Artificial Intelligence Research Visibility as Reflected in the Web of Science: A Scientometric Approach

B. Kumara[1] B T. Sampath Kumar[2] and S.N Rajashekara[3]

[1]Tumkur University, University Library, B.H. Road, Tumakuru, India

[2]Tumkur University, B.H. Road, Tumakuru, India

[3]Jyothy Institute of Commerce and Management, Bangalore, India

[1]*Corresponding author email: kumarapb@gmail.com*

Abstract:

This paper examines the research visibility of "artificial intelligence" in the Web of Science over a span of 20 years, from January 2005 to December 2024. The study is confined to only full-text articles included in the Web of Science database. The data was collected from the Web of Science database by using the keyword " artificial intelligence." To identify the research productivity of " artificial intelligence," a total of 44,313 records have been downloaded and recorded in the MS Excel spreadsheets for further analysis. Moreover, in this study, VOSviewer software tools were used to create data visualization. The study found that there is a positive correlation between the number of articles found in the Web of Science and the year; the correlation is significant (r=.796**, p=.000). It was noticed that 21,002 articles were identified as being related to artificial intelligence. The notable finding of the study is that Attia, Zachi Itzhak, has the most publications (151) and is ranked first among the top 20 researchers. The most productive year was 2024, which saw 11,869 publications, accounting for 26.8% of the total records. Noteworthy findings include that Harvard University ranked first among the top 20 institutions, with 1,086 publications. Additionally, the USA led the global rankings with 11,306 published articles, securing the top position among the 20 leading countries. Further, it is found that the overall 9,031 articles were recorded in computer science subjects, followed by engineering

subjects. The findings of the study is that, the growth rate of research publications on "artificial intelligence" in terms of publications, citations, types of publications, author productivity, productive countries, and authorship patterns etc. The study recommended that the researcher need to keep publishing quality research articles in reputable journals to have more visibility. The notable finding of the study is that there are significant trends in publication patterns and citation impacts in recent years.

Keywords: *Artificial Intelligence; Publications; Scientometric; Research visibility; Web of Science.*

Introduction

The main task of bibliographic databases is indexing publications (e.g., articles, books, conferences). Each record in databases contains metadata repositories such as the author's name, title, year, publisher, author’ s keywords, and keywords that the publishers provide. For this reason, citation databases such as Scopus and Web of Science (WoS) have separate fields for entering this metadata. Such a Web of Science Core Collection (WoSCC) as the world’ s leading scientific citation search and analytical information platform (Li et al., 2018; Shamsi et al., 2022). Publications without authorship information have been indexed as anonymous in the Web of Science database over the years. Since bibliometrics studies are widely used for bibliometricians, scientific disciplines, science policy, and management, missing significant data as authorship metadata characterizes a gray zone that directly impacts these three components, and by extension, for bibliometrics and scientometrics (Shamsi et al., 2022). The analysis teaches us that AI has emerged as a set of journals with the characteristics of a discipline only since 1988. The thereafter relatively stable set of journals includes both fundamental and applied AI-journals, and journals with a focus on expert systems. Additionally, specialties related to artificial intelligence (like pattern analysis, computer science, cognitive psychology) are identified (Van den Besselaar, and Leydesdorff, 1996). Measurable research outputs such as papers, patents, and in novations have been subject to high enduring growth rates over the last century. Yet, recent empirical evidence suggests that research

productivity is ever falling and new ideas are becoming increasingly harder to find (Gordon, 2016; Bloom et al., 2020; Bianchini et.al, 2022).

The digital world, characterized by automation and artificial intelligence (AI), is reshaping the accounting profession. It transforms traditional practices by enhancing efficiency, accuracy and decision-making capabilities (Zhang and Chen, 2024). Artificial Intelligence (AI) has emerged as a transformative force across various sectors, revolutionising industries and driving innovation. The rapid advancements in AI technologies, from machine learning and deep learning to natural language processing and computer vision, have led to an exponential increase in research activities worldwide. AI has been integrated into many facets of everyday life, such as computer gaming, Alexa, Google Assistant, and many others. In the past few decades, it has experienced enormous growth (Keshava and Shankar, 2024). The social and technological changes that society is undergoing in this century are having a global influence on important aspects such as the economy, health and education. An example of this is the inclusion of artificial intelligence in the teaching– learning processes. The objective of this study was to analyze the importance and the projection that artificial intelligence has acquired in the scientific literature in the Web of Science categories related to the field of education (Moreno-Guerrero et.al, 2020). Keeping in view the importance the study has attempt the Artificial Intelligence Research Visibility as Reflected in the Web of Science databases.

