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# A BIBLIOMETRIC ANALYSIS OF PUBLICATION PRODUCTIVITY IN THE FIELD OF OPEN AI: OUTCOMES OF SciVal ANALYTICS

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## Abstract

In recent years, the field of open AI has gained increasing significance with a growing number of scientific publications and research projects in this domain. The aim of this paper is to present a bibliometric overview of open AI research, aiming to provide a comprehensive analysis of the top countries, institutions, authors, journals, and keywords in the field. Through our bibliometric analysis, we have identified the leading contributors and research trends within open AI. This analysis serves as a valuable resource for researchers, policymakers, and stakeholders, offering insights into the current state and emerging trends in open AI research. It also aids in the identification of potential future research fields and areas of interest.

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## Key Words

Bibliometric analysis; SciVal analytics; open AI.

## INTRODUCTION

Thanks to its ground-breaking work in the field of artificial intelligence (AI), open AI is now more important than ever. Researchers and academics are becoming more and more interested in the study of AI. One key driver of this rise in interest is the significant impact that AI technologies have on a variety of industries and fields, including healthcare, finance, transportation, and more. Scientists are motivated to discover more about AI's capabilities since it has the potential to alter the course of human history.

The significance of open AI as a concept has increased the necessity of providing accessible, transparent, and helpful artificial intelligence. The organisation OpenAI, which has been at the forefront of promoting open AI concepts, has further enhanced its significance. Through several efforts, OpenAI has considerably raised the importance of open AI and played a crucial role in the advancement of the AI field. OpenAI has increased awareness of the value of open AI and its potential social impact by publicly revealing its goals and guiding principles. OpenAI has made a substantial contribution to the creation of ChatGPT and other AI model designs. An application of OpenAI's research and technology achievements is the AI language model ChatGPT. By offering a platform for human-like text generation and interaction, it exemplifies the power of open AI.

The strategy taken by OpenAI is collaborative and open, which has greatly contributed to its rise in relevance. OpenAI has developed a thriving community of researchers who actively contribute to the advancement of AI by encouraging a culture of collaboration and knowledge sharing. As a result of the organization's focus on open-source software, datasets, and research findings, researchers from all over the world can build upon previous work, hastening the rate of innovation in the sector. Researchers from all backgrounds and fields have been drawn to this open and cooperative atmosphere, encouraging multidisciplinary study and the interchange of ideas.

Additionally, OpenAI's contribution to addressing ethical issues and supporting ethical AI practises has increased its relevance. Concerns like ethics, bias, transparency, and fairness have grown in importance as AI technology develops. In these debates, OpenAI has been at the fore, pushing for ethical AI creation and application. Researchers now have a road map for carrying out AI research in a way that benefits society as a whole thanks to the organization's focus on safety research, regulatory standards, and ethical frameworks. Researchers that are motivated not only by technological achievements but also by the desire to develop AI systems that are safe, just, and helpful for humanity have backed this dedication to ethical AI.

Numerous scholarly publications have previously been written on the subject of artificial intelligence, which is becoming increasingly important. The amount of study in this field is constantly growing, which is a reflection of the quick developments and extensive uses of AI in a variety of fields. Researchers are actively interested in sharing knowledge and exchanging ideas as they become more conscious of the importance of this sector.

The significance of AI and the expanding corpus of research make it crucial to do a bibliographic study. This type of study enables a thorough assessment and evaluation of the available literature, allowing researchers to spot patterns, gaps, and potential research areas. Researchers can discover promising study directions, identify emerging research themes, and get insightful knowledge regarding the state of the field by methodically analysing the published works on AI.

A bibliographic analysis also offers a strong platform for expanding on already-known information and encouraging research collaboration. It allows the identification of significant contributors and thought leaders, fosters the sharing of ideas and best practices and aids in creating a shared understanding of the body of work already in existence. Researchers may make sure that their work is in line with the most recent advancements and significant advances in the topic by reviewing the breadth and depth of the literature.

