

Review Article

# Bibliometric Analysis of Artificial Intelligence and Focus in Morocco: A Comprehensive Study (2014-2023)

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**Abstract** - This bibliometric analysis investigates the worldwide output of scientific exploration in the field of Artificial Intelligence (AI). By examining databases such as Scopus for academic articles from 2014 to 2023, the findings demonstrate a remarkable surge in global AI research, with notable countries, including China and the United States, emerging as major players. The examination of 1084008 articles on Scopus reveals a continuous growth trend spanning from 2014 to 2023, offering a comprehensive overview of patterns, significant contributors, international collaborations, and the progression of AI research.

**Keywords** - Artificial intelligence, Data analysis, Scopus, Scientific evolution, Bibliometric analysis.

## 1. Introduction

As scientific research and development grow, Artificial Intelligence (AI) has become a major force influencing various fields and sectors. Indeed, AI makes it possible to simulate human cognitive processes, making machines capable of acquiring information, reasoning about static or dynamic situations, solving complex problems, making diagnoses, proposing decisions or action plans, explaining and communicating the conclusions reached, understanding a text or a dialogue in natural language, summarizing, learning, discovering, and all this autonomously. According to the European Parliament, artificial intelligence is defined as any tool employed by a machine to “reproduce human behaviors such as reasoning, planning and creativity.” AI is a branch of computer science research that seeks to understand the essence of intelligence and to create intelligent machines capable of reasoning and reacting by simulating human intelligence [1]. AI is used in many sectors, from aeronautics to medicine, finance, art, and civil engineering. In the field of finance, AI is manifested through algorithmic trading, which makes it possible to analyze markets, predict customer trends, manage portfolios, and track stocks. The medical sector has adopted AI to assist doctors in diagnosis, interpretation of radiological images, and early prediction of diseases. AI also plays a role in surgical assistance and the development of new treatments. In the artistic sector, many tools use AI to generate and produce pieces of music, as well as to create artificial voices. In the automotive sector, AI enables the circulation of autonomous vehicles without drivers. Braking, lane changing, collision

prevention, and other systems are integrated using AI components. In the media sector, AI can automatically generate texts and articles, TV programs, advertisements, and videos, analyze faces and objects, and automatically subtitle and summarize content. AI also provides solutions to the ecological and energy transition, enabling the development of solutions for the exploration and production of hydrocarbons, optimizing the use of natural resources, and having a positive impact on water, agriculture, biodiversity and climate change, thanks to initiatives such as Microsoft’s AI for Earth program [2]. In retail, AI streamlines the in-store customer journey, offers interactive experiences via mixed reality and provides personal assistance through digital assistants. It is crucial for improving products and better-managing inventory and logistics. Artificial intelligence also finds significant applications in defense, naval technology, aeronautics, cybersecurity, as well as in education, where it plays an increasing role in personalized teaching systems, proving their effectiveness in improving learning [3]. The main research gap is the lack of a detailed bibliometric analysis that maps the global and Moroccan landscape of artificial intelligence research. Current studies mainly focus on specific areas within artificial intelligence. In addition, the rapid evolution of AI technologies makes it essential to conduct a broader and more comprehensive bibliometric study to Identify trends and make objective choices, select research to support, raise funds and seek international collaborations, assisting each institution or nation in defining its goals, making budgetary decisions, and the evolution of research... This document begins by outlining



the data collection steps and the query and explains the research methodology. Then, the results and discussion of this study on aspects of scientific activity will be presented. Finally, the conclusions will be presented at the end.

## 2. Literature Review

### 2.1. Artificial Intelligence: A Historical Perspective

Artificial intelligence was born almost a century ago, with its major beginnings in the 1940s. Two researchers, Warren McCullough and Walter Pitts, pioneered the field by introducing the first mathematical model for creating a (global) neural network[4]. At the same time, researcher Alan Turing published the book *Computing Machinery and Intelligence*, in which he questioned the ability of machines to think[5]. In 1956, the term “artificial intelligence” was used initially at the “Dartmouth Summer Research Project on Artificial Intelligence” conference, organized by John McCarthy[6]. In 1960, Arthur Samuel took the concept of machine learning a step further, creating an artificial intelligence capable of playing checkers autonomously[7]. Over the years, advances continued, and in 1997, AI reached a historic milestone when IBM’s Deep Blue system[8] defeated a world chess champion, marking a first in the history of AI. Beginning in the 2000s, the rapid spread of technologies, including Big Data, Cloud, and GPUs, has largely contributed to the advent of artificial intelligence. The year 2023 has been marked by an explosion of Large Language Models (LLMs), such as ChatGPT[9].

### 2.2. Bibliometric Analysis: Previous Works

These articles show the evolution of Artificial Intelligence (AI) research, moving from the analysis of general trends (global AI, applications in medicine and social sciences) to more specific domains, such as smart buildings, banking, and Blockchain. They also highlight the growing importance of ethical concerns and international collaborations. Many studies adopt a bibliometric approach to analyze trends of AI (global AI, applications in medicine and social sciences) to more specific domains, such as smart buildings, banking, and Blockchain. The study “Global bibliometric mapping of the frontier of knowledge in the field of artificial intelligence for the period 1990–2019” [10] reveals a continuous increase in publications on AI over the last 30 years, using keywords extracted from titles and abstracts in the Web of Science platform. The major themes addressed are machine learning and deep learning, with the United States and China as the primary geographical regions. Other studies analyze the application of AI in different fields, such as green and smart buildings. The search[11] conducted on the Web of Science and Scopus platforms during the period from 2002 to 2020 aims to study the benefits of the convergence of AI techniques in these buildings. It shows that technologies such as fuzzy logic and Bayesian networks improve the energy efficiency and comfort of smart buildings, with the United States, China, Singapore, the United Kingdom and South Korea leading the publications in this field.

The article “Artificial Intelligence in Social Science: A Study Based on Bibliometrics Analysis” [12] covers the period 2013–2022 and studies the impact of AI in the social sciences from the Scopus database. Since 2018, significant growth in publications has been observed, mainly in the United States and China. The most prominent fields are law, education, economics, and ethics. The study also highlights the need for regulations to frame the ethical implications of AI. The medical sector is also explored in the article “A bibliometric analysis of the advance of artificial intelligence in medicine” [13], conducted on Scopus from 2015 to 2023. This period saw a significant increase in publications, with the United States and China leading the way, and “IEEE Access” emerged as the most productive journal. In the field of banking, the article “Industry 4.0 Transformation: Analyzing the Impact of Artificial Intelligence on the Banking Sector through Bibliometric Trends” [14] uses a bibliometric approach to examine 1089 articles via Web of Science. It highlights the increased use of technologies such as machine learning, neural networks, and process automation to improve operational efficiency, personalize services, and strengthen security. The most prolific countries in this field are China, the United States, and India.

Then, the article “Machine Learning and Blockchain: A Bibliometric Study on Security and Privacy” [15] explores the employing of machine learning for blockchain, analyzing publications between 2018 and 2023 via Scopus and Web of Science. The United States, Australia, and India dominate this research area, with increasing interest in the Internet of Things (IoT) ecosystem, intrusion detection, and smart contracts. Moreover, the increasing integration of artificial intelligence in language learning is also studied [16], with a focus on its role in personalizing teaching and learning processes. The study maps the existing literature on this topic through a bibliometric analysis of documents published between 2017 and 2023 on Scopus. Dominant research themes include language skills, student interaction, and personalization of learning experiences.