Review of Literature

Agarwal et al. (2016) were of the view that evaluating researchers and their research impact in modern times has become increasingly popular since a researcher’ s number of publications can easily be retrieved from any major research database such as PubMed, Scopus, and Web of Science. Mingle, Achampong and Acheampong (2020) stated that regarding academic publications, web presence indicators may include: keywords (pointers to a scientists’ area of specialization), choice of journal (journal impact factor), and parent institution (website

mentions/profiles and Institutional Repository), number of hits (total number of works/articles in a Google search); and citation counts (how many times an individual have been cited). Praveena et.al (2021) conducted a study on the scientometric analysis of research literature on Artificial Intelligence from the year 1999 to 2019. The main objective of this research work is to explore the academic research/review publication contributed by Scientists and Subject experts from an Engineering background. Shamsi et al. (2022) conducted a study that found that, with a data collection performed at Web of Science Core Collection (Woscc), 1,420,842 documents under " anonymous" authorship from 1900 to 2021 were retrieved, which accounted for 1.5% of the total documents indexed in the Woscc.

The publication data, such as yearly growth of research publications, document type, language, productive research areas, and other bibliometric indicators, were analysed. According to Kumara and Sampath Kumar (2023), the study investigates the research visibility of faculty members working at Tumkur University, India. It is observed that the number of articles published by the faculty members has increased slightly during the last 10 years. Further, it is also observed that the citation counts have increased during the last ten years in the Web of Science database. Das et.al.(2024). Investigate the study found that the top 100 most-cited papers published in the last 10 years were cited 3128 times. The United States accounted for the majority of the publications (30.7%), the Charité Medical University of Berlin had the most papers (10%), and Schwendicke was the author with the highest number of papers (16%). Journal of Dentistry (16%) published the most papers. Calvo-Rubio and Ufarte-Ruiz (2021) stated that the research about the use of Artificial Intelligence applied to journalism has increased over the years. The studies conducted in this field between January 2008 and December 2019 were analysed to understand the contexts in which they were developed and the challenges detected. The findings indicate that the largest number of publications related to this topic are concentrated in the United States and that the rise of scientific production on Artificial Intelligence in journalism

took place in 2015, when the remarkable growth of these publications began, reaching 61 in 2019. In its own right, the Web of Science, described as the most trusted publisher-independent citation database across the world, is acclaimed as the search engine which affords researchers great access, reliable discovery and assessment (Web of Science Group, 2019). In this research, the concept of AI is analysed from a bibliometric perspective of the documents indexed in the Web of Science (Wos) database. In this case, the novelty of this study focuses on presenting a documentary analysis to the scientific community using an innovative technique such as scientific mapping (Belmonte, et.al, 2019; Rodríguez-García, 2019; Moreno-Guerrero et.al, 2020).

Objective of the Study

This study focuses on the following objectives.

a) To analyse the growth and trends in Artificial Intelligence literature from 2005 to 2024.

b) To identify the various types of documents published in the field of Artificial Intelligence.

c) To determine the most prolific authors and leading academic institutions contributing to AI research.

d) To evaluate the top 10 countries and publishers with the highest output in AI-related publications.

Scope and Methodology

The data was collected from the Web of Science database using the keyword " Artificial Intelligence." The number of records found against the word " Artificial Intelligence" in the Web of Science during the last 20 years (2005-2024). A total of 44, 313 records have been downloaded and recorded in the MS Excel spreadsheets for further analysis, and VOSviewer software tools were used to create data visualisation. The study is confined to only full-text articles included in the Web of Science database. The search was for needs in the Web of Science on artificial intelligence. The following were taken into account as inclusion criteria: year-wise growth of AI literature, forms of

document publications on AI, most profiled authors, most profiled universities/institutions, most productive countries in AI literature, most cited articles, research areas, publishers, and languages.

