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Review Article

Ethical and social dynamics in artificial intelligence and society: A bibliometric study

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ABSTRACT

The study aims to provide a comprehensive bibliometric analysis of the academic literature on artificial intelligence (AI) ethics and social dynamics. Publications between 2020 and 2025 from Web of Science and Scopus databases were examined. The study aims to reveal expose the evolution, patterns, geographic distribution, and multidisciplinary structure of the subject of AI ethics. With an increase of over 100% in both databases, particularly between 2023 and 2024, the results show that the field has displayed fast expansion recently. Though there are variations in production and influence, the USA, the UK, and China dominate the field. Journal analysis shows that the journal "AI & Society" is the most influential publication in both databases. Keyword and thematic analyses show that while "AI", "ethics" and "machine learning" remain central, new themes such as "ChatGPT" and "generative AI" are on the rise. Author collaboration networks reveal the multidisciplinary nature of the field and the existence of diverse research groups. Differences in coverage between databases suggest that Scopus better represents health sciences and current technological developments, while WoS better represents ethics. This study emphasizes that the research agenda in the field of AI ethics should be more inclusive and based on interdisciplinary collaboration and provides recommendations for future research directions.

Keywords: artificial intelligence, ethics, social dynamics, bibliometrics

INTRODUCTION

The rapid advancement and widespread implementation of artificial intelligence (AI) technologies in recent years have prompted discourse regarding their financial, societal, and ethical implications. The development and application of AI systems in accordance with ethical principles are of vital importance, as they are now present in nearly every aspect of contemporary life (Hagendorff, 2020). The ethics of AI, especially in terms of fairness, transparency, privacy, and social impacts, has become a complex field that attracts the attention of researchers from different disciplines.

The literature on AI ethics has shown exponential growth in the last five years (De la Vega Hernández et al., 2023). The emergence and proliferation of generative AI systems such as ChatGPT has made ethical concerns even more visible (Dwivedi et al., 2023). Many studies examine various ethical dimensions of AI systems, such as fairness and impartiality, transparency and explainability, privacy and security, human control and accountability, data ethics, autonomy and inclusiveness (Alvarez et al., 2024; Falvo & Cannataro, 2024; Ferrara, 2024).

Concurrently, researchers are also interested in how AI influences social dynamics and human relationships. AI technology can generate positive (encouragement of community involvement, emotional support) and negative (increasing social isolation, reinforcement of group prejudices) outcomes (Baig et al., 2024; Jawad et al., 2024; Savic, 2024).

The increasing research production in the field of AI ethics and social dynamics creates the need for a comprehensive analysis of the scientific literature in this field. Bibliometric analysis offers a powerful method to understand the development, trends, and current state of a research field (Aria & Cuccurullo, 2017). But current bibliometric research in the field of AI ethics mostly concentrate on single database and lack comparison analysis. Few contemporary bibliometric studies address the influence of recent technological innovations, including generative AI.

In order to fill this research gap, this study aims to provide a bibliometric analysis of research in the field of AI ethics and social dynamics. The aim of the study is to reveal the development, trends, geographical distribution and interdisciplinary nature of the field by comparatively analyzing studies published between 2020 and 2025 in Web of Science (WoS) and Scopus databases. This comparative analysis aims to provide a more holistic perspective by identifying the differences in coverage of both databases and to understand how the research agenda in the field of AI ethics is taking shape. The following research questions (RQs) were formulated:

1. **RQ1.** What are the general bibliometric characteristics (publication trends, citation dynamics, and growth rates) of the AI ethics and social dynamics literature in the WoS and Scopus databases (2020-2025)?
2. **RQ2.** Which journals, authors, and institutions are most influential in the field, and how do their impact profiles differ across the two databases?
3. **RQ3.** How is the scientific production on AI ethics and social dynamics distributed geographically, and what cross-national patterns emerge?
4. **RQ4.** What are the core thematic clusters and keyword network structures in the AI ethics literature, and how do they differ between WoS and Scopus?
5. **RQ5.** What are the patterns of research collaboration among scholars, and which researchers serve as key connectors across research communities?

The findings of this study will give practitioners in the field of AI ethics, legislators, and researchers insightful analysis of the present situation of the discipline and future directions of research. It will also help to pinpoint areas of research and policy focus to enable the moral and responsible growth of AI technology.

LITERATURE REVIEW

Key Dimensions of AI Ethics

The rapid growth of AI technologies has sparked numerous debates regarding ethical, social, and economic challenges. The ethics of AI encompass many different aspects, such as fairness, transparency, privacy, and societal impacts, and these aspects must be addressed with great care (Hagendorff, 2020). The literature identifies certain interrelated characteristics that collectively define the ethical framework for the development and application of AI.

AI systems are expected to be fair and unbiased. Research indicates that AI can reproduce biases present in training data, potentially leading to discrimination in areas such as employment, credit scoring, and healthcare (Ferrara, 2024). Mehrabi et al. (2021) highlight how AI models in courts and healthcare settings can perpetuate existing inequalities. Alvarez et al. (2024) emphasize that fair AI requires more than just optimizing metrics; it necessitates transparency, accountability, and approaches from various fields within socio-technical systems.