The emergence of artificial intelligence is not new; its origins date back nearly a century. However, it has experienced a spectacular emergence in recent years, driven by the explosion of data and computing capacities in multiple domains. The research for AI in the Scopus database has resulted in a very detailed and diverse corpus. Moreover, previous bibliometric studies are not recent, do not cover all the fields proposed by the bibliographic databases, and tend to focus on specific aspects of AI, which provide limited results. Moreover, this study is the first of its kind to adopt a comprehensive approach to mapping the landscape of AI research. On the other hand, the novelty of this study is founded in its global approach, examining the global and Moroccan evolution of AI research, covering several disciplines and an extended and recent period. This broader perspective makes it possible to identify general trends, key contributors and

emerging research areas that could have been neglected in more focused studies. In this dynamic context, this perspective explores the global and Moroccan landscape of AI research and provides strategic information on trends, key players and future prospects in the field. By examining and analyzing this recent and extensive data, the study offers valuable lessons on scientific and technological advances and guiding future works in this rapidly evolving field.

### 3. Materials and Methods

The Scopus database is used to collect bibliometric data on articles related to artificial intelligence published between 2014 and 2023. Containing peer-reviewed scientific material, Scopus is a European database that serves as a resource for abstracts and citations [17], [18], [18], [19], [20]. With more than 93 million records dating back to 1788, it is one of the major bibliographic and citation platforms available today. With approximately 3 million new entries added each year, ensuring its steady growth. The inclusion of content in Scopus is subject to a meticulous review process that evaluates its quality and scientific rigour.

Overseen by the Content Advisory and Selection Committee (CCSA), made up of renowned researchers, scientists, and librarians from around the world, enhancing the reliability of Scopus. This bibliometric study [22][23] aims to analyze data, extract insights, and address research questions related to articles, patents, authors, inventors, journals, organizations, companies, and countries publishing in the field of AI.

Its objective is to identify areas requiring further research, inspire new research ideas, and contribute to establishing their impact on the field. Furthermore, these studies can lay the solid groundwork for the development of a field in a novel and meaningful way while also facilitating competitive intelligence or assisting in identifying partners for collaboration strategies.

The questions we seek to answer include:

- What is the count of publications and citations per research document, as well as the types of publications and languages?
- What is the yearly rate of the research increase?
- How many citations per year were received by research documents?
- Which countries are the most Prolific in the field?
- What are the most successful and cited journals?
- Which terms are frequently used?
- What are the related research themes/subjects?
- Which universities and organizations are involved?
- Which are the most SDGs (Sustainable Development Goals)?
- Which are the most popular authors on IA?
- What are the Moroccan's performances?

The field of AI receives both theoretical and practical

contributions from this study. The theoretical aspect revolves around identifying popular research topics, frequently cited articles and authors, and impactful journals to recognize research trends. This valuable information enables researchers to pinpoint gaps in the existing literature and steer future work efforts. In addition, the study aims to establish a bibliometric framework for analyzing research in this field.

This framework can be applied to other areas, allowing the detection of research trends and the identification of unexplored areas in the literature. In addition, the study explores the exploration of collaborative research networks between authors, institutions, and countries.

This information is useful in facilitating cooperation and knowledge exchange between researchers from various regions. Regarding practical contributions, they include highlighting essential research areas which other researchers can use to prioritize their research work. Other researchers can identify potential collaboration partners by identifying influential researchers and institutions.

By limiting the research period to the last 10 years (2013-2022), the query was essentially based on specific keywords in both French and English, such as "Transfer of Learning," "Deep Learning," "Neural Networks," "Artificial Intelligence," "Convolutional Neural Network," "Learning Systems," "Artificial Neural Network," "Learning Algorithm," "Deep Neural Network," "Learning Method," "Machine Learning," "Computer Vision," "Learning Model," "Cellular Neural Networks," "Deep Learning Model," "Image Classification," "Reinforcement Learning," "Image Segmentation," "Supervised Learning," "Learning Approach," "Natural Language Processing Systems," "Facial Recognition," "Semantic Segmentation," or "Graph Neural Networks."

## 4. Results of Research and Discussion

### 4.1. Publication Types and Languages

The Scopus database, consulted in July 2024, has listed 1482309 publications since 1996, with a total of 1084008 on AI between 2014 and 2023, representing 73% of AI research articles. It can be noted that interest in AI is relatively recent; the first article listed in the Scopus database was published in 1996 ("Permeability prediction with artificial neural network modelling in the Venture gas field, offshore eastern Canada" by Canada's Geological Survey) [24].

The most cited article, published by Microsoft Research, United States, titled "Deep residual learning for image recognition" [25], was published in 2016 and has accumulated 148776 citations until 2024.

Thus, between 2014 and 2023, only 34% of the corpus was open-access (Figure 1). Journal articles represented 48.4%,

followed by conference proceedings (44.98%), reviews (2.2%), and other types of documents (e.g., chapters, conference reviews, etc.), as shown in Table 1. English (96,88%) was the first used language, followed by Chinese (2,68%) and Turkish (0,18%).

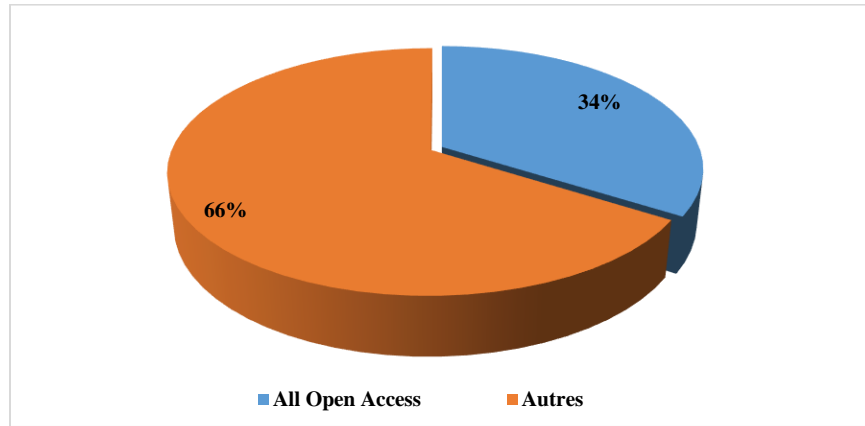
**4.2. Evolution of Publications and Citations on AI Between 2014 and 2023**

The total production between 2014 and 2023 amounted to 1084008. This represents a total increase of 10.44% (rising from 39303 in 2014 to 152576 in 2023). Academic production is an indicator of productivity.

