



Information Research – Vol. 30 No. iConf (2025)

# How is AIGC shaping the world: an analysis of bibliometrics

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DOI: <https://doi.org/10.47989/ir30iConf47227>

## Abstract

**Introduction.** While artificial intelligence-generated content (AIGC) research is expanding, it largely focuses on specific domains, with limited analysis of its global impact across countries and disciplines. This paper seeks to fill that gap, offering insights into regional AIGC development for policymakers, investors, and researchers.

**Data and Methods.** Using bibliometric methods, this study analyses 11,638 AIGC-related publications from the period between ChatGPT's release on November 30, 2022, and July 31, 2024. A set of indicators is applied to assess the research performance globally, across continents, and in top-performing countries/regions.

**Analysis and Results.** Findings show global engagement in AIGC research, focusing on AI technological advancements, healthcare, education, and ethics. However, there is a notable lack of integration between AIGC and basic disciplines. AIGC research performance mirrors global economic development patterns, reflecting significant imbalances.

**Conclusions.** The study emphasizes the unequal global development of AIGC, calling for enhanced international cooperation, optimized resource allocation, and tailored strategies to close technological gaps.

## Introduction

Artificial intelligence-generated content (AIGC) services are designed to support rapid and personalized multimodal content creation, along with a wide range of applications such as digital marketing, standard knowledge services, video game design, and filmmaking (Cao et al., 2023). By automating the generation of vast amounts of rich, personalized, high-quality content, AIGC has become a driving force for innovation, playing a key role in the next-generation internet paradigm, metaverse, and digital twin technologies. A study by PricewaterhouseCoopers estimates that AI could boost global GDP by 14%, or approximately \$15.7 trillion, by 2030 (PwC, 2017). These figures underscore AIGC's transformative impact on economic growth and its role in accelerating technology adoption.

As an indispensable driving force in the transition to a new era of digital civilization, AIGC has injected fresh vitality into global technological and economic development, offering new opportunities in sectors like healthcare, education, and finance (Cooper, 2023; Dowling & Lucey, 2023; Khan et al., 2023; Lim et al., 2023; Thirunavukarasu et al., 2023). However, due to the inherent characteristics of AI models, coupled with economic, technological, and social factors, AIGC also introduces challenges such as ethics, privacy concerns, algorithmic bias, and regulatory oversight (Cotton et al., 2024; Dwivedi et al., 2023; Gao et al., 2023; Lund et al., 2023). Moreover, it exacerbates global imbalances in areas such as technology, economy, education, and resource distribution (Regmi, 2024; Wang et al., 2024). Therefore, it is crucial to explore how AIGC integrates across different regions and sectors, which can provide insights into the imbalances it creates and inform strategies for responding AIGC's role in shaping future societal development on a global scale.

While significant research exists on AIGC, much of it focuses on specific areas or perspectives such as banking (Beckmann & Hark, 2024; Chaouali et al., 2024; Kim & Song, 2024), libraries (Fruehauf et al., 2024; Lo, 2023; Oddone et al., 2024), and autonomous driving (Xu, Niyato, Chen, et al., 2023; Xu, Niyato, Zhang, et al., 2023; Zheng et al., 2023). Few studies, however, address the broader impact of AIGC across various countries and fields from a global perspective. This paper fills that gap by employing bibliometric methods to map the global landscape of AIGC-related research. It provides a macro-level analysis of the research performance of different continents and key countries in AIGC-related topics, offering insights into the development of AIGC across regions. These findings can inform regional policymaking, national strategic planning, economic investments, resource allocation, and international research collaboration.

## Data and methods

In this paper, we firstly recognized the framework of the search formula by reviewing and backtracking the important literature, which not only contains AIGC, but also includes AIGC tools, technologies, tasks, and applications, etc.; thereafter, we supplemented the relevant keywords through the literature examination and expert consultation; and finally, through several rounds of adjustment, we obtained a search query containing about 100 search keywords, to maximize recall and ensure precision in the search for AIGC-related literature. Using the Web of Science Core Collection, a search was conducted on September 1, 2024, to retrieve relevant articles, reviews, and proceeding papers published between the release of ChatGPT on November 30, 2022, and July 31, 2024. This resulted in a dataset of 11,638 documents.