Both transparency and explainability are crucial for ethical AI governance. Falvo and Cannataro (2024) have highlighted that these are fundamental components for enhancing user trust. However, the opaque nature of deep learning models poses significant challenges (Nazeer, 2024). While Balasubramaniam et al. (2023) identified four key elements of explainability needs, Vainio-Pekka et al. (2023) demonstrated the capacity of explainable artificial intelligence (XAI) tools to enhance interpretability. Particularly in high-risk sectors such as banking and healthcare, non-transparent AI decision-making processes can jeopardize the principle of informed consent. This may negatively affect fundamental rights (Hwang, 2024; Mittelstadt, 2019).

Closely related are concerns about security and privacy. AI systems typically process significant amounts of personal data (Achuthan et al., 2024; Davenport et al., 2020), and traditional privacy concerns are becoming increasingly complex due to the growing automation of data collection (Martin & Zimmermann, 2024). Floridi (2020) has noted that big data applications can jeopardize meaningful consent, particularly when data is collected via wearable technologies and social media (Canali et al., 2023). Consequently, striking a balance between data usage and privacy protection remains a significant challenge (Achuthan et al., 2024; Zhang et al., 2021).

The human control and accountability dimension addresses the necessity for humans to retain decision-making authority over AI systems (Chen et al., 2023; Margetis et al., 2021). The human-centered artificial intelligence (HCAI) approach advocates for expert participation at every stage of AI deployment and the application of "human-in-the-loop" methodologies (Chen et al., 2023; Margetis et al., 2021). This principle applies across various fields; for example, while Nakao et al. (2023) emphasize human-machine collaboration in financial services, Rokhshad et al. (2023) argue that even when AI is used in dentistry, the ultimate responsibility must remain with clinicians. Regardless of the level of AI autonomy, responsibility for the outcomes always lies with humans (Hagendorff, 2020).

Ethical data collection and use represent another critical dimension. Franzke et al. (2021), by developing the data ethics decision aid framework, demonstrated that legal regulations alone are insufficient without ethical evaluation. In the healthcare sector, regulations such as general data protection regulation (GDPR) and HIPAA provide fundamental safeguards for data protection by emphasizing principles of transparency, data minimization, and informed consent (Andrieux et al., 2024; Nasir et al., 2024). The issue of autonomy and control concerns how the balance of responsibility shifts as AI becomes more capable in decision-making. While Kamila and Jasrotia (2023) emphasize that the increasing autonomy of AI raises unresolved issues regarding epistemic accountability, Amann et al. (2020) argue that autonomous systems must be designed to align with ethical standards and social norms. Griffin et al. (2025) found that AI developers are aware of ethical challenges but face significant shortages in resources and training to address these issues effectively.

Finally, for AI technologies to be inclusive and accessible, they must work equally well for people from all backgrounds. Research has highlighted AI's capacity to empower marginalized communities (Kasun et al., 2024; Khan, 2024) and, at the same time, its capacity to perpetuate entrenched inequalities, particularly for minority groups in healthcare (Marko et al., 2025) and communities in the Global South. Capraro et al. (2024) highlighted the paradox that AI can simultaneously worsen and lessen social inequality. The researchers suggested extensive policy changes, such as equitable taxation, worker representation, and public AI-focused institutions.

All of these results show that an interdisciplinary framework based on social welfare, justice, and human rights is necessary for AI ethics. To support the responsible growth and use of AI, it is still very important to make sure that ethical standards are the same around the world and that regulatory frameworks, industrial applications, and academic study all work together.

The Effect of AI on Social Dynamic

AI's possible consequences for social dynamics and interpersonal relationships have attracted a lot of interest when it is integrated into different spheres of human life (Dwivedi et al., 2023; Evans et al., 2024; Hohenstein et al., 2023). These consequences span the spectrum, ranging from positive to negative outcomes along a continuum.

Positive impacts of AI on social dynamics and human relations

AI has introduced new ways to communicate and build relationships, especially through social media platforms and chatbots. AI-powered features such as personalized content recommendations and friend suggestions have encouraged community engagement and social connections (Baig et al., 2024). On platforms such as Replika, algorithms powered by AI have been shown to provide emotional support and companionship, thereby affording users a secure space for self-expression and the evolution of their identity (Kouros & Papa, 2024; Savic, 2024).

The emergence of AI companions has been posited as a potential remedy for the escalating epidemic of loneliness. These systems, such as Replika, prove especially advantageous for individuals who encounter difficulties in establishing human relationships, as they provide nonjudgmental interactions and readily available support (Dehnert, 2023; Savic, 2024). Empirical research indicates that individuals utilizing such platforms generally experience positive and fulfilling relationships, which may contribute to a decrease in feelings of isolation (Li & Zhang, 2024; Savic, 2024).

AI plays a crucial role in facilitating social connection in online learning environments. AI agents can support learners in these environments by simulating empathy and adaptability, addressing social isolation, and promote a sense of community (Liu et al., 2024; Savic, 2024).

AI companions such as Replika provide individuals with a platform to investigate their identities and articulate their thoughts devoid of apprehension regarding judgment (Ge, 2024). This phenomenon has been particularly empowering for younger users who predominantly engage with these platforms to navigate their self-concept in the contemporary digital era (Bhutani et al., 2024; Kouros & Papa, 2024).

The negative impact of AI on social dynamics and human relations

Although AI companions offer emotional support, they lack the real empathy and reciprocity that define close relationships. This shortage could lead to a lower capacity to create and sustain important personal contacts, therefore aggravating social isolation over a lengthy period (Kim & McGill, 2024; Savic, 2024).