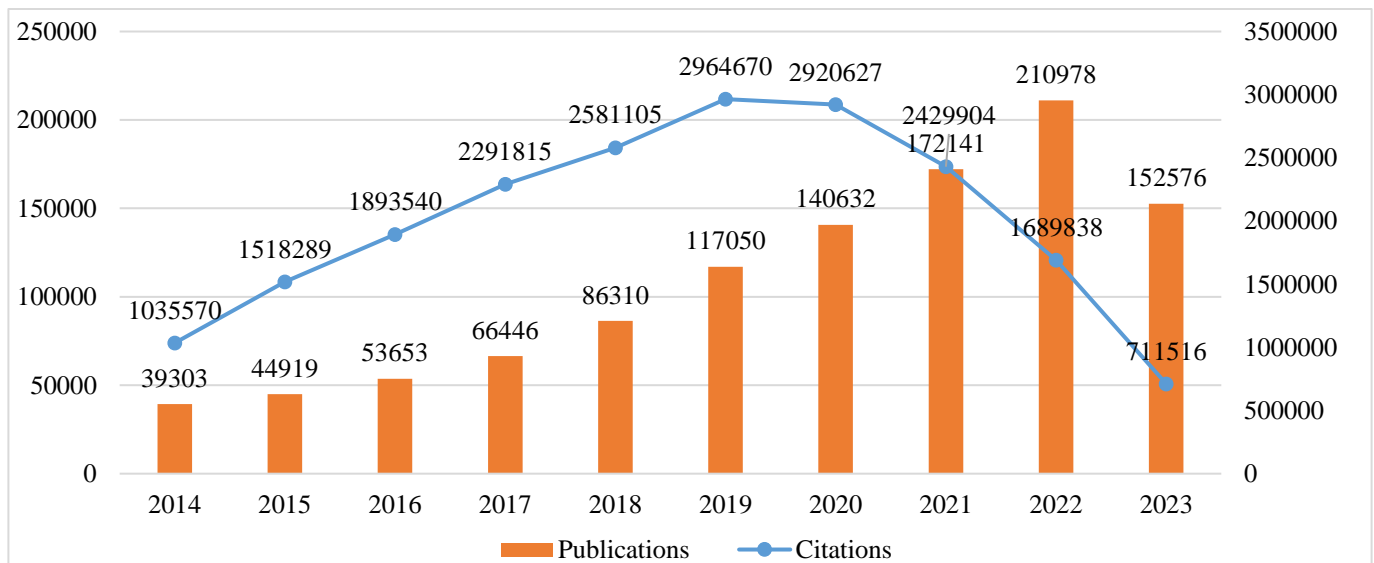
In this analysis, all types of publications were considered, including articles, journals, conference communications, book chapters, etc. This corpus received 20036874 citations. A significant increase is observed in citations, but this has decreased significantly since 2020 (Figure 2).

**Table 1. Types of publications**

| Publications type | Number of publications | % of publications |
|-------------------|------------------------|-------------------|
| Article           | 524633                 | 48,40%            |
| Conference Paper  | 487547                 | 44,98%            |
| Review            | 23836                  | 2,20%             |
| Chapter           | 22567                  | 2,08%             |
| Conference Review | 12935                  | 1,19%             |
| Editorial         | 3323                   | 0,31%             |
| Book              | 2196                   | 0,20%             |
| Note              | 2140                   | 0,20%             |
| Retracted         | 1624                   | 0,15%             |
| Letter            | 1373                   | 0,13%             |
| Erratum           | 691                    | 0,06%             |
| Short Survey      | 612                    | 0,06%             |
| Data Paper        | 496                    | 0,05%             |



**Fig. 1 Open access en IA (2014-2023)**

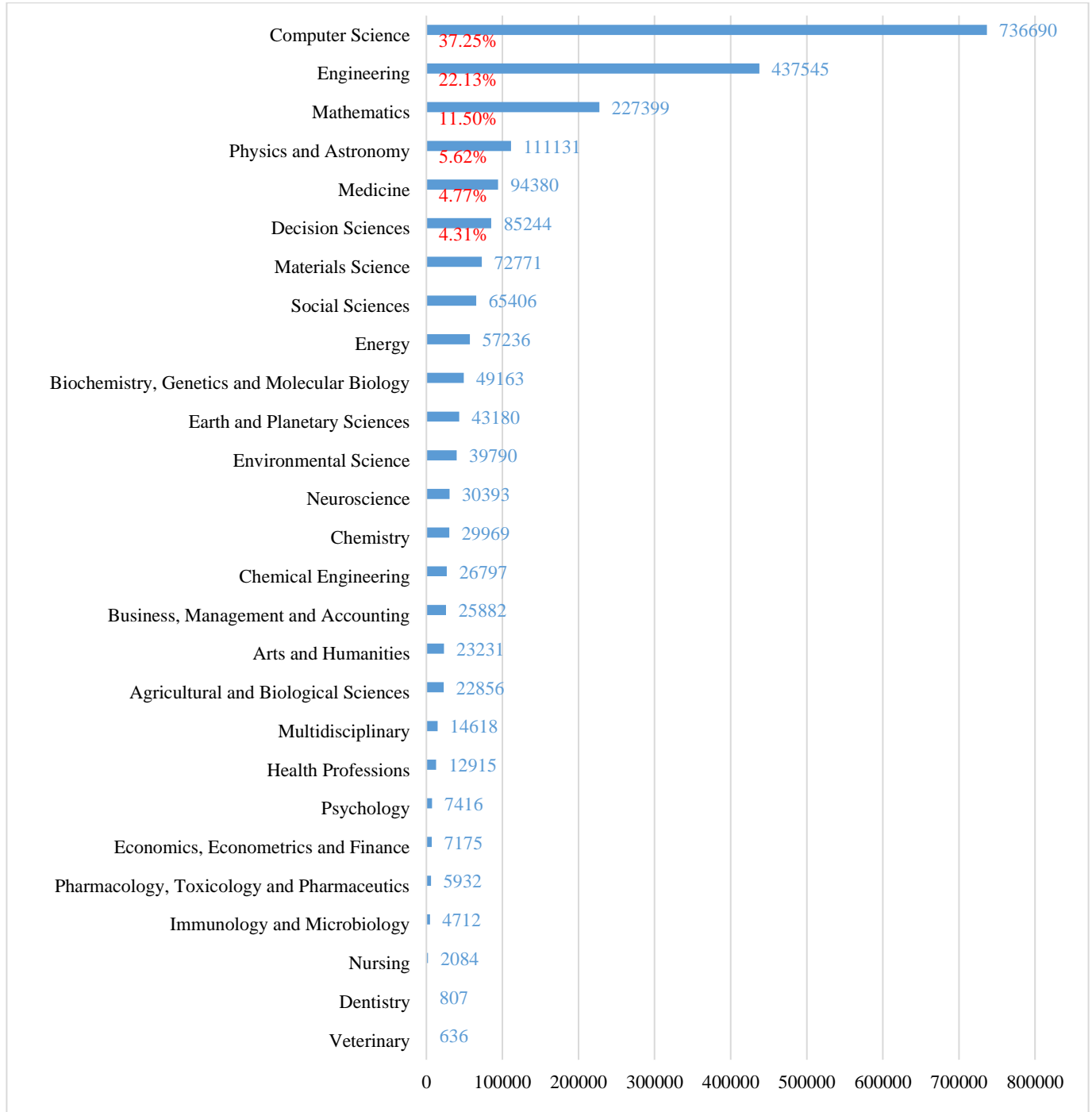


**Fig. 2 Publications and citations IA 2014-2023**

**4.3. The Distribution of Subject Areas**

In Figure 3, “Computer Science” ranked first during the study period (736690 publications), representing 37.25% of all articles on AI. Engineering held the second position (437545 articles, or 22.13%), followed by Mathematics (227399 articles, or 11.50%) and Physics and Astronomy (111131 articles, or 5.62 %). The six main thematic areas covered 85.58% of this study (Figure 4). As illustrated in Table 2,

publications in the major six domains have seen growth since 2014, with Computer Science holding a dominant position over the past decade with a growth rate of 13.03%. The Engineering domain with a growth rate of 17.52%, then Mathematics with a growth rate of 13.35%, succeeded by Physics and Astronomy with a growth rate of 28.67%, follow this. Medicine shows a growth rate of 25.91%, and Decision Science has a growth rate of 26.33%.