The following bibliographic analysis will allow us to navigate the huge landscape of existing literature, keep up with the most recent developments, and direct the course of AI research in the future. With this analysis, the researchers can cooperatively drive innovation, tackle pressing issues, and realise the full potential of artificial intelligence in a variety of disciplines by building on the current body of knowledge.

## **MATERIALS AND METHODS**

We used the logical framework suggested by Donthu et al. (2021) for conducting the bibliometric performance analysis. This framework provides detailed instructions and a systematic structure for conducting bibliometric analysis. A similar logical framework was used in our study to ensure a thorough and organised analysis of the subject issue.

The first stage of our bibliometric analysis involved defining the objectives and constraints of the study. This necessitated carefully specifying the parameters and study emphasis to ensure that the analysis was in line with our goals. By establishing these criteria, we were able to narrow down the relevant literature and concentrate on the specific open AI subjects that interested us.

In the next stage, we applied techniques and strategies that were particularly selected for the goal and scope of our investigation. This involved considering many factors, such as the type of data that was accessible, the questions we were attempting to address, and the level of detail we desired in our research. Furthermore, one of the most important aspects of our investigation was gathering and analysing the data required for the bibliometric analysis. To ensure thorough coverage of the topic area, this meant painstakingly assembling essential information from dependable databases. We carefully picked and structured the data to support accurate analysis and interpretation.

Finally, the quantitative analysis stage offered insightful information on the open AI research ecosystem and trends. We were able to locate

important conclusions in the analysed data that not only aided in a greater comprehension of the subject but also served as a basis for further research and well-informed decisions.

According to the most frequently used factors which are presented in Table 1, productivity and scientific impact was determined (Avanesova & Shamliyan, 2018; Craig et al., 2021; Purkayastha et al., 2019). Microsoft Excel program was used to create the analysis (see also Cucari et al., 2023).

**Table 1.** The performance parameters

Indicator	Measured entity characteristics	Definition
Scholarly output	Productivity	The number of indexed in Scopus publications
Citations	Scientific impact	The number of citations received by an entity's publications
Field-weighted citation impact	Scientific impact	The number of citations received by an entity's publications compared with the average number of citations received by all other similar publications in the data universe
International collaboration	Collaboration between international coauthors	The number of internationally co-authored publications

Our bibliometric study was conducted in a methodical and organised manner using accepted frameworks and procedures. We were able to properly identify the purpose and scope of our study, choose the best techniques, obtain pertinent data, and draw insightful conclusions from the quantitative analysis by following this logical framework. This meticulous approach strengthens the validity and dependability of our conclusions, guaranteeing that our work makes a significant contribution to the body of knowledge on open AI.

## RESULTS

For the bibliometric analysis, we chose the platform SciVal due to its high-quality data and comprehensive coverage of both technical and social science fields, as well as books, book chapters, and conference proceedings (Baas et al, 2020). Elsevier's SciVal is a web-based analytics platform for gathering, contrasting, and evaluating bibliometric data, including summarizing research on specific scientific subjects and fields (Dresbeck, 2015).

We used the default ASJC (All Scopus Journal Categories) classification to describe the open AI literature. In this section, we provide an overview of the scientific productivity and impact of the research output of the observed scientific topic.

In the previous six years, preceding the writing of this paper (2017–2022), this research area consisted of 555 publications, with the increasing interest of researchers, since the scholarly output increased from 7 publications in 2017 to 184 in 2022 (see also Figure 1). The number of papers, featuring researchers' international collaboration, equals 92 for the entire period, increasing from 3 in 2017 to 30 in 2022.

Throughout the six-year observed period, 5279 citations in all, including self-citations, were made. Due to the multidisciplinary nature of the open AI research domain and the varying citation patterns among scientific disciplines, the citation data must be normalized (Podlubny, 2005). Elsevier SciVal prefers to employ a straightforward normalized citation metric that shows the number of citations in relation to a value of 1.0, which corresponds to the worldwide normalized average for all scientific areas as indexed by Scopus. In comparison to the global average, scores below 1.0 indicate a lesser level of scientific effect, while those above 1.0 indicate a higher level. This metric, known as the Field-Weighted Citation influence (FWCI), makes it simple to compare the influence of research across several scientific disciplines (Purkayastha et al., 2019). The average FWCI metric value for the observed scientific topic is 2.07 (for the entire 2017–2022 period), greatly decreasing from 7.99 in 2017 to 1.59 in 2022. This suggests that older articles had a greater impact on today's research, even though the field remains highly attractive to researchers.