It has been shown that AI driven customizing on social media platforms promotes divisiveness and strengthens group identity. AI algorithms could worsen in-group prejudices and reduce exposure to diverse points of view by creating content that fits users' pre-existing tendencies, hence contributing to further social fragmentation (Jawad et al., 2024; Zulfiqar et al., 2024).

Users of these connections may prefer them over personal relationships, therefore the continual availability and predictability of AI companions could cause emotional dependency. Such dependence could impede the acquisition of required social skills needed to navigate the complexity of personal contacts (Wu, 2024). Empirical research on interaction with tailored material on social media has found that it can lower self-esteem, increase anxiety, and distort self-perception. Younger users, more likely to interact with AI-driven communication tools, should especially be concerned about this phenomenon (Bhutani et al., 2024; Jawad et al., 2024).

The integration of emotional intelligence into AI systems raises important ethical concerns, including data privacy and the potential for emotional manipulation. As AI systems collect extensive data on users' emotional preferences, the risk of misuse and abuse becomes increasingly evident (Liu et al., 2024; Wu, 2024).

Ethical considerations and future directions

In the advancement and execution of AI systems, ethical considerations such as transparency, equity, and the empowerment of users ought to be prioritized. Sustaining the integrity of social dynamics relies on ensuring that AI technologies serve to augment rather than supplant human interactions (Baig et al., 2024).

AI systems ought to be meticulously crafted to mitigate the potential for algorithmic bias and the dissemination of erroneous information. Consequently, robust regulatory frameworks and governance structures are imperative to guarantee that AI-driven algorithms do not reinforce detrimental stereotypes or exacerbate social inequities (Baig et al., 2024; Hohenstein et al., 2023; Liu et al., 2024).

As AI finds increasing presence in social interactions, the encouragement of digital literacy and critical thinking skills becomes essential. Users should be aware of the limitations and possible prejudices of AI systems so they may interact appropriately with them (Rosenbaum et al., 2024; Serpa et al., 2025).

The advancement of AI ought to prioritize the establishment of systems that enhance human welfare while simultaneously safeguarding essential components of human interconnectivity. This necessitates a judicious strategy that prioritizes ethical accountability as paramount, alongside technological progress (Li & Zhang, 2024; Rezaev, 2021).

AI Ethics and Social Impacts: Synthesis of Bibliometric Research

An expanding corpus of bibliometric scholarship has increasingly attempted to chart the intellectual topography of AI ethics research, bringing into view not only the temporal trajectories through which the field has evolved, but also the uneven geographic distribution of scholarly productivity, the widening interdisciplinary range of contributing domains, and the recurring thematic concerns that have come to define the literature; accordingly, a careful synthesis of these studies is indispensable, both for situating the present investigation within the broader research tradition and for clarifying the unresolved conceptual and empirical gaps to which this study is designed to respond.

Evolution of AI ethics research

Over the last several years, research on AI ethics has undergone a pronounced and unmistakable acceleration, a development that has been documented across multiple bibliometric investigations, each of which has proposed its own periodization of the field's growth and transformation. De la Vega Hernández et al. (2023), for instance, identified an exponential increase in publications over the previous five years, whereas Gao et al. (2024), adopting a more developmental perspective, distinguished three major phases in the evolution of AI ethics scholarship, namely an incubation period spanning 2004 to 2013, a phase characterized by intensified efforts to develop human-like AI between 2014 and 2019, and, beginning in 2020, a transition toward HCAI systems. Within the more specialized context of healthcare, Fosso Wamba and Queiroz (2023) proposed an even longer historical framing, delineating four periods between 1977 and 2020 and noting that the steepest rise in publication activity occurred after 2015. Nevertheless, because these temporal classifications were largely formulated before the emergence of generative AI applications such as ChatGPT in late 2022, they were unable to account for the novel ethical challenges introduced by these systems, challenges that have since substantially reoriented scholarly debate. Indeed, the implications of ChatGPT for scholarly communication have rapidly become a major object of inquiry, as illustrated by Adhikari et al. (2025), who examined its effects on productivity, inclusivity, and academic integrity in higher education and, in doing so, reconceptualized it not merely as a technological instrument but as a systemic force capable of reshaping academic practice itself.

Geographic distribution and productivity

One of the most persistent and methodologically consistent findings across bibliometric analyses concerns the pronounced geographic asymmetry that characterizes research output in AI ethics, with publication activity concentrated heavily in a relatively small number of countries. Li and Zhang (2024) reported that English-speaking nations, most notably the USA, the UK, Australia, and Canada, occupy a dominant position within the field, while Chuang et al. (2022) demonstrated that, although scholars from 66 different countries had contributed to the literature, the ten most productive nations together accounted for approximately 94% of all publications, with the USA alone responsible for 47.59%. Ionescu et al. (2024) identified similar trends in their study on agent-based modeling and AI; in this field, the USA, China, the UK, Canada, and Germany have emerged as the leading nations. Ciobanu and Meșniță (2021), in their review of AI ethics research in the business world, reached the same conclusion and demonstrated that the primary contributions in this field have come from the USA and the UK. This concentration is analytically significant because it highlights the unresolved issue of whether ethical paradigms, conceptual vocabulary, and normative assumptions derived from the literature adequately represent the experiences and priorities of researchers and communities in the Global South; this question has not been sufficiently explored in existing bibliometric records.