Data Analysis and Interpretation

Table 1: Year-wise growth of AI Literature from 2005 to 2024

Years	Visibility of Records	% of Visibility of Records	Cumulative Records Received	% of Cumulative Records	r	p-value
2005	122	0.3	137	0.3	.796**	.000
2006	137	0.3	259	0.6		
2007	142	0.3	401	0.9		
2008	149	0.3	550	1.2		
2009	171	0.4	732	1.7		
2010	180	0.4	903	2.0		
2011	182	0.4	1083	2.4		
2012	190	0.4	1273	2.9		
2013	206	0.5	1479	3.3		
2014	267	0.6	1746	3.9		
2015	272	0.6	2018	4.6		
2016	366	0.8	2384	5.4		
2017	576	1.3	2960	6.7		
2018	1247	2.8	4207	9.5		
2019	2642	6.0	6849	15.5		
2020	3887	8.8	10736	24.2		
2021	5614	12.7	16350	36.9		
2022	7434	16.8	23784	53.7		
2023	8660	19.5	32444	73.2		

2024	11869	26.8	**44313**	**100**
Total	**44313**	**100**		

*** Correlation is significant at the 0.01 level (2-tailed).*

The increase in AI literature each year is presented in Table 1. The table shows that 44313 records were found in Web of Science between 2005 and 2024. The study found that most of the minor articles were located in 2005 (122, or 0.3%), while the greatest number of articles were identified in 2024 (11,869, or 26.8%). Pearson's correlation has been used to determine the relationship between the year and the quantity of articles published over the last 20 years. The study's findings indicate that the year and record visibility have a significant positive association (r=.796**, p=.000).

Table 2: Various types of documents published in the field of Artificial Intelligence

Document Types	Records	% of Records	Visibility of	r	p-Value
Articles	21002	47.4		-.655**	.002
Review Articles	5426	12.2			
Proceedings Papers	5356	12.1			
Meeting Abstract	5001	11.3			
Editorial Material	4071	9.2			
Letters	1072	2.4			
Early Access	1000	2.3			
Retracted Publication	475	1.1			
Correction	298	0.7			
Book Review	260	0.6			
News Item	181	0.4			
Retraction	133	0.3			
Book Chapter	16	0.04			
Data Paper	7	0.02			
Meeting	7	0.02			

Publication with Expression of Concern	4	0.01
Biographical Item	2	0.0
Item Withdrawal	1	0.0
Reprint	1	0.0
Total	44313	100

*** Correlation is significant at the 0.01 level (2-tailed).*

Table 2 shows that there are forms of documents and publications on AI. The study found that, based on the visibility of documents as shown in Web of Science, the study also attempted to determine which documents were the most productive. According to the table, most of the documents are articles (21002, 47.4%), followed by review articles (5426, 47.4%) and proceedings papers (5356, 12.2%). Pearson's correlation has been applied to determine the relationship between the document types and the visibility of records published over the last 20 years. The study found a significant association between the most productive documents and the number of records. The positive correlation between findings indicates that the year and record visibility have a significant positive association (r=-.655**, p=.002).

Table 3: Most prolific authors contributing to AI research.

Name of the Researchers	No. of Articles	Percentage	Rank
Attia, Zachi Itzhak	151	11.5	1
Friedman, Paul	140	10.7	2
Noseworthy, Peter A.	103	7.9	3
Lopez-Jimenez, Francisco	94	7.2	4
Mori, Yuichi	78	6.0	5
Hassan, Cesare	74	5.7	6
Ting, Daniel Shu Wei	72	5.5	7
Ock, Chan-Young	62	4.7	8
Saba, Luca	62	4.7	9
Misawa, Masashi	61	4.7	10