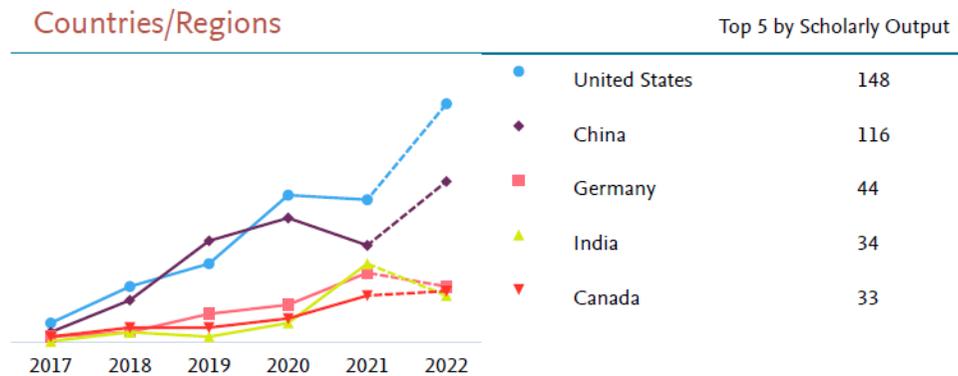
The top 10 countries, according to the scholarly output in the field, for the 2017–2022 period, are presented in Table 2. Furthermore, Figure 1 represents the increasing interest in the observed field by the top 5 countries.

**Table 2.** Scholarly output and research impact for the observed topic in the top 10 countries (2017–2022)

Country/Region	Scholarly Output	FWCI	Citation Count
United States	148	4.16	2769
China	116	1.47	774
Germany	44	2.66	346
India	34	0.73	40
Canada	33	3.75	1080
United Kingdom	31	2.75	378
South Korea	19	0.77	62
Japan	17	1.24	79
Italy	14	1.52	53
Netherlands	14	3.45	784

Source: SciVal (March 2023).

**Figure 1.** Scholarly output by the years for the observed topic in the top 5 countries



Source: SciVal (March 2023).

Most of 10 the most productive and influential universities and other research institutions in the field are located in China (5 or all) and the U.S. (3 of all), one in Canada, and one in France (see Table 3).

**Table 3.** Top 10 global research institutions in the observed field, per scholarly output and impact (2017–2022)

Institution	Country/Region	Scholarly Output	FWCI	Citation Count
Chinese Academy of Sciences	China	18	1.12	59
University of Science and Technology of China	China	11	0.94	53
Alphabet Inc.	U.S.	9	15.53	883
University of Chinese Academy of Sciences	China	9	1.43	30
University of Toronto	Canada	9	5.66	256
CNRS	France	8	2.86	40
Stanford University	U.S.	8	1.31	52
University of California at Berkeley	U.S.	8	6.35	207
Tsinghua University	China	7	0.82	36
Zhejiang University	China	7	1.86	61

Source: Elsevier SciVal (March 2023).

The top 10 individual researchers, ranked per their scientific output and impact in the observed field, and the values of their bibliometric performance indicators, are presented in Table 4.