By comparing UN member states and their respective continents, this study identifies the country/region and its corresponding continent for each article. To better capture collaborative contributions from different countries/regions, we do not differentiate between the order of authors or the extent of their contributions. This means an article may be classified under multiple continents and countries/regions simultaneously. Based on the citation topics in InCites, each article in the dataset is categorized into unique macro-topics and micro-topics. Citation topics are

algorithmically derived citation clusters, developed by CWTS, Leiden. This system uses a three-level hierarchical classification, consisting of 10 macro-topics, 326 meso-topics, and 2,449 micro-topics. Macro- and meso-topics are manually labelled based on content, while micro-topics are algorithmically labelled by their most significant keywords. This classification method, with its clear and concise macro-topics and comprehensive, detailed micro-topics, is well-suited for macro- and micro-level analyses of AIGC literature across various continents and countries/regions.

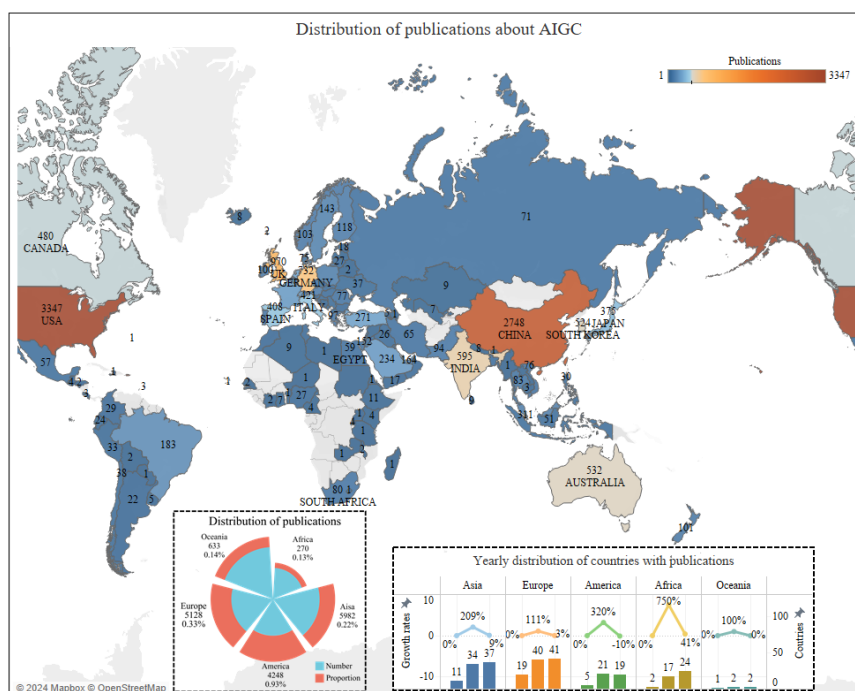
In addition to the number of papers published, we have selected two normalized indicators as the main measures for the academic influence of each continent and country/region: impact relative to world (IRW) and category normalized citation impact (CNCI). To minimize the influence of extreme paper counts or citation frequencies, this study also uses journal normalized citation impact (JNCI), citation impact, documents in the top 1%, and top 10% as supplementary reference indicators (The meanings of each indicator can be found in <https://incites.zendesk.com/hc/en-gb/sections/22667267182225-Indicators-and-Calculations>).

Accordingly, the study will outline the global distribution of AIGC-related research, highlight the extent of AIGC's impact on different countries/regions, and offer decision-making support for stakeholders.