Disciplines and subfields

With the expansion of research in the field of AI ethics, it has become increasingly clear that this field has an interdisciplinary structure. However, the relative importance of different disciplines has shifted unevenly over time and across subject areas. Chuang et al. (2022) noted that despite the growing influence of sociology in recent years, engineering has remained the primary disciplinary influence in AI ethics research since the 1980s, emphasizing that this reflects the field's historically technical focus. Additionally, De la Vega Hernández et al. (2023) found that medical sciences, engineering, and computer science collectively dominate the research landscape, though robotics, deep learning, and machine learning have emerged as the fastest-growing subfields. Fosso Wamba and Queiroz (2023) supported these findings by identifying machine learning, deep learning, and robotics as the most commonly used AI techniques in the health research literature. Yet, despite the value of these disciplinary mappings, they have tended to underrepresent or altogether overlook the increasingly important intersections between AI ethics and such domains as educational research, the social sciences, and sustainability studies, all of which have become sites of intensifying ethical concern and debate but remain comparatively underexplored from a bibliometric standpoint.

Ethical concerns and issues

The bibliometric literature has consistently identified a broad and recurring set of ethical concerns associated with the development and application of AI, although different studies have organized these concerns according to somewhat different conceptual taxonomies. Zhang et al. (2021), for example, argued that AI-related techniques, including machine learning, data analysis, robotics, and cloud technologies, generate ethical problems linked to fairness, discrimination, data privacy, and cybercrime. Building on this conversation, Gao et al. (2024) put forward a seven-part classification of the main ethical issues. These include the Collingridge dilemma, the moral and ontological status of AI, problems with transparency and explainability, privacy protection, fairness and equity, algorithmic governance and human disempowerment, and the possible threat of superintelligence. Ciobanu and Meșniță (2021) conducted a content analysis that revealed four principal subject clusters: data security, privacy, robots and automation, and human impact. This provides an alternate yet complementary depiction of the ethical framework within the sector. However, the emergence of generative AI has brought forth a unique array of challenges, especially with academic integrity and scholarly communication, which were not predominant in previous bibliometric studies. Eleftheriou et al. (2025) recorded the ethical challenges faced by peer tutors in writing centers, such as the difficulty in recognizing AI-generated content, the complexities of addressing requests to "humanize" machine-generated text, and the struggle of navigating inconsistent institutional policies. Similarly, Adhikari et al. (2025) emphasized that the absence of coherent and standardized institutional guidance regarding AI attribution has intensified uncertainty surrounding academic honesty, authorship, and intellectual property in scholarly settings.

Research gaps and the contribution of the present study

When the findings of prior bibliometric research are brought together, several important gaps become readily apparent, each of which points to the need for a more comprehensive and methodologically integrative approach. First, the majority of existing studies have relied on a single bibliographic database, most commonly either WoS or Scopus, rather than undertaking a comparative analysis across multiple databases, a limitation that constrains the generalizability of their conclusions because each database differs in its journal coverage, disciplinary inclusiveness, and geographic representation. Second, the rapid emergence of generative AI technologies since late 2022 has produced a series of ethical issues, including AI-generated authorship, hallucinated references, and the increasingly ambiguous boundary between human and machine intellectual labor, that fall outside the temporal scope of much of the earlier bibliometric literature. Third, prior investigations have only rarely integrated bibliometric mapping with thematic network analysis and keyword co-occurrence techniques in ways that would illuminate the structural organization and internal dynamics of the field more fully. Fourth, whereas AI ethics and social dynamics are profoundly intertwined fields, bibliometric syntheses that concurrently address them are scarce, as the majority of studies have investigated these subjects in isolation rather than emphasizing their intersection.

In light of these constraints, the current study conducts a dual-database bibliometric analysis of literature on AI ethics and social dynamics published from 2020 to 2025, explicitly incorporating the generative AI era and its related conceptual transformations. This study aims to provide a more comprehensive, comparative, and structurally nuanced account of the field's intellectual configuration, geographic distribution, and emerging research frontiers by integrating keyword co-occurrence networks, thematic mapping, and collaboration analysis from both WoS and Scopus, surpassing previous bibliometric investigations.

METHOD

In this study, a bibliometric analysis of scientific publications in the field of AI ethics and social impacts was conducted. The research covers studies published between 2020 and 2025 from the WoS and Scopus databases. This time frame was selected to capture the most recent phase of AI ethics research, which coincides with the rapid proliferation of large language models and generative AI systems such as ChatGPT, as well as intensified global policy discussions surrounding AI governance. The search query used in the data collection process was designed to include keywords such as "artificial intelligence", "ethics", "social impact". The data obtained were analyzed using bibliometric indicators such as citation analysis, keyword analysis, institutional collaboration, and country contribution. In addition, research trends and concentration areas in the field were identified through common keyword networks and thematic maps.

Data Collection Process

In this study, a structured data collection process to comprehensively review the scientific literature in the field of AI ethics and social impacts was followed. The data collection process followed a systematic approach guided by the PRISMA 2020 (Page et al., 2021) (**Figure 1**). This process included formulating a search strategy, searching databases, eliminating duplicate records, and applying inclusion/exclusion criteria.

The search query used in this study was designed to cover the topic comprehensively: (("artificial intelligence" OR "AI" OR "chatbot*") AND ("ethic*" OR "moral*" OR "social impact*" OR "social implication*" OR "social dynamic*" OR "social effect*" OR "social consequence*" OR "social responsibility" OR "societal impact*")).