Repici, Alessandro	58	4.4	11
Wiwanitkit, Viroj	45	3.4	12
Kapa, S.	42	3.2	13
Tada, T	41	3.1	14
Wong, Tien Yin	40	3.1	15
Macedo, Manuel Guilherme	39	3.0	16
Yaseen, Zaher Mundher	38	2.9	17
Nourani, Vahid	36	2.8	18
Denniston, Alastair	36	2.8	19
Keane, Pearse	36	2.8	20
	1308	**100.00**	

Table 3 shows the visibility of the most productive author profiles reflected in the Web of Science database. The study found that Attia, Zachi Itzhak, has the most publications (151) and is ranked first among the top 20 researchers. Furthermore, Friedman, Paul (140), and Noseworthy, Peter A. (103) have published articles and ranked second and third, respectively.

Table 4: Most prolific academic institutions contributing to AI research.

Name of the Universities/Institutions	No. of Articles	Percentage	Rank
Harvard University	1086	10.4	1
University of California System	895	8.6	2
Harvard University Medical Affiliates	823	7.9	3
University of London	785	7.5	4
Mayo Clinic	627	6.0	5
Harvard Medical School	624	6.0	6

Stanford University	522	5.0	7
University of Texas System	512	4.9	8
University of Toronto	467	4.5	9
University College London	443	4.2	10
State University System of Florida	419	4.0	11
Egyptian Knowledge Bank EKB	412	3.9	12
University System of Ohio	396	3.8	13
National University of Singapore	379	3.6	14
University of Oxford	378	3.6	15
Massachusetts General Hospital	358	3.4	16
Chinese Academy of Sciences	331	3.2	17
Imperial College London	331	3.2	18
Johns Hopkins University	331	3.2	19
Pennsylvania Commonwealth System of Higher Education PCSHE	331	3.2	20
Total	**10450**	**100.0**	

The top 20 most productive profiles of the universities/institutions are presented in Table 4. Noteworthy findings include that Harvard University ranked first among the top 20 institutions, with 1,086(10.4%) publications, followed by the University of California System (895, 8.6%) and Harvard University Medical Affiliates (823, 7.9%).

Table-5: Top-10 Most cited articles in AI literature

Authors	Article Title	Name of Journals	Publication Year	Citations	Rank
Arrieta et.al.	Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI	Information Fusion	2020	4313	1
Topol, EJ	High-performance medicine: the convergence of human and artificial intelligence	Nature Medicine	2019	3174	2
Adadi, A; Berrada, M	Peeking Inside the Black-Box: A Survey on Explainable Artificial Intelligence (XAI)	IEEE Access	2018	3025	3
Miller, T	Explanation in artificial intelligence: Insights from the social sciences	Artificial Intelligence	2019	2543	4
Hosny et.al.	Artificial intelligence in radiology	Nature Reviews Cancer	2018	2111	5
Jiang et.al	Artificial intelligence in healthcare: past, present and future	Stroke and Vascular Neurology	2017	1822	6
Liu et.al.	Artificial intelligence for fault diagnosis of rotating machinery: A review	Mechanical Systems and Signal Processing	2018	1503	7
Huang et.al.	Artificial Intelligence in Service	Journal of Service Research	2018	1487	8
Yu, KH; Beam, AL; Kohane, IS	Artificial intelligence in healthcare	Nature Biomedical Engineering	2018	1452	9
Dwivedi et.al.	Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy	International Journal of Information Management	2021	1388	10

Top-10 most cited articles reflected in the Web of Science is presented in the table 5. It is found that the article entitled “ Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI, by Arrieta and others published in 2020 has received 4,313 citations. Further, another highly cited article is “ High-performance medicine: the convergence of human and artificial intelligence” by Topol, E.J., published in 2019 received 3,174 citations.