## Results and discussion

### Global overview

Figure 1 illustrates the global distribution of publications related to AIGC following the release of ChatGPT. The data indicate that, since then, an increasing number of nations have engaged in AIGC research. Specifically, over 80% of countries/regions in Asia and Europe have contributed to this body of work. African countries with relevant outputs in 2023 grew by 750%, with 24 African countries having published AIGC-related papers as of the data collection date. This trend demonstrates that AIGC research and applications are no longer concentrated in a few technology-developed regions but are spreading worldwide.



**Figure 1.** Distribution of publications about AIGC

The data suggest a regional imbalance in AIGC-related research. Asia and Europe have the highest number of publications, while the Americas have the highest percentage of AIGC-related papers, which is close to 1%. Notably, AIGC-related papers in Asia are mainly concentrated in China (46%), while in the Americas they are mainly concentrated in the United States (65%), reflecting the fact that AI technology has become the focal point of the global technology competition landscape. Although Oceania has fewer publications overall, its contribution from Australia and New Zealand is notable. In contrast, smaller nations in Oceania have yet to significantly engage in AIGC research, likely due to limited resources. Africa, with 266 papers from 24 countries, faces constraints in research resources and infrastructure, potentially slowing AIGC development. Nonetheless, many African nations are making efforts to explore AIGC's societal applications and build their technological capacities, even if only through an article.

Figure 2 illustrates the keywords co-occurrence network and the evolving trends of subject terms in global AIGC literature. Over time, researchers' focus has shifted from early terms like *'conversational agent'* to *'Chatbot'*, and more recently to *'ChatGPT'*, eventually broadening to *'generative AI'*. This progression reflects the advancement of human-computer interaction from basic conversational robots to sophisticated generative AI platforms, highlighting ongoing improvements in user experience, functional complexity, and application scenarios. Technologically, attention has transitioned from early concepts such as *'deep learning'*, *'GAN (generative adversarial networks)'*, and *'CNN (convolutional neural network)'* to *'NLP (natural language Pprocessing)'* and *'transformer'* architectures, and now to *'LLM (large language models)'*. This shift demonstrates the evolution of AI from traditional deep learning methods to generative AI technologies centered around NLP, particularly the development of Transformer models and LLM.

High-frequency keywords indicate that since the release of ChatGPT, *'artificial intelligence'* has emerged as the dominant keyword in AIGC research. As a prominent application, *'ChatGPT'* naturally draws significant attention and discussion within the field. Additionally, the increasing frequency of terms such as *'LLM'* and *'generative AI'* in recent literature suggests a growing focus on the fundamental technologies and core architectures of generative AI. This shift highlights a transition in research from application-oriented tools to foundational technologies, signalling an expansion of AIGC studies from single model applications to a broader technical foundation and theoretical framework.

Red nodes around the high-frequency keywords highlight recent trends in AIGC research. On one hand, terms such as *'education'*, *'higher education'*, *'patient education'*, and *'health'* indicate the expanding application of AIGC technology in education and medicine. This suggests that AIGC is extending beyond science and academic research into various societal domains, showing promise in addressing practical problems. On the other hand, the frequent co-occurrence of keywords like *'Prompt engineering'*, *'task analysis'*, *'performance'*, *'accuracy'*, *'quality'*, and *'readability'* reflects a growing focus on the performance and precision of AIGC models. Researchers are exploring ways to enhance model output quality, improve content readability, and optimize task execution. This shift underscores the importance of performance optimization as AIGC technology advances from development to practical application. Additionally, the appearance of terms such as *'anxiety'*, *'challenges'*, and *'future'* indicates that while technological advancements are a focus, researchers are also considering potential challenges and social risks associated with AIGC. The rapid growth of generative AI raises issues related to ethics, security, privacy, and social anxiety, prompting scholars to contemplate future developments and address these concerns.