**Fig. 3 The distribution of subject categories IA (2014-2023)**

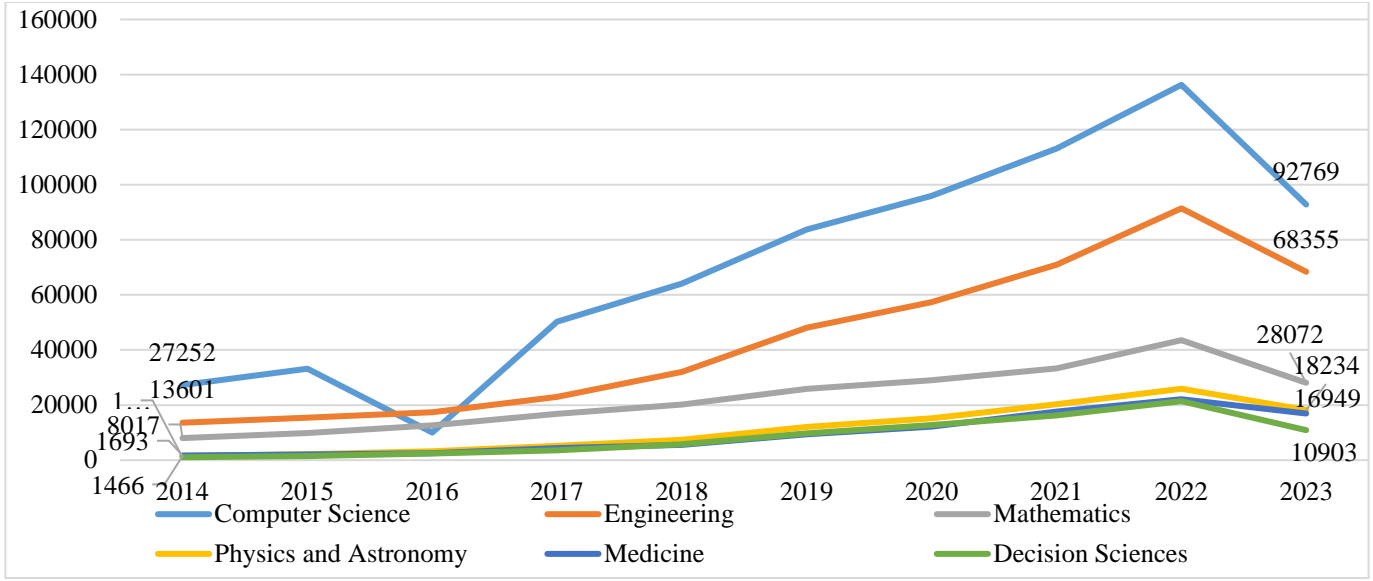


FIG. 4 EVOLUTION BY AI DOMAIN (2014-2023)

Table 2. The six main thematic domains

|                       | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021   | 2022   | 2023  | % growth rate (2014-2023) |
|-----------------------|-------|-------|-------|-------|-------|-------|-------|--------|--------|-------|---------------------------|
| Computer Science      | 27252 | 33239 | 10014 | 50269 | 64078 | 83709 | 95979 | 113113 | 136268 | 92769 | 13,03%                    |
| Engineering           | 13601 | 15366 | 17373 | 22996 | 32004 | 48077 | 57373 | 70979  | 91421  | 68355 | 17,52%                    |
| Mathematics           | 8017  | 9874  | 12624 | 16823 | 20191 | 25866 | 29014 | 33365  | 43553  | 28072 | 13,35%                    |
| Physics and Astronomy | 1466  | 2188  | 3227  | 5194  | 7375  | 12004 | 15163 | 20350  | 25930  | 18234 | 28,67%                    |
| Medicine              | 1693  | 2064  | 2533  | 4345  | 5526  | 9378  | 12178 | 17644  | 22124  | 16949 | 25,91%                    |
| Decision Sciences     | 1053  | 1445  | 2373  | 3611  | 5811  | 9690  | 12691 | 16250  | 21417  | 10903 | 26,33%                    |



Fig. 5 Word cloud

**4.4. Keyword Analysis**

The figure highlights the most used words in the field of AI. In Figure 5, we extracted all keywords related to artificial intelligence and utilized a word cloud model visualized with Flourish.studio (a freemium model of data visualization software Flourish.studio)[13]. Each keyword was weighted according to the frequency of publications containing it (Figure 5).

**4.5. Top 20 Prolific Countries**

China tops the list as the highest-producing country with 322543 publications, of which 24.2% are in collaboration. The United States follows closely in second place with 183756 publications, of which 24.2% are in collaboration. The United States follows closely in second place with 183756 publications, of which 24.2% are in collaboration. The United States follows closely in second place with 183756 publications, of which 24.2% are in collaboration.

publications, 40.5% of which are collaborative. India secures the third position with 128086 publications, 16% of which are in collaboration. The United Kingdom ranks fourth with 57293 publications, and Germany holds the fifth position with 44934 publications (Figure 6).

**4.6. Most Popular Scopus Sources**

As indicated in Table 4, research on AI was primarily indexed in journals such as “Lecture Notes in Computer Science”, “IEEE Access”, “ACM International Conference Proceeding Series”, “Advances in Intelligent Systems and Computing”, and the journal “Communications in Computer and Information Science..