This inquiry was conducted utilizing the WoS and Scopus databases on March 9, 2025, encompassing publications from the years 2020 through 2025. The preliminary search generated a total of 10,538 records from the WoS and 9,967 records from Scopus. Subsequent to the removal of duplicate entries, 10,500 distinct records were ascertained in the WoS and 9,860 in Scopus. The criteria for inclusion consisted of

(1) publication date between 2020 and 2025,

(2) written in the English language,

(3) classified as either a research article or a review article, and

(4) concentrating on the ethical implications of AI or its societal effects.

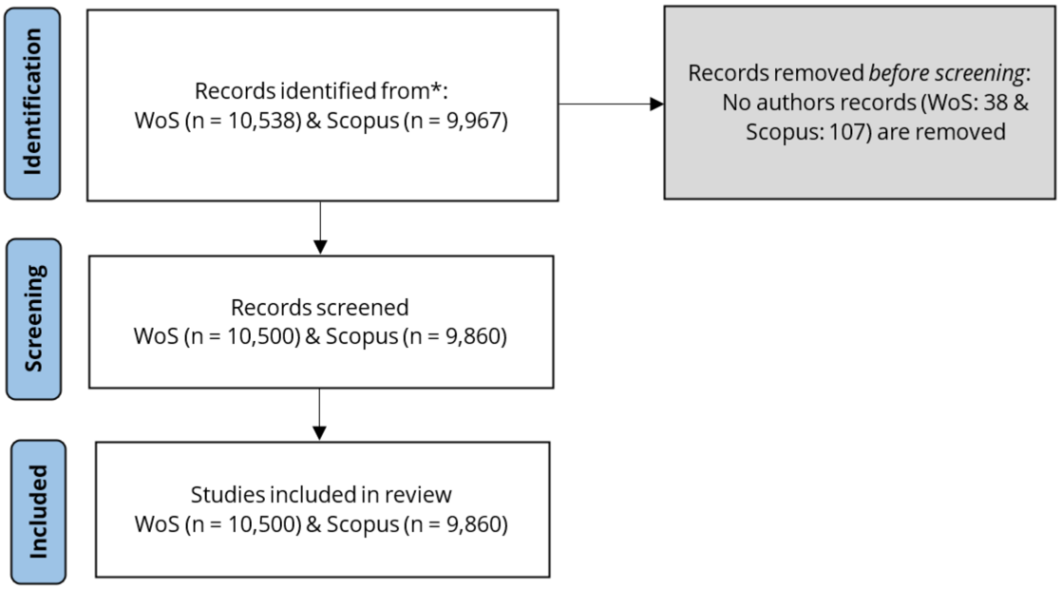

Figure 1. Data collection process (modified from PRISMA 2020)

Data Analysis

In this study, the "Bibliometrix 4.3.2" package in RStudio (2024.12.0) was used to analyze the collected bibliometric data. Bibliometrix is a comprehensive open source tool for bibliometric and scientometric analysis (Aria & Cuccurullo, 2017). Tableau was also used for data visualization.

In the analysis, data from the WoS and Scopus databases were evaluated separately. Basic bibliometric indicators (annual publication numbers, citation patterns) and impact measures (h-index, g-index, m-index) were calculated (Hirsch, 2005). Productivity and impact analyses were conducted at the author, institution, and country levels.

In keyword analysis, common word networks were created, and the relationships between words were examined. In this process, centrality (betweenness) and importance (PageRank) values were calculated (Callon et al., 1983). In addition, thematic maps were created to understand the conceptual structure of the research area (Cobo et al., 2011).

When examining collaboration patterns, author collaboration networks were analyzed, and different research groups were identified. Clear graphs, maps, and tables were created using Tableau software for visualization (Glänzel & Schubert, 2004).

FINDINGS

The findings are organized in alignment with the five RQs guiding this study. First, the general bibliometric characteristics and publication trends are presented (**RQ1**). This is followed by an analysis of the most influential journals, authors, and institutions (**RQ2**), the geographic distribution of research output (**RQ3**), keyword network structures and thematic maps (**RQ4**), and collaboration patterns among researchers (**RQ5**).

Although the two databases contain a similar number of references (WoS: 3,479 and Scopus: 3,567), WoS has more documents (10,500 vs. 9,860). The higher annual growth rate in WoS (10.62%) compared to Scopus (9.43%) indicates a faster literature expansion in WoS in the field of AI ethics (**Table 1**).

Scopus stands out in citation dynamics. The average number of citations of articles in Scopus (13.92) is significantly higher than in WoS (10.3). This difference suggests that publications in Scopus may have a wider impact.

There is an interesting contrast in terms of content: WoS has more author keywords (24,302 vs. 21,013), while Scopus has far more auto-generated keywords, so-called "keywords plus" (24,642 vs. 8,898). This suggests that Scopus offers a wider conceptual net for content identification.