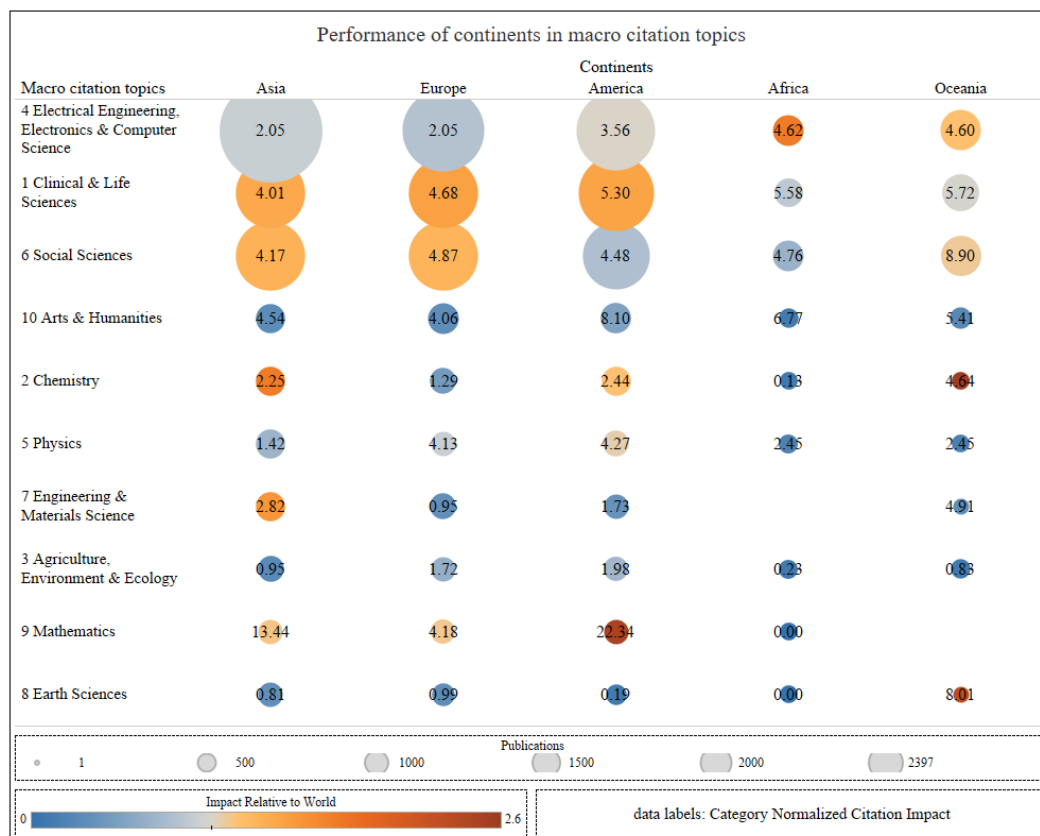


around the world. A detailed review of the papers from these regions indicates that many are produced in collaboration with institutions in Asia, Europe, and the Americas. This suggests that, despite limited resources, enhancing international cooperation can significantly boost scientific research output and global impact. Meanwhile, the Americas excel across all indicators, demonstrating strong overall influence. Asia and Europe show similar scores in CNCI, but Asia has a higher number of highly cited papers and a greater proportion of papers in the Documents in the top 1% compared to Europe, highlighting Asia's superior performance in high-impact research.

In the fields of clinical and life sciences, the findings differ from the latter. Among Asia, Europe, and the Americas, where the volume of publications allows for comparison, the Americas lead in most impact indicators and normalized indicators, followed by Europe and Asia. Despite Oceania's relatively small number of publications, its proportion of high-impact papers remains notable, while Africa's performance across all indicators is comparatively lower.

In social sciences, Oceania's influence stands out distinctly. Despite having only 189 papers, Oceania has a proportion of Documents in the top 1% and top 10% of approximately 15.64% and 35.45%, respectively, significantly surpassing the other continents. Additionally, Oceania's CNCI is 4.28, the highest among the continents. Africa, with 71 publications in social sciences, has about 9.86% of its papers in the Documents in the top 1%, ranking just behind Oceania. Although Asia, Europe, and the Americas show close performance in social sciences, Europe exhibits a higher citation impact than Asia and the Americas, resulting in relatively higher IRW and CNCI for Europe.