**Table 4.** Top 10 researchers in the observed field, ranked per scholarly output and impact (2017–2022)

Author	Affiliation	Country/Region	Scholarly Output	FWCI	Citation Count
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Cao, Lei	Logistical Engineering University China	China	7	0.66	46
Chen, Xiliang	Logistical Engineering University China	China	7	0.66	46
Xu, Zhixiong	Army Academy of Border and Coastal Defense	China	7	0.66	46
Kozłowski, Norbert	Wrocław University of Science and Technology	Poland	6	1.23	25
Li, Houqiang	University of Science and Technology of China	China	6	0.69	15
Unold, Olgierd	Wrocław University of Science and Technology	Poland	6	1.23	25
Li, Chenxi	Logistical Engineering University China	China	5	0.90	45
Zhou, Wengang	University of Science and Technology of China	China	5	0.83	15
Nagy, Zoltan	University of Texas at Austin	U.S.	4	7.00	55
Banerjee, Abhijit	Maulana Abul Kalam Azad University of Technology	India	3	0.39	4

Source: SciVal (March 2023).

The top 10 journals, publishing the analyzed research, are listed in Table 5.

**Table 5.** Top 10 Scopus sources in the observed field, ranked per scholarly output (2017–2022)

Scopus Source	Scholarly Output	FWCI	Citation Count
Lecture Notes in Computer Science	26	0.91	48
Advances in Neural Information Processing Systems	14	12.85	1079
ACM International Conference Proceedings Series	13	2.83	42
IEEE Access	13	0.98	100
Communications in Computer and Information Science	9	0.91	9
IEEE Transactions on Neural Networks and Learning Systems	9	0.94	56
Proceedings of the International Joint Conference on Neural Networks	8	0.28	10
CEUR Workshop Proceedings	7	0.34	4
IEE Conference on Computational Intelligence and Games, CIG	7	1.25	87
IJCAI International Joint Conference on Artificial Intelligence	7	0.62	22

Source: SciVal (March 2023).

Lastly, the table below shows the top 10 keywords and in how many scholarly outputs these top keywords were used over the observed years.

**Table 6.** Top 10 key phrases in the observed field (2017–2022)

Keywords	2017	2018	2019	2020	2021	2022	All
Reinforcement Learning	6	32	50	78	103	116	385
Deep Learning	0	11	16	33	36	56	152
Reinforcement Learning (machine learning)	0	17	14	27	33	45	136
Artificial Intelligence	1	14	14	18	28	42	117
Critics	2	6	7	13	19	18	65
Q Learning	1	6	11	12	19	15	64
Language Model	0	0	6	12	11	19	48
Multi-agent Systems	0	2	3	1	12	19	47
Optimization Policy	1	4	5	5	8	11	34
Natural Language Processing Systems	0	0	1	8	7	14	30

Source: SciVal (March 2023).

## DISCUSSION

According to the metrics used, this section presents the results of the bibliometric analysis in the observed field.

For a variety of reasons, there is undoubtedly now a lot more writing and interest on the topic of open AI than there was in the past. Let us mention the three most obvious:

- The field of AI is expanding and evolving swiftly. As new applications of AI emerge and current technology develops, it is necessary to do ongoing research and have ongoing discussions to stay abreast of these advancements. Open AI is driving these breakthroughs, and many researchers are interested in examining the results.
- OpenAI has established itself as one of the leading organizations in the AI industry. Academics, researchers, and industry professionals have shown a great deal of interest in and consideration for their concentration on developing cutting-edge AI technology, such as their GPT models. As a result, OpenAI has made several contributions to the field of artificial intelligence, and a sizable body of literature has been written about it.
- OpenAI has assumed a leading position in distributing its findings to a wider audience. They have published several papers, supplied open-source code, and made their models available for use by others to build upon. This level of openness and collaboration has encouraged other academics to engage with OpenAI's work and grow the body of research on the topic.

Furthermore, below we list some of the potential reasons for the high number of publications and interest in the field of open AI in the United States and China:

- **Research and Development Powerhouses:** China and the U.S. are both renowned as being among the world's leaders in technical innovation, with a particular emphasis on AI research and development. They are home to a large number of respected academic institutions, research centres, and tech businesses that actively improve AI. These nations' substantial expenditures in AI talent and infrastructure have sparked a thriving research scene and promoted an innovative mindset.
- **Technical Rivalry:** China and the U.S. have been vying with each other to develop the most advanced AI applications. Increased research activity and a rising interest in open AI concepts have been sparked by this competition. The promotion of AI research and development has also been aided by government initiatives and policies in both nations, which has stoked interest in and publications about open AI.
- **Market Size and Economic Potential:** The world's two largest economies, U.S. and China, have significant market potential for AI-driven technologies. A strong ecosystem of research, development, and commercialization has resulted from the economic promise that has drawn resources and investments into the field of AI. Leading IT companies and startups are present in both nations, which increases public interest in and production of publications about open AI.