Table 1. Descriptive information on WoS and Scopus databases

Main information about data	WoS	Scopus
Timespan	2020:2025	2020:2025
Sources (journals, books, etc.)	3,479	3,567
Documents	10,500	9,860
Annual growth rate %	10.62	9.43
Document average age	1.9	1.86
Average citations per document	10.3	13.92
Document contents		
Keywords plus (ID)	8,898	24,642
Author’s keywords (DE)	24,302	21,013
Authors		
Authors	41,383	30,297
Authors of single-authored docs	1,754	1,983
Authors collaboration		
Single-authored documents	1,978	2,220
Co-authors per document	5.17	3.95
International co-authorships %	31.78	28.87
Document types		
Article	10,500	9,860

Table 2. Compare citation and number of article over years

Database	Year	Articles	MeanTC/article	MeanTC/year
WoS	2020	652	35.80	5.97
	2021	1,086	22.51	4.50
	2022	1,323	14.76	3.69
	2023	2,063	13.66	4.55
	2024	4,296	2.82	1.41
	2025	1,080	0.47	0.47
Scopus	2020	617	50.94	8.49
	2021	900	33.48	6.70
	2022	1,174	19.25	4.81
	2023	1,947	19.03	6.34
	2024	4,254	3.68	1.84
	2025	968	0.34	0.34

There are also significant differences in author collaboration patterns. The number of co-authors per document is higher in WoS (5.17) than in Scopus (3.95). In addition, the international co-authorship rate in WoS (31.78%) is higher than in Scopus (28.87%). On the other hand, the number of single-authored documents is higher in Scopus (2220 vs. 1978). These data suggest that there is a more collaborative and international research trend in WoS, while individual studies are more common in Scopus.

There has been a noticeable increase in the number of articles in both databases over the years (**Table 2**). Especially in 2024, there was a dramatic jump in the number of articles in both WoS and Scopus. From 2023 to 2024, the number of articles in WoS increased from 2,063 to 4,296, an increase of about 108%, while Scopus showed a similar increase (118%) from 1947 to 4254 in the same period. This shows that academic interest in AI ethics is experiencing a phenomenal surge in 2024.

In terms of citation dynamics, a similar pattern is observed in both databases: older articles are expected to have higher citation averages. However, it is striking that articles in Scopus have higher average citation values for each year than their counterparts in WoS. For example, for articles in 2020, the average citation in Scopus (50.94) is 42% higher than in WoS (35.8). This difference suggests that journals indexed in Scopus may reach a wider readership or contain more influential publications.

Scopus is also superior in terms of average annual citations per article. In 2020, articles received an average of 8.49 citations per year in Scopus compared to 5.97 in WoS. This difference persists in the following years.

An interesting observation is the citation performance of 2,023 articles. While the annual average number of citations per article for 2,023 articles in WoS is 4.55, this value is even higher in Scopus with 6.34. This suggests that more effective studies on AI ethics were published in both databases in 2023.

Table 3. Most influential sources in AI ethics

D	Source	h-i	h-r	g-i	g-r	m-i	m-r	TC	TC-r	NP	NP-r
WoS	AI & Society	31	1	49	1	5.167	1	3,871	1	388	1
	IEEE Access	16	8	25	17	2.667	13	990	11	196	2
	BMJ Open	13	17	31	8	2.167	23	1,254	6	183	3
	Ethics and Information Technology	17	7	25	16	2.833	10	986	12	134	4
	Sustainability	21	2	35	3	3.500	2	1,649	3	112	5
	Cureus Journal of Medical Science	13	18	24	21	2.167	26	682	27	96	6
	Science and Engineering Ethics	19	3	38	2	3.167	5	1,519	4	76	7
	Scientific Reports	13	21	26	15	2.167	25	775	18	76	8
	Applied Sciences–Basel	9	41	25	18	1.500	56	678	28	63	9
	Journal of Medical Internet Research	16	10	34	4	2.667	12	1,213	7	60	10
	Education and Information Technologies	14	13	29	10	2.800	11	867	15	60	11
	Big Data & Society	17	6	33	6	2.833	9	1,119	8	46	17
	Technology in Society	18	5	32	7	3.000	6	1,090	9	42	21
	Journal of Business Ethics	18	4	29	9	3.000	7	896	13	36	23
	Minds and machines	12	25	34	5	2.000	27	1,274	5	34	24
	IEEE Transactions on Geoscience and Remote Sensing	16	9	27	12	3.200	4	738	20	31	32
	JMIR Medical Education	13	20	21	25	3.250	3	462	48	31	33
	International Journal of Artificial Intelligence in Education	12	24	21	26	3.000	8	672	31	21	54
	BMC Medical Informatics and Decision Making	6	69	11	73	1.000	116	1,012	10	11	115
	International Journal of Information Management	8	57	10	78	1.333	87	2,208	2	10	129
Scopus	AI and Society	34	1	55	1	5.667	1	4,353	2	329	1
	Philosophy and Technology	22	2	40	4	3.667	2	1,752	5	85	5
	Science and Engineering Ethics	21	3	46	2	3.500	3	2,155	3	59	6
	Big Data and Society	20	4	40	5	3.333	5	1,643	7	48	13
	Ethics and Information Technology	20	5	30	12	3.333	6	1,138	17	93	4
	Technology in Society	20	6	41	3	3.333	4	1,709	6	45	16
	IEEE Access	19	7	30	13	3.167	8	1,146	16	153	2
	Journal of Business Ethics	19	8	28	17	3.167	9	1,170	14	28	28
	Computers in Human Behavior	18	9	30	14	3.000	11	1,578	8	30	26
	Sustainability (Switzerland)	18	10	39	6	3.000	10	1,544	9	59	7
	Education and Information Technologies	16	12	38	7	3.200	7	1,462	12	57	9
	Proceedings of the ACM on Human-Computer Interaction	16	13	29	16	2.667	16	907	25	59	8
	BMJ Open	15	14	33	10	2.500	17	1,259	13	136	3
	Computers and Education: Artificial Intelligence	14	16	38	8	2.800	14	1,478	11	46	14
	Minds and Machines	13	22	36	9	2.167	25	1,846	4	36	22
	Applied Sciences (Switzerland)	11	26	27	19	1.833	44	789	31	56	10
	Journal of Business Research	9	47	12	67	1.500	68	1,508	10	12	97
	International Journal of Information Management	8	57	11	73	1.600	60	5,164	1	11	107

