence is becoming a determining factor in the formation of a new digital marketing paradigm, transforming both the technological components of marketing practices and the communication architecture of interaction with consumers. As a result, this issue is becoming the subject of intensified scientific reflection by researchers in technical and economic scientific fields.

The existence of a trend of increasing attention of scientists to the use of artificial intelligence in digital marketing in recent years is also noted by scientists engaged in bibliometric studies of this issue — Altayli et al. [4], Gökerik & Aktaş [5], Hue & Hung [6], Ismagiloiva et al. [7], Khandelwal et al. [7], Nalbant & Aydin [9], Oueslati & Ayari [10], Paatlan & Ranga [3], Sánchez-Camacho et al. [11], Sang [12].

The aim of the study is to conduct a bibliometric analysis of scientific publications related to the use of artificial intelligence in digital marketing.

The study results of the use of artificial intelligence in digital marketing are based on bibliometric analysis. This research method of scientific publications combines quantitative and qualitative indicators and is used for a comprehensive study of the industry based on analyzing the relationships between keywords and citations of publications. Bibliometric analysis allows you to identify key trends and patterns of various nature (thematic, structural, chronological, geographical, collaborative, citation, etc.) in scientific discourse, which makes it possible to systematically track the evolution of research on artificial intelligence in the marketing field and identify promising directions. To conduct a bibliometric analysis of the topic of the use of artificial intelligence in digital marketing, the authors currently use various scientometric databases (Scopus, Web of Science, Google Scholar, etc.) and various software tools (VOSviewer, Bibliometrix, SciMAT, CiteSpace, etc.). This article was based on the scientific works of scientists indexed in the Scopus database. The instrumental basis of the study was the tools built into the Scopus database and the VOSviewer software.

2. Results and discussion

In digital marketing research, there is now a clear understanding among scientists that artificial intelligence is a powerful tool for transforming marketing practices. It allows developing personalized marketing strategies, increasing brand awareness, customer engagement, and conversion rates. Artificial intelligence provides maximum value for consumers through rapid adaptation to their preferences. The active implementation of large language models (GPT-4, Claude, DeepSeek) in various industries confirms the validity of this approach to improving marketing processes. Another proof of the increasingly important role of artificial intelligence in the

implementation of digital marketing practices is the significant increase in interest among scientists in this issue in the last five years. A bibliometric analysis of the Scopus scientometric database, which covered 1345 English-language publications with the key words "digital marketing" and "artificial intelligence" in the titles, abstracts, and keywords of the publications, revealed a clear trend towards their exponential growth (Fig. 1).

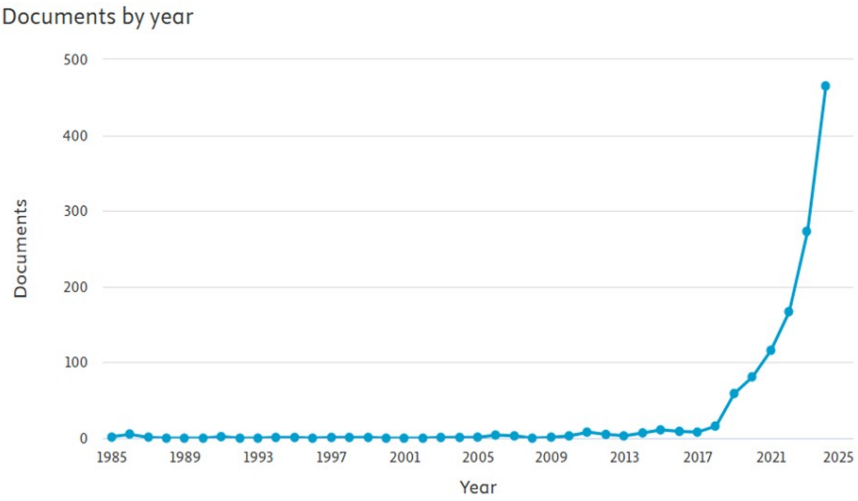

Figure 1: Dynamics of publication activity of authors in the Scopus scientometric database by research area: digital marketing and artificial intelligence
Source: generated by authors based on Scopus database

The results of the analysis (Fig. 1) show that until 2018 this area of scientific research remained relatively understudied, however, since 2019–2020, there has been a rapid rise in the publication activity of authors. The demonstrated exponential growth of scientific interest was due to a number of factors that stimulated the active implementation of artificial intelligence technologies in digital marketing practices: 1) Technological breakthrough in the field of developing artificial intelligence tools, in particular, the appearance of GPT-2 in February 2019; 2) The emergence of purely marketing-oriented tools and systems with artificial intelligence, which began to be implemented in the marketing activities of enterprises, e.g., the launch in June 2018 of the "Google Marketing Platform" service, for implementing online advertising campaigns and analyzing marketing activities; 3) The application of artificial intelligence, particularly advanced analytics, for large volumes of marketing data collected via Internet of Things technology; 4) The rapid growth of e-commerce has led to the emergence of practices of interactive interaction with consumers online using chatbots and other artificial intelligence tools.