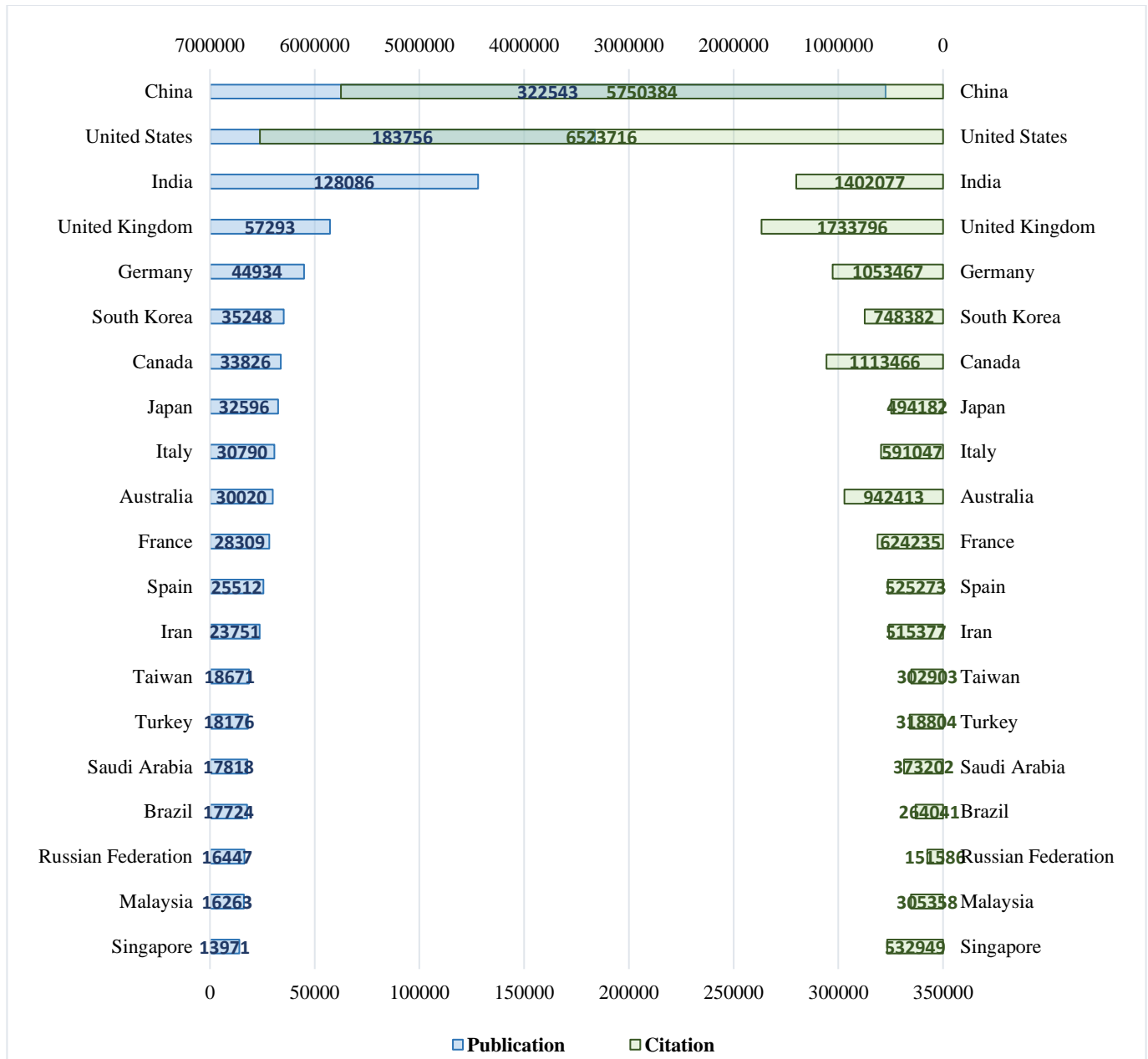


Fig. 6 Countries with the highest publications on AI (2014-2023)

Table 3. Country's performances

| Rang | Country/Region     | Scholarly Output | Citation Count | International Collaboration (%) |
|------|--------------------|------------------|----------------|---------------------------------|
| 1    | China              | 322543           | 5750384        | 24,2%                           |
| 2    | United States      | 183756           | 6523716        | 40,5%                           |
| 3    | India              | 128086           | 1402077        | 16%                             |
| 4    | United Kingdom     | 57293            | 1733796        | 64,7%                           |
| 5    | Germany            | 44934            | 1053467        | 46,7%                           |
| 6    | South Korea        | 35248            | 748382         | 30,6%                           |
| 7    | Canada             | 33826            | 1113466        | 56,8%                           |
| 8    | Japan              | 32596            | 494182         | 34,6%                           |
| 9    | Italy              | 30790            | 591047         | 47,3%                           |
| 10   | Australia          | 30020            | 942413         | 66,7%                           |
| 11   | France             | 28309            | 624235         | 57,6%                           |
| 12   | Spain              | 25512            | 525273         | 50,9%                           |
| 13   | Iran               | 23751            | 515377         | 38,5%                           |
| 14   | Taiwan             | 18671            | 302903         | 34,9%                           |
| 15   | Turkey             | 18176            | 318804         | 27,4%                           |
| 16   | Saudi Arabia       | 17818            | 373202         | 74,9%                           |
| 17   | Brazil             | 17724            | 264041         | 34,3%                           |
| 18   | Russian Federation | 16447            | 151586         | 24,7%                           |
| 19   | Malaysia           | 16263            | 305358         | 52,9%                           |
| 20   | Singapore          | 13971            | 532949         | 71%                             |

Table 4. Journal's performances

| Scopus Source  | Publications | Citations | CiteScore 2023 | SNIP 2023 | SJR 2023 |
|--|--------------|-----------|----------------|-----------|----------|
| Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) | 44598        | 473635    | 2,6            | 0,59      | 0,606    |
| IEEE Access  | 18429        | 449727    | 9,8            | 1,44      | 0,96     |
| ACM International Conference Proceeding Series   | 13705        | 60991     | 1,5            | 0,23      | -        |
| Advances in Intelligent Systems and Computing  | 12137        | 54571     | -              | -         | -        |
| Communications in Computer and Information Science   | 10761        | 31788     | 1,1            | 0,25      | 0,203    |
| Sensors  | 9635         | 199790    | 7,3            | 1,25      | 0,786    |
| Proceedings of SPIE - The International Society for Optical Engineering  | 9388         | 19420     | 0,5            | 0,2       | -        |
| CEUR Workshop Proceedings  | 9324         | 22100     | 1,1            | 0,23      | -        |
| Neurocomputing   | 7978         | 260123    | 13,1           | 1,86      | 1,815    |
| Lecture Notes in Networks and Systems  | 7920         | 13810     | 0,9            | 0,28      | 0,171    |
| Journal of Physics: Conference Series  | 7232         | 25970     | 1,2            | 0,3       | -        |
| Applied Sciences (Switzerland)   | 6749         | 94665     | 5,3            | 0,92      | 0,508    |
| Lecture Notes in Electrical Engineering  | 6225         | 11752     | 0,7            | 0,14      | 0,147    |
| Expert Systems with Applications   | 5327         | 203852    | 13,8           | 2,43      | 1,875    |
| Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition                                       | 5007         | 1166870   | 43,5           | 6,7       | -        |
| Remote Sensing   | 4709         | 124279    | 8,3            | 1,33      | 1,091    |
| Procedia Computer Science  | 4690         | 82582     | 4,5            | 0,87      | -        |
| Proceedings of the International Joint Conference on Neural Networks   | 4645         | 38472     | 2,8            | 0,58      | -        |
| Neural Computing and Applications  | 4302         | 95256     | 11,4           | 1,68      | 1,256    |
| Scientific Reports   | 4129         | 106363    | 7,5            | 1,18      | 0,9      |

#### 4.7. Top 20 Institutions

Regarding the ranking of the leading research affiliations in the field of AI, the Chinese Academy of Sciences in China took the lead, followed by CNRS in France. Next was Anna

University in India, Tsinghua University, and, in fifth position, the Chinese Academy of Sciences University in China. Overall, the majority of affiliations were Chinese (15 Chinese affiliations out of the total top 20) (Table 5).