Table-6: Top 20 Most productive countries in AI literature

Countries/Regions	Records	Percentage	Rank
USA	11306	23.8	1
Peoples R China	8060	16.9	2
England	3467	7.3	3
India	2659	5.6	4
Germany	2518	5.3	5
Italy	2381	5.0	6
Canada	1984	4.2	7
Australia	1820	3.8	8
South Korea	1762	3.7	9
Spain	1673	3.5	10
France	1524	3.2	11
Japan	1346	2.8	12
Saudi Arabia	1185	2.5	13
Netherlands	1089	2.3	14
Taiwan	954	2.0	15
Iran	901	1.9	16
Switzerland	853	1.8	17
Brazil	766	1.6	18
Singapore	678	1.4	19
Turkiye	670	1.4	20
Total	**47,596**	**100.0**	

Note: *The number of articles excludes 44,313 since many authors have contributed articles collaboratively.*

Table 6 presents the top 20 most productive countries in AI literature. The study found that the USA led the global rankings with 11,306 (23.8%) published articles, securing the top position among the 20 leading countries followed by China (8,060, 16.

9%), England (3,467- 7.3%) and India (2659, 5.6%), secured 2nd, 3rd and 4th rank respectively.

Table 7: Areas of Research in AI (Top-20)

Research Areas	Records	Percentage	Rank
Computer Science	9031	20.7	1
Engineering	8156	18.7	2
Science, Technology, Other Topics	2243	5.1	3
Radiology, Nuclear Medicine, Medical Imaging	2093	4.8	4
General Internal Medicine	2061	4.7	5
Business Economics	1905	4.4	6
Telecommunications	1855	4.3	7
Oncology	1699	3.9	8
Chemistry	1520	3.5	9
Environmental Sciences Ecology	1423	3.3	10
Materials Science	1377	3.2	11
Surgery	1351	3.1	12
Cardiovascular System Cardiology	1315	3.0	13
Neurosciences Neurology	1284	2.9	14
Gastroenterology Herpetology	1254	2.9	15
Health Care Sciences Services	1170	2.7	16
Physics	1086	2.5	17
Education Educational Research	1017	2.3	18
Medical Informatics	934	2.1	19

Energy Fuels		855	2.0	20
	Total	**43,629**	**100.0**	

Table 7 shows the top 20 research areas. It is found that the overall 9,031 articles were recorded in computer science subjects secured in 1st rank, followed by engineering (8,156, 18.7%), science and technology (2,243, 5.1%) and also radiology nuclear medicine medical imaging (2,093, 4.8%) subjects secured 2nd, 3rd and 4th rank respectively.