Efendioğlu reached similar conclusions regarding the acceleration of artificial intelligence research in digital marketing since 2018. The researcher notes that this surge in research can be explained by various factors, in particular technological progress, data analytics, improving customer experience and optimizing marketing strategies [13]. At the same time, the author does not cite specific technological factors or the emergence of individual software platforms that would have led to a sharp increase in scientific publications in this area.

Based on analysis of scientific results from multiple researchers (Altayli et al. [4], Gökerik & Aktaş [5], Khandelwal et al. [8], Nalbant & Aydin [9], Sánchez-Camacho et al. [11]), it has been established that interest in applying artificial intelligence to digital marketing will continue to grow significantly. This trend is driven by AI's substantial development potential. In the future, this growth will likely accelerate proportionally with the emergence of enhanced AI capabilities, more effective integration with other Industry 4.0 technologies, and increasing implementation levels within enterprise marketing information systems.

As the results of the analysis conducted using built-in tools in the Scopus scientometric database showed, the majority of publications in the field of using artificial intelligence in digital marketing

are carried out by scientists from four countries — India, the USA, China and the UK. This indicates a high level of digitalization of marketing activities in these countries, a high level of involvement of scientists from these countries in solving the problem of optimizing marketing budgets in the processes of implementing digital marketing campaigns, as well as a high level of international cooperation in this area. In particular, the highest level of citations are publications in the journal "International Journal of Information Management", written by groups of authors under the leadership of British researcher J.K. Dwivedi — "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy" (2023) and "Setting the future of digital and social media marketing research: perspectives and research propositions" (2021).

On the other hand, the experience of companies from these countries in using artificial intelligence in marketing can serve as a benchmark for forming their own digital marketing strategies, taking into account the regional context. Such studies are published mainly in publications related to computer science (24.3%) and engineering (12.5%), which indicates the existence of a significant number of technological problems in implementing artificial intelligence in digital marketing, as well as in publications of economic and social orientation (business, management and accounting (17.2%), economics, econometrics and finance (9.5%), social sciences (7.9%), decision-making (6.6%)), which reveal the impact of this tool on the marketing activities of enterprises and marketing firms, its management processes, individual marketing practices and its impact on the economy and society as a whole. As the results of bibliometric analysis showed, the largest number of works on the research topic is placed in monographic publications and collections of conference abstracts Lecture notes in networks and systems and Lecture Notes in Computer Science, published by the Springer publishing house.

Using the software tool for forming and visualizing bibliometric networks VOSviewer to the results of the analysis of publications in the Scopus scientometric database allowed us to build two bibliometric maps that reflect the relationships of the keywords "digital marketing" and "artificial intelligence" with others used by the authors when researching the outlined topic.

The first map was formed based on publications that contain the keywords "digital marketing" and "artificial intelligence" in their title (Fig. 2).

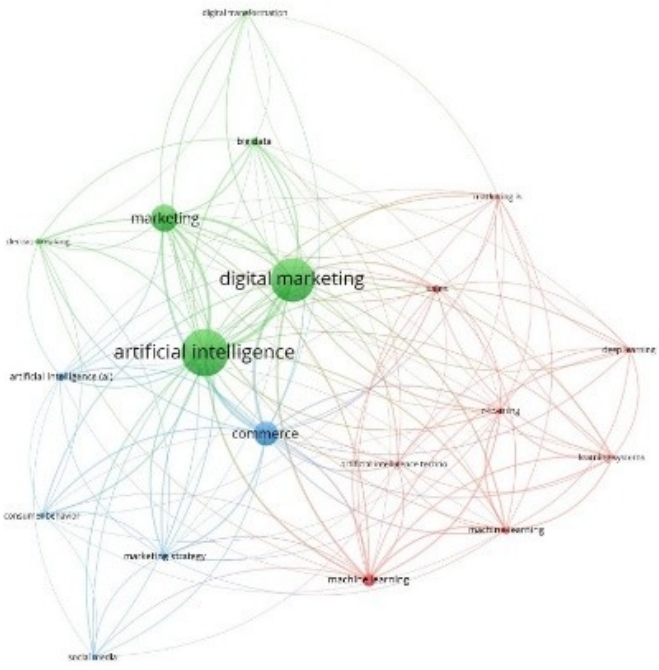

Figure 2: Bibliometric map formed by the key phrases "digital marketing" and "artificial intelligence" contained in the titles of publications included in the scientometric database "Scopus" for 1985–2024