**Table 5. Institution's performances**

| Institution  | Sector     | Country/Region | Scholarly Output | Citation Count | International Collaboration (%) | Citations per Publication |
|--|------------|----------------|------------------|----------------|---------------------------------|---------------------------|
| Chinese Academy of Sciences                              | government | China          | 20985            | 555806         | 26,4                            | 26,5                      |
| CNRS   | government | France         | 14770            | 296013         | 51,6                            | 20                        |
| Anna University  | academic   | India          | 12676            | 112710         | 12,5                            | 8,9                       |
| Tsinghua University                                      | academic   | China          | 11350            | 362084         | 35,7                            | 31,9                      |
| University of Chinese Academy of Sciences                | academic   | China          | 10652            | 236861         | 20,8                            | 22,2                      |
| Shanghai Jiao Tong University                            | academic   | China          | 8800             | 198658         | 32,3                            | 22,6                      |
| Zhejiang University                                      | academic   | China          | 8318             | 186538         | 33,7                            | 22,4                      |
| Harbin Institute of Technology                           | academic   | China          | 6592             | 176847         | 28,4                            | 26,8                      |
| Peking University  | academic   | China          | 6582             | 187192         | 33,8                            | 28,4                      |
| University of Electronic Science and Technology of China | academic   | China          | 6539             | 153080         | 34,5                            | 23,4                      |
| Beihang University                                       | academic   | China          | 6260             | 144939         | 28,2                            | 23,2                      |
| Wuhan University   | academic   | China          | 5948             | 153176         | 28,6                            | 25,8                      |
| Nanyang Technological University                         | academic   | Singapore      | 5855             | 232010         | 69,1                            | 39,6                      |
| Massachusetts Institute of Technology                    | academic   | United States  | 5819             | 315685         | 44,8                            | 54,3                      |
| Huazhong University of Science and Technology            | academic   | China          | 5586             | 158670         | 31                              | 28,4                      |
| Beijing University of Posts and Telecommunications       | academic   | China          | 5510             | 99734          | 20,3                            | 18,1                      |
| Stanford University                                      | academic   | United States  | 5408             | 374165         | 39,1                            | 69,2                      |
| Southeast University, Nanjing                            | academic   | China          | 5389             | 120727         | 32,2                            | 22,4                      |
| Sun Yat-Sen University                                   | academic   | China          | 5280             | 139755         | 34                              | 26,5                      |
| Beijing Institute of Technology                          | academic   | China          | 5255             | 99975          | 27                              | 19                        |

#### 4.8. Journals' Performances

There are four quartiles for the classification of the reputation of journals: Q1 for the top 25%, Q2 for the top 26% to 50%, Q3 for the top 51% to 75%, and Q4 for the top 76% to 100%.

As shown in Figure 7 and Table 6, 48.8% of documents on AI were indexed in Q1, 21.2 % in Q2, 16.8% in Q3, and 13.2% in Q4 journals. This dispersion shows the high quality of the corpus.

#### 4.9. Research Activity in the SDGs (Sustainable Development Goals)

The Sustainable Development Goals (SDGs), also referred to as the Global Goals, in 2015 they were developed by the United Nations. They are a global initiative to eradicate poverty, preserve the environment, and ensure everyone can live in peace and prosperity by 2030. Since 2018, Elsevier has developed search queries to assess SDG advancement. These queries are also used in THE Impact rankings alongside other academic data.[26]

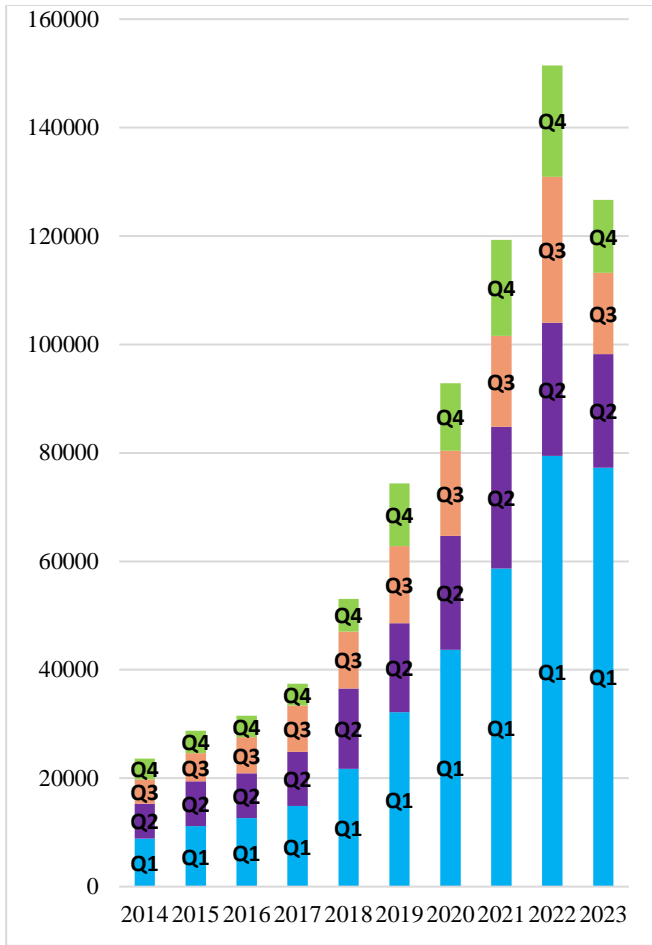


Fig. 7 Documents by quartile -IA-

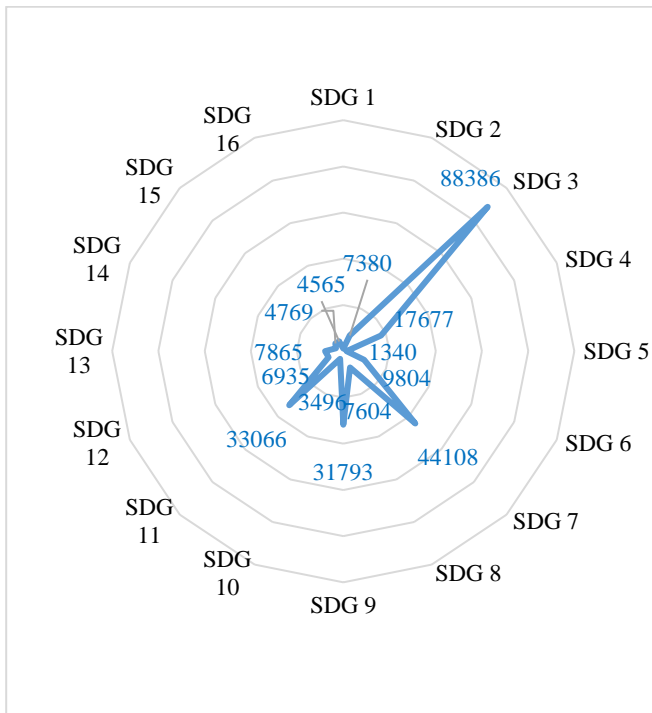


Fig. 8 Research initiatives related to the SDG areas

Table 6. Number of publication by quartiles

| Quartiles        | Publications | Publication share % |
|------------------|--------------|---------------------|
| Q1 top 25%       | 360462       | 48.8                |
| Q2 top (26%-50%) | 156891       | 21.2                |
| Q3top(51%-75%)   | 123968       | 16.8                |
| Q4 top(76%-100%) | 97624        | 13.2                |