Notably, among the 24 articles published in the field of mathematics in the Americas, the citation impact exceeds 10, and the proportions of Documents in the top 1% and top 10% are 25% and 37.5%, respectively, indicating a strong influence of the Americas in AIGC research within mathematics. The reference value of the measurements for other disciplines is limited due to the small number of papers.



**Figure 3.** Performance of continents in macro citation topics

### Performance of top countries in micro-topics

Based on the number of published papers, this article examines the top 10% of countries in each continent and identifies their top 5 micro-topics. The analysis reveals that research from countries in Asia, Europe, and the Americas predominantly centers on five micro-topics: deep learning, artificial intelligence in healthcare and medicine, human-robot interaction, natural language processing (NLP), and open data.

China leads in the number of publications within the field of deep learning. Additionally, NLP is a significant research topic in China, aligning with the country's rapid advancements in artificial intelligence applications and language models. However, in terms of citation impact, articles from China show slightly lower or similar levels compared to global and disciplinary averages, with a notable disparity when compared to the United States. This suggests that China still faces challenges in accumulating high-quality, high-impact research outcomes. This gap may be attributed to variability in paper quality or the fact that many highly cited papers originate from leading research institutions in other countries.

The United States exhibits exceptional citation influence, particularly in artificial intelligence in healthcare and medicine, as well as deep learning. Notably, in the deep learning field, the U.S. not only publishes a significant number of papers but also achieves substantial global impact. This underscores the United States' leading position in AI fundamental research and technology application, particularly in practical fields such as medicine and healthcare.

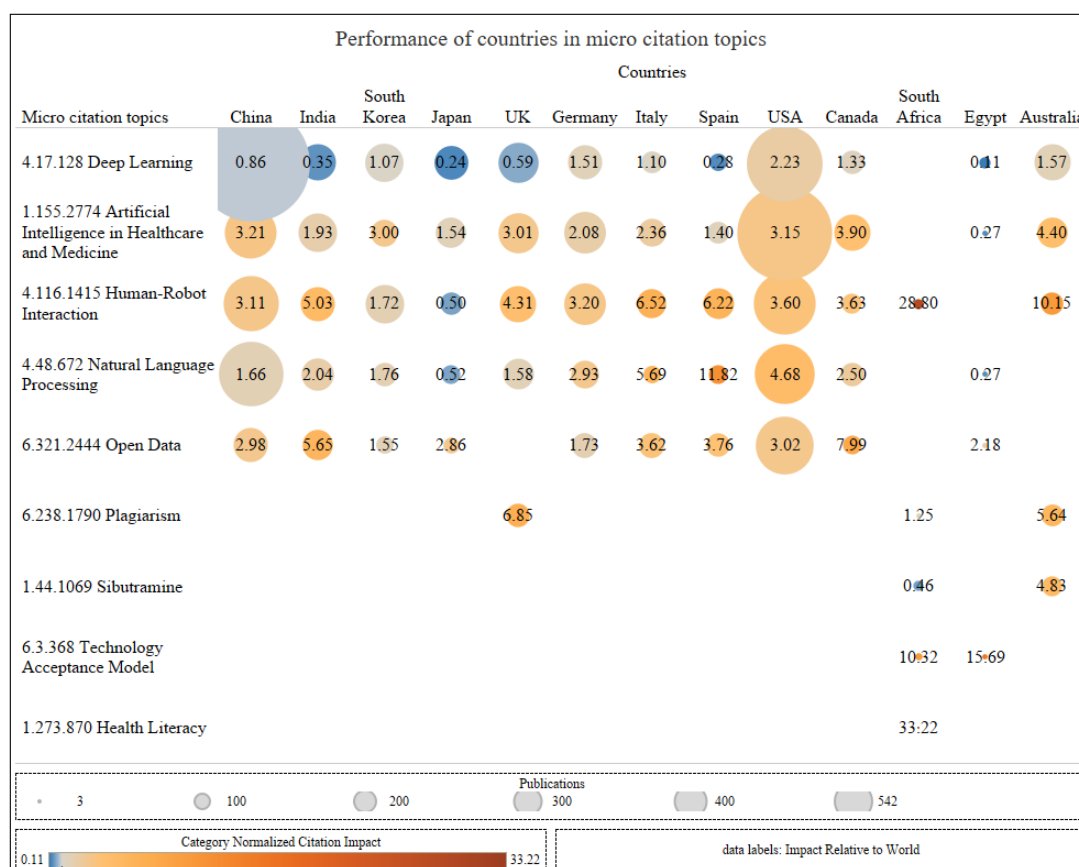
Unlike other countries in Asia, Europe, and the Americas, the UK does not feature open data among its top five research topics. Instead, it focuses on plagiarism, with notable citation performance in this area. This indicates that the UK's research on AI applications in academic ethics, anti-cheating