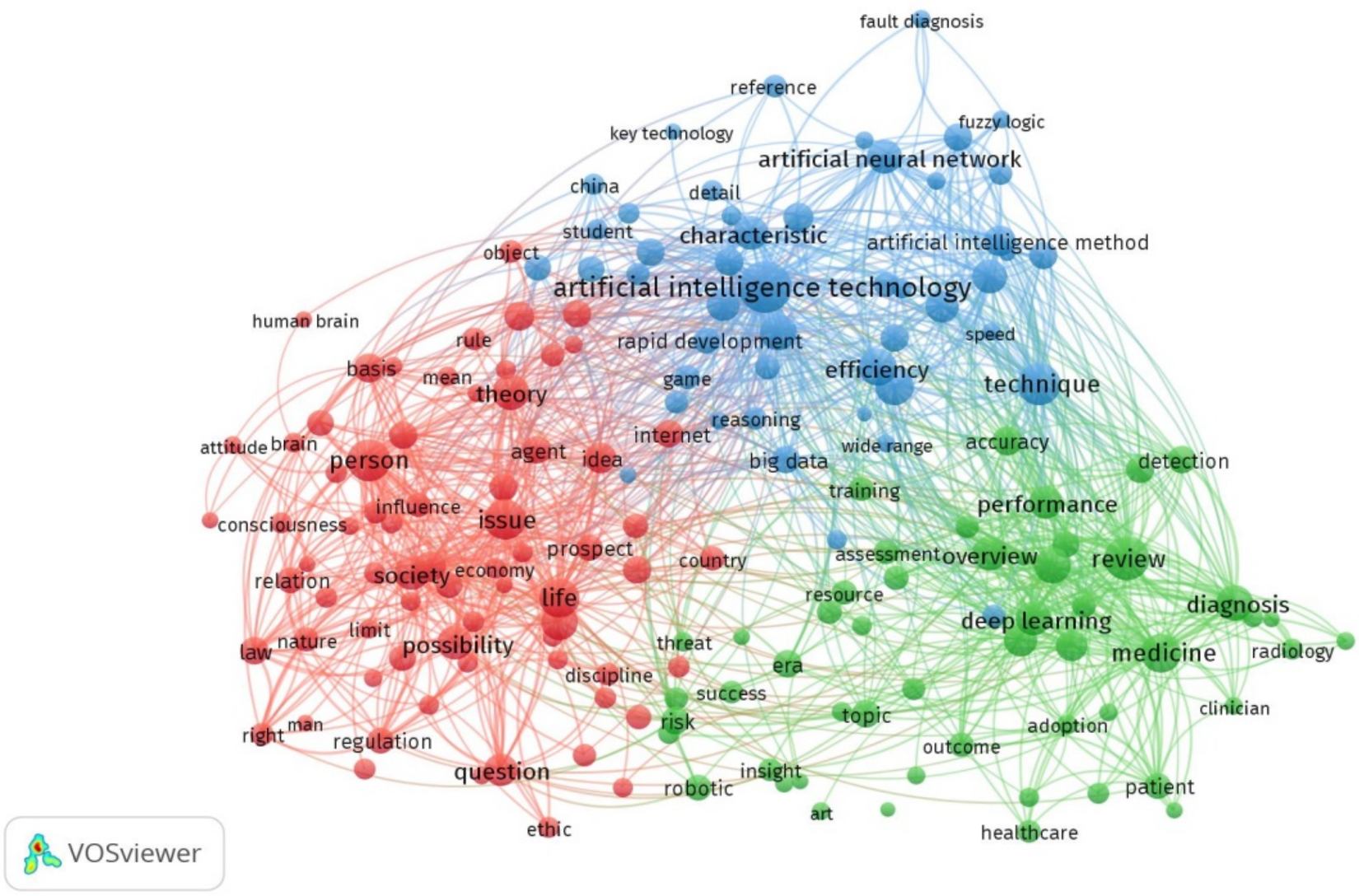

Figure-1: Network Visualization for the keywords

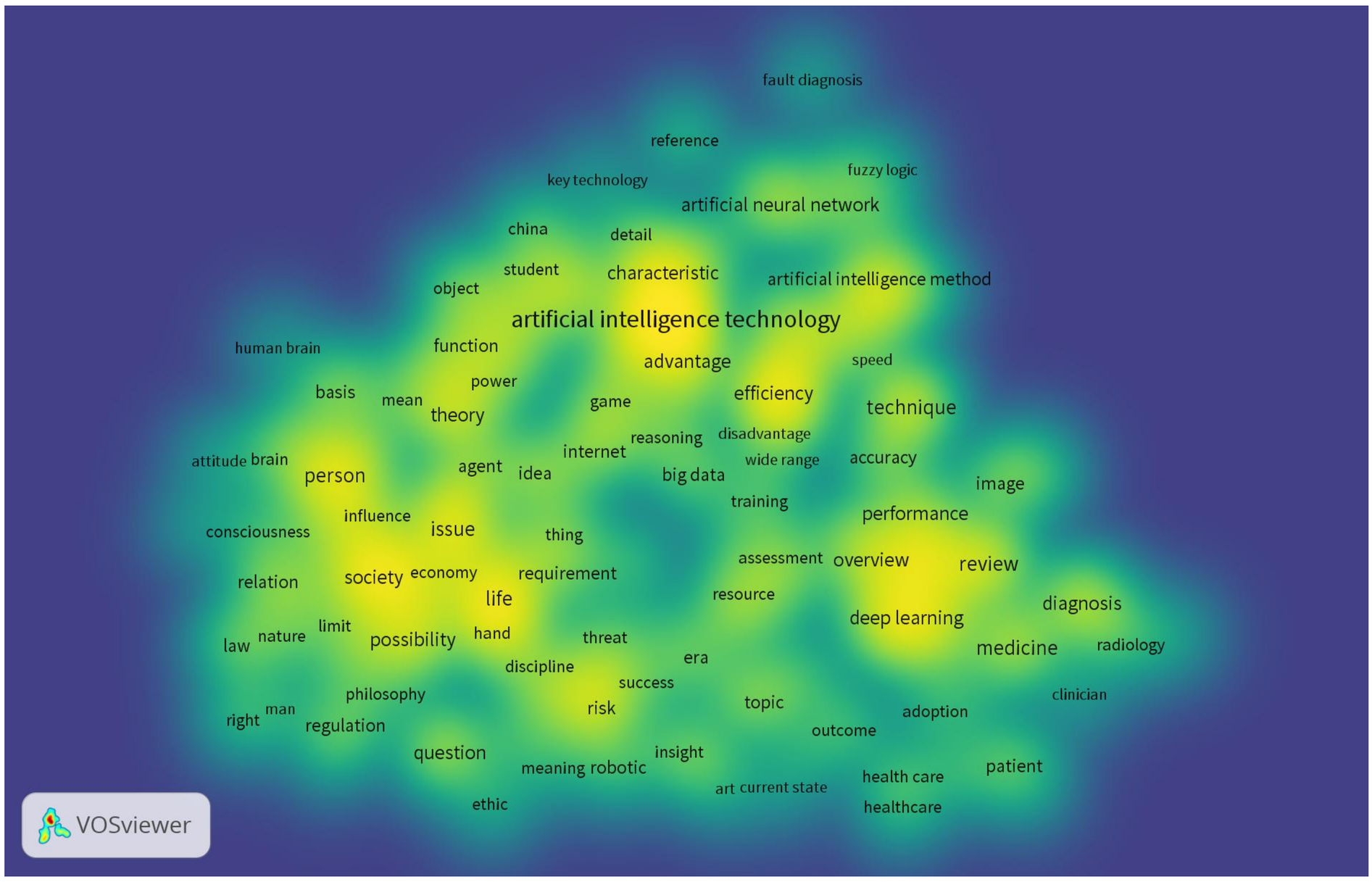

Figure 2. Density visualization for the frequency of the keywords.

Table 8: Top 10 countries with the highest output in AI-related publications.

Publishers	Records	Percentage	Rank
Elsevier	8829	25.3	1
Springer Nature	5726	16.4	2
IEEE	3543	10.1	3
MDPI	3316	9.5	4
Wiley	3023	8.6	5
Lippincott Williams & Wilkins	1602	4.6	6
Oxford Univ Press	1307	3.7	7
Taylor & Francis	1243	3.6	8
Frontiers Media Sa	1100	3.1	9

Sage	1005	2.9	10
Nature Portfolio	810	2.3	11
Hindawi Publishing Group	706	2.0	12
Assoc Computing Machinery	596	1.7	13
Bmj Publishing Group	381	1.1	14
Wiley-Hindawi	330	0.9	15
Emerald Group Publishing	313	0.9	16
Assoc Research Vision Ophthalmology Inc	295	0.8	17
Amer Chemical Soc	281	0.8	18
Amer Medical Assoc	280	0.8	19
Thieme Medical Publishers	263	0.8	20
Total	**34,949**	**100.0**	

Table 8 shows the visibility of the top 20 publishers in the Web of Science database. Elsevier publisher ranked first among the top 20 publishers worldwide, with 8,829 (25.3%) published records, followed by Springer Nature (5,726, 16.4%), IEEE (3,543, 10.1%), and MDPI (3,316, 9.5%).

Table 10: Top 10 languages with the highest output in AI-related publications.

Languages	Number of Records	Percentage	Rank
English	41920	94.6	1
German	353	0.8	2
Spanish	104	0.2	3

French	62	0.1	4
Turkish	34	0.1	5
Portuguese	19	0.0	6
Hungarian	12	0.0	7
Unspecified	12	0.0	8
Chinese	11	0.0	9
Other Languages	1786	4.0	10
Total	**44,313**	**100.0**	

The visibility of artificial intelligence records in the Web of Science database published in different languages is presented in Table 9. The study found that, among the top 10 languages, 94.6% of the artificial intelligence records were published in the English language. Furthermore, very few of the articles are published in other languages (4.0%).