Table 7. Research initiatives related to the SDG areas

| Sustainable Development Goals                  | Publications |
|--|--------------|
| SDG 1: No Poverty                              | 1114         |
| SDG 2: Zero Hunger                             | 7380         |
| SDG 3: Good Health and Well-being              | 88386        |
| SDG 4: Quality Education                       | 17677        |
| SDG 5: Gender Equality                         | 1340         |
| SDG 6: Clean Water and Sanitation              | 9804         |
| SDG 7: Affordable and Clean Energy             | 44108        |
| SDG 8: Decent Work and Economic Growth         | 7604         |
| SDG 9: Industry, Innovation and Infrastructure | 31793        |
| SDG 10: Reduced Inequality                     | 3496         |
| SDG 11: Sustainable Cities and Communities     | 33066        |
| SDG 12: Responsible Consumption and Production | 6935         |
| SDG 13: Climate Action                         | 7865         |
| SDG 14: Life Below Water                       | 3360         |
| SDG 15: Life on Land                           | 4769         |
| SDG 16: Peace, Justice and Strong Institutions | 4565         |

As shown in Figure 8 and Table 7, the top five SDGs discovered by the AI corpus are SDG 3: Good Health and Well-being, which represents 8.15%; SDG 7: Affordable and Clean Energy with 4.07%, SDG 11: Sustainable Cities and Communities with 3.05%, SDG 9: Industry, Innovation and Infrastructure with 2.93%, SDG 4: Quality Education with 1.63%

4.10. Most Popular Authors on IA (2014-2023)

Table 8. Most popular author on AI (2014-2023)

| Rank | Author             | Affiliation                                | Country/Region | Scholarly Output | Citation Count | International Collaboration (%) |
|------|--------------------|--|----------------|------------------|----------------|---------------------------------|
| 1    | Jiao, Licheng      | Xidian University                          | China          | 463              | 14473          | 17,9                            |
| 2    | Tao, Dacheng       | University of Sydney                       | Australia      | 433              | 33294          | 83,6                            |
| 3    | Shen, Dinggang     | ShanghaiTech University                    | China          | 388              | 22972          | 74,7                            |
| 4    | Zhang, Mengjie     | Victoria University of Wellington          | New Zealand    | 387              | 12308          | 31,5                            |
| 5    | Acharya, U. R.     | University of Southern Queensland          | Australia      | 379              | 30048          | 99,5                            |
| 6    | Chen, C. L.philip  | South China University of Technology       | China          | 377              | 18056          | 57,3                            |
| 7    | Pedrycz, Witold    | University of Alberta                      | Canada         | 376              | 9778           | 94,7                            |
| 8    | Schuller, Björn W. | Imperial College London                    | United Kingdom | 346              | 12429          | 89,9                            |
| 9    | Zhang, Yudong      | University of Leicester                    | United Kingdom | 323              | 14801          | 92,3                            |
| 10   | Li, Xuelong        | Northwestern Polytechnical University Xian | China          | 320              | 20899          | 26,2                            |

Table 9. General morocco’s performance on Scopus 2014-2023

|                                    | Overall | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|------------------------------------|---------|------|------|------|------|------|------|------|------|------|------|
| <b>International Collaration %</b> | 22      | 20   | 16,9 | 14,5 | 18   | 15,7 | 17,9 | 18,6 | 26,7 | 27,2 | 24,8 |
| <b>Publications Count</b>          | 5774    | 115  | 130  | 269  | 373  | 478  | 613  | 806  | 834  | 1102 | 1054 |
| <b>Citations Count</b>             | 59744   | 987  | 1256 | 4125 | 4027 | 9722 | 7959 | 9485 | 9944 | 7921 | 4318 |
| <b>Citations per Publications</b>  | 10,3    | 8,6  | 9,7  | 15,3 | 10,8 | 20,3 | 13   | 11,8 | 11,9 | 7,2  | 4,1  |
| <b>Authors</b>                     | 14209   | 3171 | 314  | 3499 | 877  | 4057 | 4406 | 2121 | 2255 | 2798 | 6822 |

Table 10. Number of publications by quartiles in morocco

|                  |           | Overall | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|------------------|-----------|---------|------|------|------|------|------|------|------|------|------|------|
| <b>Quartiles</b> | <b>Q1</b> | 1026    | 3    | 11   | 24   | 30   | 38   | 72   | 101  | 188  | 254  | 305  |
|                  | <b>Q2</b> | 978     | 17   | 20   | 13   | 42   | 151  | 101  | 135  | 138  | 190  | 171  |
|                  | <b>Q3</b> | 1094    | 14   | 12   | 40   | 108  | 77   | 96   | 141  | 173  | 257  | 176  |
|                  | <b>Q4</b> | 916     | 5    | 18   | 27   | 18   | 54   | 134  | 55   | 141  | 141  | 323  |

4.11. Emphases on Morocco (Moroccan Performances)

AI research in Morocco is following a similar evolution to that observed globally, moving from an analysis of general trends to a more targeted exploration in specific areas. Ethical concerns and international collaborations are becoming increasingly important, as is the integration of AI in various sectors.

From 2014 to 2023, Moroccan research on AI was published in 5774 publications, which received 59744 citations. 17.77 % of these documents were indexed in Q1

sources, and 32 % of these papers were open-access. Morocco ranked among the top 40 countries publishing the most research in artificial intelligence. At the African level, it ranked second after Egypt (Figure 9). At the Arab level, it ranked fourth after Saudi Arabia, Egypt and the United Arab Emirates (Figure 10 ) Among affiliations, “Mohammed V University in Rabat” holds the first position with 1363 publications, and the second is “The University of Hassan II Casablanca“ with 917, then in third place “Sidi Mohamed Ben Abdellah University of Fez“ with 880 publications. Morocco collaborated mainly with France, Canada, the USA, and Spain.