measures, and educational technology has garnered significant attention within the academic community.

Although African countries have fewer AIGC publications, they have increased their scientific research influence through international collaborations, particularly with Asia, Europe, and the Americas. Egypt's research aligns closely with that of European and American countries, while South Africa's focus areas differ. In addition to human-robot interaction and the technology acceptance model, South Africa's research also addresses specific issues such as health literacy, Sibutramine, and plagiarism.

Australia demonstrates strong citation influence in globally prominent topics such as deep learning, artificial intelligence in healthcare and medicine, and human-robot interaction. Additionally, Australia's research on plagiarism and Sibutramine is notable, reflecting its emphasis on academic integrity and health technology applications.

Although the number of papers published by different countries across various topics is relatively similar, citation influence varies significantly. For instance, India excels in human-computer interaction and open data. Italy and Spain have notable citation influence in human-computer interaction, with Spain's NLP papers particularly influential, though its deep learning papers are less impactful. These variations highlight differences in AIGC-related resource allocation, technological strengths, and research needs among countries, providing valuable insights into the global development landscape.



**Figure 4.** Performance of countries in micro citation topics



## Conclusions

While AIGC has introduced disruptive technological changes across various industries and fields, it has also intensified global imbalances in technology, economy, education, and healthcare. Over the past two years, 123 countries/regions have published AIGC-related papers, primarily concentrated in three key fields: electrical engineering, electronics and computer science, clinical and life sciences, and social sciences. Asia, Europe, and the Americas exhibit notable advantages in research scale and international influence, with significant contributions from the United States and China in advancing AIGC technology. Oceania, though limited in research volume, demonstrates strong citation impact, while Africa generally lags behind.

As AIGC technology continues to evolve, adapting development strategies to align with its progress is crucial for decision-makers. Policymakers are expected to collaboratively develop global AIGC standards and ethical guidelines to foster technology sharing and address the digital divide. Enhancing multilateral cooperation through global platforms could help countries, particularly in Africa, access, and exchange research, potentially promoting more equitable global development. National strategies should consider local technological strengths; for instance, the U.S., Canada, and Australia might focus on advancing AIGC in medical fields and support international collaborations to improve technology levels. Investors should be attentive to emerging AIGC technologies like deep learning and NLP, as early investments might offer returns and assist in technology dissemination, especially in regions with less development. Researchers are advised to explore high-impact AIGC areas and integrate these with fundamental disciplines, while also strengthening international cooperation, particularly with African researchers, to support advancements in both technology and basic research.

## Acknowledgements

This paper was supported by post-funding of National social science (research on empowering publishing knowledge services with digital intelligence), comprehensive construction technology of standard text resources and key elements (5400-202318585A-3-2-ZN), the Young Scientists Fund of the National Natural Science Foundation of China (Grant No.72304215), and the Young Librarian Research Guidance Fund of Wuhan University Library (Grant No.2023-PY-02). In addition, the authors would like to acknowledge and thank Xia Liu, Ying Liu, Jia Lin, and Wenbo Tu of Wuhan University Library for their guidance and support in the earlier process of literature retrieval.

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