Analysis of the formed bibliometric map (Fig. 2) allowed us to establish that when studying the issues of using artificial intelligence in digital marketing, scientists also pay attention to studying the following aspects: (1) The use of direct tools related to AI technology — machine learning, deep learning; (2) Studying its interaction with Big Data tools, provided that they are used simultaneously with them; (3) Analysis of the role of artificial intelligence tools in the process of implementing digital marketing practices using social networks, in the process of implementing e-commerce; (4) The impact of artificial intelligence on making marketing management decisions and on the digital transformation of the marketing activities of the enterprise in general. The second map was formed based on publications that also contain two of the same key phrases in their title, in the abstract and in the keywords of the publication, which allowed us to obtain a wider range of related areas of research (Fig. 3).

Analysis of the formed bibliometric map (Fig. 3), which provides network visualization, allowed us to identify detailed areas of research related to the use of artificial intelligence in digital marketing and which concern both the technological features of the implementation of this process and the consequences of its impact on digital marketing practices, consumer behavior, marketing activities of enterprises and society in general.

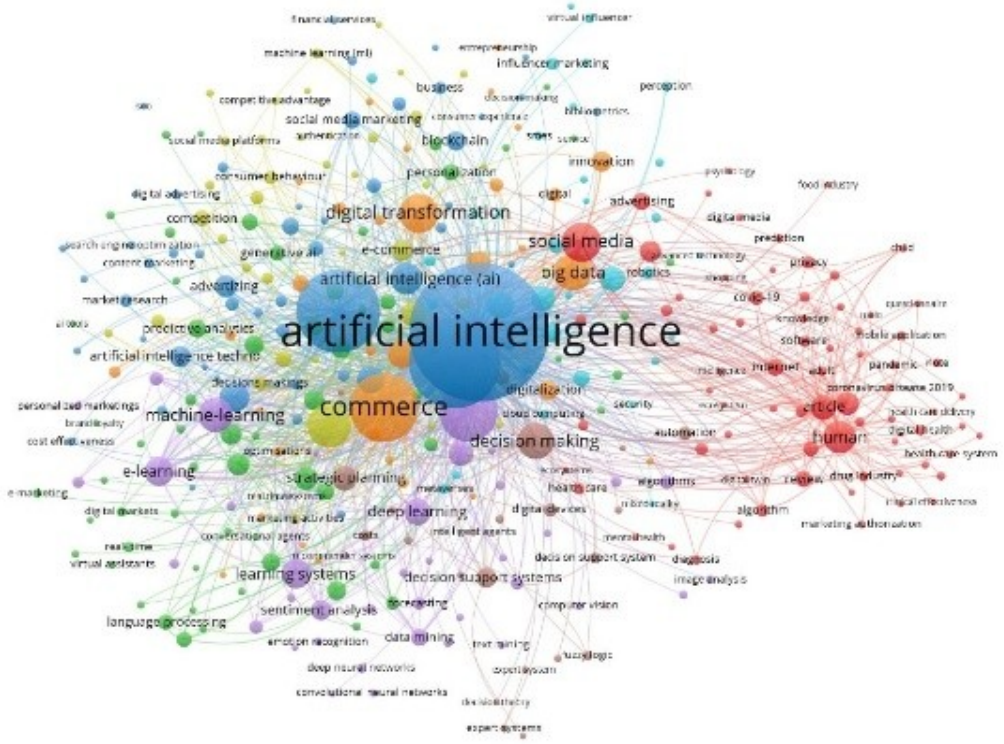

Figure 3: Bibliometric map formed by the key phrases “digital marketing” and “artificial intelligence” contained in the title of publications, in the abstract and in the keywords of publications included in the Scopus scientometric database for 1985–2024