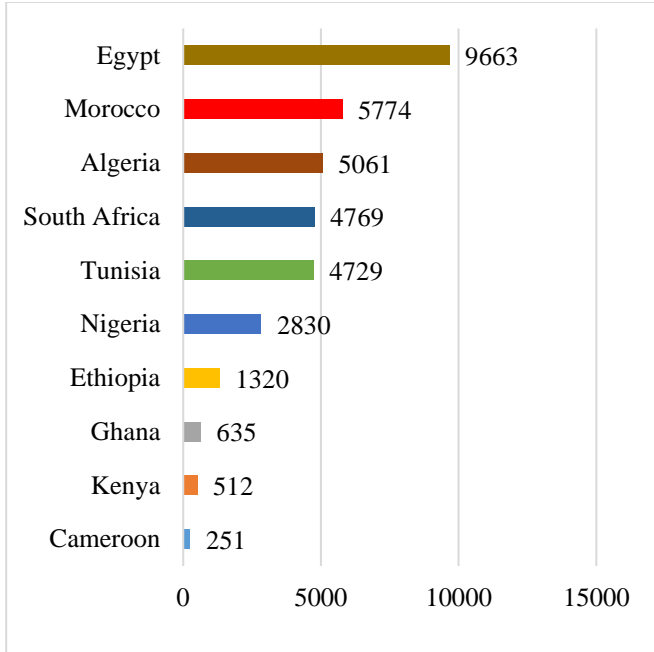


Fig. 9 African top 10 ranking on AI

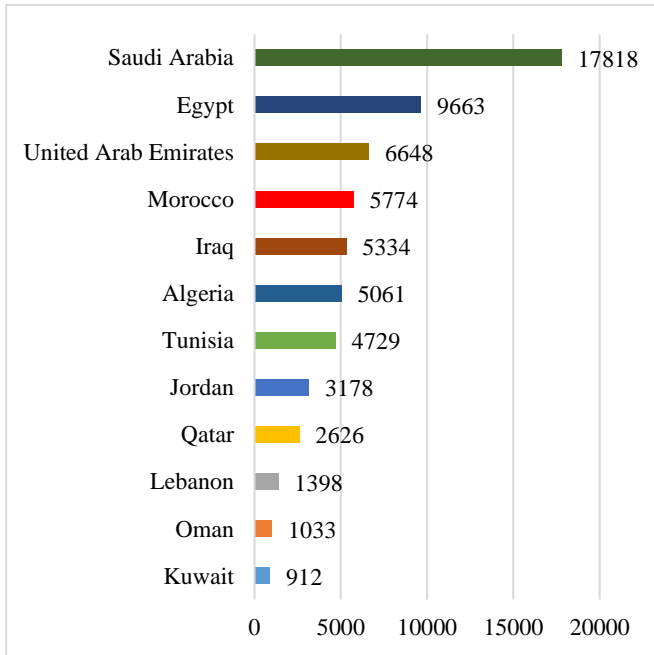


Fig. 10 Arab top 10 ranking on AI

**4.12. Discussion**

This bibliometric study aims to analyze data, extract insights, and answer research questions related to articles, authors, inventors, journals, organizations, companies, and countries publishing in the field of artificial intelligence. It produced results that sparked significant debates. It covers 1084008 publications from 2014 to 2023 in the Scopus database that accumulates 20036874 citations with an annual growth rate of 10.44%. This illustrates the largest Interest researchers have in this field.

Table 11. Moroccan institutions AI

| Institution                          | Scholarly Output | Citation Count |
|--------------------------------------|------------------|----------------|
| Mohammed V University in Rabat       | 1363             | 12826          |
| University of Hassan II Casablanca   | 917              | 8244           |
| Sidi Mohamed Ben Abdellah University | 880              | 11930          |
| Abdelmalek Essaâdi University        | 554              | 4007           |
| University of Moulay Ismail          | 465              | 5477           |
| Ibn Tofail University                | 452              | 3573           |
| Cadi Ayyad University                | 388              | 5341           |
| University Sultan Moulay Slimane     | 285              | 2508           |
| Ibn Zohr University                  | 278              | 3806           |
| Mohamed I University                 | 260              | 2145           |

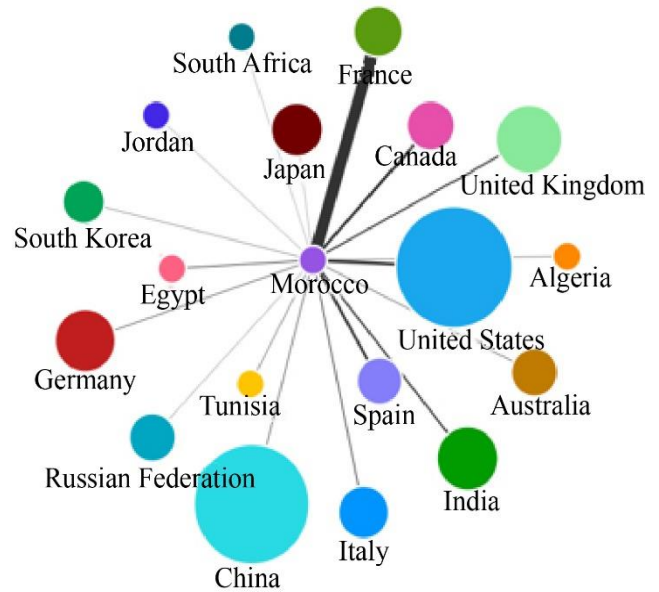


Fig. 11 The main countries of collaboration on AI

Table 12. The main countries of collaboration on AI

| Country              | Scholarly Output | Citation Count |
|----------------------|------------------|----------------|
| France               | 503              | 6398           |
| Canada               | 123              | 2182           |
| United States        | 122              | 2714           |
| Spain                | 117              | 1779           |
| Saudi Arabia         | 79               | 1231           |
| India                | 78               | 1133           |
| United Kingdom       | 78               | 2405           |
| Italy                | 48               | 1528           |
| United Arab Emirates | 48               | 819            |
| Belgium              | 44               | 1118           |

Six themes dominate the AI research corpus (85.58% of the publications): Computer Science, Engineering Mathematics, Physics and Astronomy, Medicine and Decision Sciences. These areas intersect to drive scientific output in AI. The results produced by a total of 50 AI keywords indicate that this corpus is of high quality. The analysis of the corpus that the researchers prefer to publish their scientific research in the leading journals such as: “Lecture Notes in Computer Science”, “IEEE Access”, “ACM International Conference Proceeding Series”, “Advances in Intelligent Systems” and Computing”, and “Communications in Computer and Information Science... The Chinese institutions are well represented, with 15 of the top 20 contributors. More than 50 % are indexed in Q1 and Q2, which reveals the good quality and impact of the research. Even though only one-third of the corpus is open access, it has accumulated several citations, showing that it is the current topic in recent years.

Moreover, the analysis showed a positive impact on aspects of AI on Sustainable Development Goals (SDGS), including SDG 3: Good Health and Well-being, SDG 7: Affordable and Clean Energy, SDG 11: Sustainable Cities and Communities, SDG 9: Industry, Innovation and Infrastructure, SDG 4: Quality Education; On the Moroccan side, it follows the same global trend in terms of the evolution of publications. However, it must focus on collaboration with China, the United States and India or strengthen partnerships with Saudi Arabia and Egypt. The goal of this study is to identify areas requiring further research, inspire new research ideas, and help establish their impact on the field. In addition, these studies can lay a solid foundation for the development of a field in new and meaningful ways while facilitating competitive intelligence or helping to identify partners for collaborative strategies.

## 5. Conclusion

This bibliometric review article looked at a comprehensive review of 1084008 publications from 2014 to 2023. The aim

was to address 11 research questions by analyzing data from the Scopus database, with a particular focus on the global production of research in the field of artificial intelligence. The results revealed an impressive annual growth rate of 10.44% in scientific publication trends. In addition, this corpus has 20036874 citations. The Chinese Academy of Sciences in China emerged as the most productive institution, closely followed by CNRS in France and Anna University in India. Even though the majority of affiliations publishing in the field of AI were Chinese, the top three countries contributing to scientific output were China, the United States, and India. Notably, the most cited sources on the subject were the “Lecture Notes in Computer Science”, “IEEE Access”, and “ACM International Conference Proceeding Series.” In addition, it was found that 48.8 % of AI publications were indexed in Q1 journals.

Furthermore, six domains (Computer Science, Engineering, Mathematics, Physics and Astronomy, Medicine and Decision Science) covered 85.58% of AI publications between 2014 and 2023. Finally, the study of Morocco demonstrated that the publications count is 5774, and it received 59744 citations in the field of AI. In the world, Morocco was ranked 40th among the leading research countries, positioned fourth among Arab nations, and second in Africa.

Morocco has significant development potential in AI and to improve its visibility at the global level. It must invest more in AI research and development, strengthen research infrastructure and local expertise, promote strategic partnerships with global AI players such as China and the United States, and then train and develop AI skills. The results should shed light on potential directions and perspectives for upcoming research in the rapidly expanding field of AI by providing a comprehensive overview of trends related to AI research.

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