Note: D: Databases; h-i: h-index; h-r: h-rank; g-i: g-index; g-r: g-rank; m-i: m-index; m-r: m-rank; TC-r: TC rank; NP-r: NP-rank; h-index is the number of publications (h) that have received at least h citations, reflecting both productivity and impact; g-index is a variant of the h-index that gives more weight to highly cited articles; m-index is h-index divided by the number of years since the author's first publication, indicating annual impact rate; TC is total citations received; NP is number of publications; & Rankings are database-specific

The data for 2025 is not yet complete, so the number of citations is expected to be low. However, the general trend shows that the rapid increase in the number of publications in the field of AI ethics will continue.

In both databases, the journal "AI & Society" ranks first in the h-index ranking (WoS: 31, Scopus: 34). This journal stands out as the most influential publication in the field and ranks first in terms of the number of articles in both databases (WoS: 388, Scopus: 329). This shows the journal's leadership in the field in terms of both publication volume and impact (**Table 3**).

Some journals have somewhat different impact values based on the two databases. For instance, although only ninth in the h-index ranking (h-index = 16), the journal "IEEE Access" ranks second in WoS in terms of quantity of articles (196). In Scopus, the same journal ranks seventh in the h-index ranking (h-index = 19). This shows that although the journal is represented by more articles in WoS, it is more influential in Scopus. An interesting situation emerges when the total number of citations (TC) is compared. In WoS, the journal "international journal of information management" ranks second in total citations (2,208), while in Scopus it ranks first (5,164). However, in both databases, this journal ranks low in terms of the number of articles (WoS: 129th place, Scopus: 107th place). This indicates that the journal publishes a small number of articles with very high impact.

In terms of m-index values (h-index divided by journal age), the journal "AI & Society" has the highest value in both databases (WoS: 5.167, Scopus: 5.667). This shows that the journal consistently publishes articles with a high impact factor. Regarding multidisciplinary interaction, the journal "Science and Engineering Ethics" shines out. Both databases highly score this journal (WoS: h-index rank 3, Scopus: h-index rank 3). Likewise,

Table 4. Top authors in AI & ethics

D	Author	h-i	h-r	g-i	g-r	m-i	m-r	TC	TC-r	NP	NP-r
WoS	Zhu, X. X.	21	1	43	1	3.500	1	1,926	5	66	2
	Wang, Y.	16	3	42	2	2.667	3	1,829	6	86	1
	Floridi, L.	16	2	24	8	2.667	4	1,427	11	24	26
	Pennycook, G.	15	4	16	36	2.500	5	2,058	2	16	65
	M, M.	12	5	37	3	2.000	9	1,976	4	37	12
	Mou, L.	12	6	22	14	2.000	10	516	160	25	24
	Taddeo, M.	12	8	18	27	2.000	11	794	95	18	50
	Rand, D. G.	12	7	14	47	2.000	13	1,736	8	14	82
	Wang, J.	11	14	28	4	1.833	16	840	91	48	6
	Zhang, J.	11	15	26	5	1.833	17	706	108	40	8
	Shi, Y.	11	11	20	21	2.200	7	438	193	28	22
	Zhu, X.	11	16	21	17	2.200	6	472	175	22	32
	Gupta, S.	11	9	21	16	2.750	2	569	144	21	35
	Ryan, M.	11	10	16	37	1.833	19	615	136	16	66
	Stahl, B. C.	11	12	15	42	2.200	8	1,700	9	15	74
	Zhang, Y.	10	26	25	7	1.667	26	668	123	53	3
	Li, Y.	10	22	24	9	1.667	27	594	138	49	4
	Liu, Y.	10	23	18	28	1.667	30	368	227	49	5
	Li, X.	10	21	23	12	1.667	29	566	146	43	7
	Wang, X.	10	24	24	10	1.667	28	617	135	39	9
	Li, J.	10	19	26	6	1.667	25	688	122	38	10
	Raman, R.	9	27	19	24	1.800	20	2,076	1	19	43
	Wirtz, J.	6	136	8	185	1.000	202	1,770	7	8	227
	Dwivedi, Y. K.	5	166	6	313	1.000	230	2,028	3	6	381
	Janssen, M.	4	320	4	654	0.667	1367	1,484	10	4	725
Scopus	Floridi, L.	16	1	26	3	2.667	1	1,974	20	26	15
	Taddeo, M.	15	2	24	4	2.500	2	1,469	98	24	20
	Wang, Y.	13	3	44	1	2.167	4	2,001	19	63	1
	Wang, J.	12	5	24	5	2.000	5	609	160	42	3
	Zhang, J.	12	6	24	6	2.000	6	610	159	35	7
	Ryan, M.	12	4	17	16	2.000	10	828	127	17	33
	Wang, Z.	11	8	30	2	1.833	13	928	124	31	12
	Stahl, B. C.	11	7	13	35	2.200	3	2,495	15	13	58
	Zhang, Y.	10	12	21	9	2.000	8	473	217	48	2
	Li, X.	10	9	19	12	1.667	17	399	252	41	4
	Li, Y.	10	10	24	7	1.667	16	597	161	33	9
	Raman, R.	10	11	24	8	2.000	7	4,966	2	24	19
	Liu, Y.	9	13	15	25	1.500	32	252	465	40	5
	Zhang, X.	9	16	19	13	1.500	30	401	249	33	10
	Liu, X.	8	25	18	15	1.600	23	347	293	37	6
	Wang, X.	8	27	17	19	1.600	24	315	337	35	8
	Li, L.	8	23	20	10	1.333	69	400	251	22	22
	Zhang, Z.	8	30	20	11	2.000	9	459	221	20	27
	Dwivedi, Y. K.	8	19	10	63	1.600	29	5,209	1	10	87
	Janssen, M.	5	113	6	208	0.833	869	4,044	3	6	222
	Kar, A. K.	5	114	5	280	1.000	192	3,696	5	5	307
	Mogaji, E.	4	248	6	225	0.800	906	3,890	4	6	223
	Rana, N. P.	4	258	5	321	0.800	921	3,676	6	5	308
	Duan, Y.	3	397	7	186	0.600	1,563	3,663	7	7	168
	Hughes, L.	3	460	4	485	0.600	1,598	3,659	8	4	451
	Walton, P.	2	2,355	4	640	0.333	9,913	3,656	9	4	452
	Jones, P.	2	1,458	3	994	0.400	9,566	3,655	10	3	756