The significantly lower representation and fewer publications on the subject of open AI from European nations and academic institutions are caused by several factors:

- **Research and Funding Disparities:** Disparities in research funding may exist despite the fact that Europe has renowned universities and research centres when compared to the U.S. and China. The number and size of research initiatives can be affected by the amount of funding available for AI research, which can lead to fewer publications in the area of open AI.
- **Regulatory Environment:** The General Data Protection Regulation (GDPR) and other strict data protection and privacy laws have been adopted in Europe. While user privacy and data security are given top priority by these policies, they can also present difficulties and additional obstacles for researchers working with the vast datasets required for AI research. Some academics might be deterred from pursuing open AI projects or publicising their results due to the difficult regulatory environment.
- **Collaboration and the Academic-Industry Gap:** Europe faces certain difficulties in bridging the academic and industrial gaps. To encourage applied research and the commercialization of AI technology, there may be a need for closer collaboration between academic institutions, research organisations, and businesses.

Increased publications and interest in open AI can be attributed to a more solid industry-academia partnership.

- **Resource Allocation and Priorities:** European institutions and countries may place a different emphasis on certain aspects of AI research than others, such as ethics, justice, and transparency. Although these factors are significant, they might take some time and energy away from open AI research and publications.
- **Cultural Factors:** Academic customs and traditions are examples of cultural elements that may have an impact on publication rates. The overall publishing output on open AI may be impacted by regional variations in research methodologies, publication standards, and academic incentives.

Here, let us point out that there are outstanding academics, organisations, and projects that are supporting open AI research in Europe. Through several initiatives, partnerships, and financing schemes, efforts are being made to increase the visibility of EU countries and research institutions and their contributions to the field of open AI.

Finally, it is not surprising to find numerous significant study clusters when analysing the frequency of keywords in open AI research. The primary clusters found consist of:

- **Machine Learning**, which is a fundamental component of open AI as it encompasses a broad range of algorithms and techniques.
- **Deep Learning**, which has gained widespread acceptance in open AI research due to its capacity to manage enormous datasets and produce cutting-edge performance in numerous fields.
- **Reinforcement Learning**, which is essential to open AI research because it makes it possible to create autonomous agents that can learn and decide in challenging situations.
- **Criticism** in open AI research, which is not surprising. It is crucial to critically assess the ethical implications, potential biases, transparency, and fairness of AI technologies as they are progressively incorporated into society. Research on the ethical, social, and legal implications of AI may fall under this cluster. It may also explore potential hazards and ensure that AI systems are developed and deployed responsibly.

We learn more about the focal areas and trends in the field by identifying these important clusters in open AI research. These clusters represent the ongoing attempts to improve AI methods, create moral frameworks, and deal with the difficulties and constraints brought on by AI technologies.

## CONCLUSION

The purpose of this study was to assess the overall research output in the open AI subject. Our analysis of academic outputs' bibliometric data offers important new perspectives on the state of open AI research. We have determined the top countries, institutions, journals, authors, and keywords in the subject by analysing publication patterns and trends. This analysis

provides a thorough overview of the key researchers and current research agendas in the open AI sector.

The geographic distribution of open AI research can be better understood by understanding the top countries, indicating the dominance of particular areas and the amount of research effort in various parts of the world. The leading academic and research institutions that are at the forefront of open AI research can be learned about by looking at the top institutions. By influencing and producing research, these institutions have a big impact on the field.