Such areas include: (1) Digital technologies in marketing—digital advertising, online advertising, programmatic advertising, SMM, influencer marketing, content marketing; (2) Artificial intelligence tools—machine learning [14, 15], deep learning, e-learning, natural language processing, generative artificial intelligence [16, 17], chatbots, decision trees, sentiment analysis, engineering education, predictive analytics, forecasting; (3) Others related to the use of artificial intelligence, IT technologies —Big Data, Data mining, blockchain, digital storage, metaverse, virtual reality, augmented reality,

Internet of Things, Industry 4.0, Marketing 4.0; (4) Economic aspects of the use of artificial intelligence — e-commerce, sales, decision-making, competition, consumer intentions, consumer behavior, behavioral research, personalization, digital transformation; (5) The impact of artificial intelligence on marketing activities—decision-making, decision-making theory, decision-making support systems, expert systems, strategic planning, marketing strategy, digital marketing strategy.

Fig. 4 shows the 15 keywords that were most frequently found in the studied sample of scientific publications. The font size of publications reflects their weight (frequency of repetition) in the total number of keywords present in the title, keywords, and abstracts of publications, and reflects which of the selected areas are most actively researched by scientists.

Figure 4: "Keyword cloud" of the most frequently occurring terms across the analyzed publication sample

Having analyzed the research of scientists related to the use of artificial intelligence in digital marketing, through the transformation of the formed bibliometric map from network visualization (Fig. 3) to chronological overlay visualization, a trend of changing the main object of such scientific research was highlighted. Thus, if during 2020–2022 scientists paid the main attention to studying the features of use, problems and opportunities of artificial intelligence tools used in marketing, then from 2023 the predominant attention of researchers began to focus on the specifics of the implementation of marketing practices in the conditions of using various artificial intelligence tools and the general issues of digital transformation of marketing activities as a result of their application. The main reason for such changes in scientific research is seen by Sanchez-Camacho et al. in the unprecedented growth of the spread of artificial intelligence in open access [11].

In general, the existence of the identified trend indicates that research in this area is in constant development and is expanding due to the acceleration of the pace of involving new artificial intelligence tools in digital marketing practices and their effective integration with other Industry 4.0 technologies (Big Data, Internet of Things, cloud computing, etc.) as part of the marketing information system of the enterprise. In particular, as Paatlan & Ranga note, the wide popularity of this scientific topic is the result of an important triple influence—how artificial intelligence rethinks marketing, the available more or less accurate data and the emergence of new Big Data on the ground [3]. Thus, the authors confirm that the popularity of research on the use of artificial intelligence in digital marketing is directly related to the significant role in its development of such technologies as the Internet of Things and Big Data.

Conclusions

This article presents a bibliometric analysis of artificial intelligence applications in digital marketing. The research examines two samples of scientific articles spanning 1985–2024, indexed in the Scopus scientometric database and selected using the key phrases "digital marketing" and "artificial intelligence". The first sample was formed by the correspondence of these key phrases in the titles of English-language publications, and the second — similarly, but included in addition to the title also annotations in the Scopus scientometric database keywords.

In general, the results obtained confirm the significance of the issues of using artificial intelligence in digital marketing in forming a new marketing paradigm. According to the results of the bibliometric study conducted using tools built into the Scopus scientometric database and using the VOSviewer software, it was established: 1) The existence of a rapid rise in the publication activity of scientists on the research topic since 2019–2020; 2) The leaders in research on the use of artificial intelligence in digital marketing are scientists from India, the USA, China and the UK; 3) Such research is published mainly in publications in computer engineering sciences (36%) and socio-economic sciences (41%); 4) Detailed and insufficiently developed areas of scientific research related to the use of artificial intelligence in digital marketing are: digital technologies in marketing; artificial intelligence tools; others related to the use of artificial intelligence, IT technologies; economic aspects of the use of artificial intelligence; the impact of artificial intelligence on marketing activities; 5) The existence of a dependence on the use of artificial intelligence in digital marketing on the level of development and effective interaction with the Internet of Things and Big Data.

The conducted bibliometric study has several limitations that should be taken into account by other scientists when using and interpreting its results. First, only the Scopus scientometric database was used for the analysis, so the scope of the study can be expanded by processing publications from other databases. Second, the VOSviewer software was used to interpret and visualize the analysis results. Using other similar software tools, based on their functionality, may allow obtaining results in other scientific sections and dimensions. Overcoming these limitations can be considered a prospect for further scientific research.

Declaration on Generative AI

While preparing this work, the authors used the AI programs Grammarly Pro to correct text grammar and Strike Plagiarism to search for possible plagiarism. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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