Discussion and Conclusion

The present study found various interesting results regarding the research visibility of AI literature. Firstly, the study found that the authors have published many AI-related research articles in various journals over the last 20 years. The growth rate of AI literature increased every year from January 2005 to December 2024, with a total of 44,313 publications downloaded from the Web of Science database. In this context, it is observed from the study that there is a significant positive correlation between the year and publications.

Secondly, Table 2 shows the forms of publications on AI. The study found that most of the documents are articles (21,002, 47.4%), followed by review articles (5,426, 47.4%) and proceedings papers (5,356, 12.2%). The notable finding of the study is that more articles were published compared to other bibliographical documents. The study found a significant positive correlation between the most productive documents and the number of records. In this context, the study recommended that authors publish more articles from other bibliographical documents from reputable publishers. The notable finding of the study is that Attia, Zachi Itzhak, has the most publications (151) and is ranked first among the top 20 researchers. In this context, it is recommended that the researcher need to keep publishing quality research articles in reputable journals to have more visibility.

References:

Belmonte, J.L.; Moreno-Guerrero, A.-J.; López-Núñez, J.-A.; Pozo-Sánchez, S. Analysis of the Productive, Structural, and Dynamic Development of Augmented Reality in Higher Education Research on the Web of Science. Appl. Sci. 2019, 9, 5306.

Bi WL, Hosny A, Schabath MB et al (2019) Artificial intelligence in cancer imaging: clinical challenges and applications. CA Cancer J Clin 69:127–157. https://doi.org/10.3322/caac.21552

Bianchini, S., Müller, M., & Pelletier, P. (2022). Artificial intelligence in science: An emerging general method of invention. Research Policy, 51(10), 104604.

Calvo-Rubio, L. M., & Ufarte-Ruiz, M. J. (2021). Artificial intelligence and journalism: Systematic review of scientific production in Web of Science and Scopus (2008-2019).

Das, D., Kshetrimayum, N., & Devi, R. S. (2024). Scientometric analysis of 100-most-cited papers on AI in dentistry. International Dental Journal, 74, S6.

Keshava & Shankar B.C. (2024)., Global Research On Artificial Intelligence: A Scientometric Study, *Fifth International Conference on Science & Technology Metrics (STMet 2024), 117-130.*

Praveena, K. Veerakumar, ,S Rajeswari, 2021, Scientometric study of Academic Publications on Artificial Intelligence, Indian Journal of Library and Information Science, 15(2):57– 64.

Labhart N, Hasler B, Zbinden A (2012) The ShanghAI Lectures: a global education project on artificial intelligence. J Univers Comput Sci 18:2542–2555. https://doi.org/10.5167/uzh-73349.

Lei, Y., & Liu, Z. (2019). The development of artificial intelligence: A bibliometric analysis, 2007–2016. Journal of Physics: Conference Series, 1168(2), 022027. https://doi.org/10.1088/1742-6596/1168/2/022027.

Li. J (2018) Cyber security meets artificial intelligence: a survey. Front Inform Technol Electron Eng 19:1462–1474. https://doi.org/10.1631/fitee.1800573.

Moreno-Guerrero, A. J., López-Belmonte, J., Marín-Marín, J. A., & Soler-Costa, R. (2020). Scientific development of educational artificial intelligence in Web of Science. *Future Internet*, *12*(8), 124.

Rodríguez-García, A.-M.; Belmonte, J.L.; Montoro, M.A.; Guerrero, A.J.M. Productive, Structural and Dynamic Study of the Concept of Sustainability in the Educational Field. Sustainability 2019, 11, 5613.

Shamsi, A., Silva, R. C., Wang, T., Raju, N. V., & Santos-d' Amorim, K. (2022). A grey zone for bibliometrics: publications indexed in Web of Science as anonymous. Scientometrics, 127(10), 5989-6009.

Van den Besselaar, P., & Leydesdorff, L. (1996). Mapping change in scientific specialties: A scientometric reconstruction of the development of artificial intelligence. Journal of the American Society for Information Science, 47(6), 415-436.

Zhang,L. and Chen,A.(2024), " A deep dive into an AI startup company in the pandemic" , Issues in Accounting Education, Vol. 39 No. 2, pp.183-197.