The top ten writers uncovered by our analysis are significant contributors to the body of open AI literature. Their efforts and knowledge have made a tremendous impact on the field's development and advancement. We can determine the top publishing venues in the area of open AI by analysing the top journals. These periodicals provide as forums for sharing research findings and advancing academic discourse. Last but not least, knowing the top keywords helps one grasp the main themes and areas of open AI research. The primary ideas, approaches, and subject areas that researchers in the field are concentrating on are reflected in these keywords.

It is crucial to acknowledge the limits of our study in the following sections:

- **Data Limitations:** The scholarly outputs that are present in the chosen dataset are the basis for our investigation. There may be gaps in our findings as a result of the exclusion of some pertinent papers.
- **Language Bias:** Because our analysis was limited to English-language publications, there may have been a bias against other languages' research.
- **Methodological Considerations:** Bibliometric analyses offer quantitative information on research output, but they might not adequately reflect the value or significance of a single publication. Additionally, the results could be affected by the criteria and thresholds used to choose the top nations, organisations, authors, journals, and keywords.
- **Landscape Change:** Open AI is a vibrant and quickly developing field. Our analysis gives a brief overview of the state of the field, but subsequent advances could change the picture. To capture the changing trends and contributions in open AI research, ongoing monitoring and sporadic updates are required.

Future studies in this field might examine the following topics:

- **Cross-Language Analysis:** A multilingual analysis of open AI research could offer a more thorough knowledge of the worldwide contributions and aid in overcoming linguistic prejudices.
- **Collaboration Networks:** Analysing the networks of cooperation across nations, organisations, and authors may reveal trends in knowledge exchange and cross-disciplinary cooperation in the open AI community.
- **Citation Analysis:** A citation analysis can shed light on the impact and reach of open AI research by analysing citation patterns and impact

measures. It can be used to find key publications, authors, and organisations advancing the topic.

- **Subfield Analysis:** Deeper insights into specialised fields of study and future trends can be gained by further examining subfields within open AI, such as ethics, fairness, interpretability, or particular application domains.
- **Comparing financing and policies:** Comparing financing and policies can provide light on how funding goals and regulatory frameworks affect the growth of open AI research. This is done by examining the connections between funding, regulations, and research outputs across various nations and institutions.

The significance of open AI in the current AI environment originates from its ground-breaking research, collaborative style, and dedication to moral AI. Researchers from all over the world have been drawn to the organization's work, which has encouraged them to learn more about AI research and further it. Open AI continues to be a crucial catalyst for creativity, teamwork, and the responsible development of artificial intelligence as AI technologies continue to change our future.

It is possible to anticipate an exponential increase in the number of research projects and publications on the subject of open AI. Due to developments in machine learning, deep learning, natural language processing, and other related fields, the field of artificial intelligence is developing at an impressive rate. Given the profound effects and industry-changing potential of AI, it continues to be one of the most alluring and in-demand study fields today.

A rich environment for research and creativity is created by the rapid advancement of AI technology and its growing integration into a variety of industries, including healthcare, banking, transportation, and entertainment. Researchers are attracted to this area of study because there are so many opportunities to tackle difficult problems and come up with fresh answers. AI research is interdisciplinary, incorporating computer science, mathematics, statistics, and cognitive science, which adds to its appeal and promotes cooperation among specialists from many fields.

Further, AI is a subject of tremendous significance and public attention due to the societal consequences it has, such as ethical issues, privacy problems, and the effect on employment. There is an increasing need for in-depth research as AI technologies improve and spread to assure responsible development, moral deployment, and knowledgeable policymaking.

These elements make it clear that open AI research interest will keep rising. The academic community, business leaders, and governments are aware of the value of funding AI research to take advantage of its potential advantages and reduce its possible perils. Researchers are expected to add to the growing body of knowledge as the subject develops and grows by investigating new areas, creating cutting-edge models and algorithms, and taking on the difficulties that lie ahead.

Open AI is positioned as a highly desirable study subject due to the convergence of rapid technological breakthroughs, widespread applicability, and societal effect. As academics work to realise its full potential, address

new problems, and pave the path for a future driven by intelligent systems, it is anticipated to continue to experience a spike in research papers and publications.

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