Note: D: Databases; h-i: h-index; h-r: h-rank; g-i: g-index; g-r: g-rank; m-i: m-index; m-r: m-rank; TC-r: TC rank; NP-r: NP-rank; h-index is the number of publications (h) that have received at least h citations; g-index is a citation-weighted variant of the h-index; m-index is h-index normalized by academic career length (years since first publication); TC is total citations; NP is number of publications; & Rankings are calculated within each database independently

the highly ranked journals "Technology in Society" and "Journal of Business Ethics" show the close link of AI ethics with the domains of social sciences and business in both databases.

All things considered, the journal rankings in both databases expose the multidisciplinary character of the field of AI ethics. The high rankings of journals from several disciplines like medical, engineering, computer science, business and social sciences indicate that studies on AI ethics cover a broad spectrum of academic interests.

Zhu, X. X. (h = 21) ranks first in the h-index ranking in the WoS database, while Floridi, L. (h = 16) ranks first in Scopus (**Table 4**). Interestingly, Floridi, L. is ranked second in WoS. This indicates that Floridi, L. has a high impact on both databases, while the impact of Zhu, X. X. is primarily seen in publications registered in WoS.

Table 5. Contribution of institutions

Database	Institution	Articles
WoS	University of Oxford	404
	Technical University of Munich	357
	Stanford University	272
	University of Granada	261
	University of Toronto	242
	University of Cambridge	183
	National University of Singapore	175
	Monash University	160
	Delft University of Technology	157
	Harvard Medical School	145
Scopus	University of Oxford	189
	University of California	148
	University of Toronto	126
	Stanford University	112
	University College London	108
	University of Cambridge	97
	National University of Singapore	94
	Technical University of Munich	92
	Monash University	88

In terms of the number of articles (NP), Wang, Y. (86 articles) ranks first in WoS, while Wang, Y. (63 articles) ranks first in Scopus. However, this author's h-index is 16 (3rd place) in WoS and 13 (3rd place) in Scopus. The consistency implies that Wang, Y. is acknowledged as a prolific and significant author in both databases.

Conversely, the overall citations (TC) ranks exhibit somewhat significant variations. In WoS, Raman, R. (2,076 citations) is the most often referenced author; in Scopus, Dwivedi, Y. K. (5,209 citations) ranks first. The example of Dwivedi Y. K. is particularly striking; while only 6 articles are listed in WoS (ranked 381), 10 articles are listed in Scopus (ranked 87). However, in terms of citation impact, he ranks first in Scopus and third in WoS. This shows that the author reaches a wider readership through journals indexed in Scopus.

Taddeo, M. ranks second in the h-index ranking in Scopus (h = 15) and eighth in WoS (h = 12). Similarly, Ryan, M. is ranked fourth in Scopus (h = 12) but tenth in WoS (h = 11). These variations imply that certain databases better capture particular authors. Notably, both databases show a great concentration of Chinese authors (authors with surnames like Wang, Li, Zhang, and Liu). Particularly highly ranked in both rankings are writers such Zhang, Y., Li, Y., Liu, Y., and Wang, J. This demonstrates the major contributions made in the subject of AI ethics by Chinese scholars.

Notable authors are also high citations but somewhat few papers. For instance, Janssen, M. ranks 10th in total citations (1,484) yet WoS lists him with just 4 papers (ranked 725th). In Scopus, he is ranked 3rd (4,044 citations) with 6 articles (222nd place). This shows that the author has produced a few very influential studies.

Comparing the m-index values (h-index divided by the researcher's career), it can be seen that authors such as Floridi, L. and Taddeo, M. are ranked high in both databases. This suggests that these authors have been making a consistent impact in the field for a long time.

In conclusion, these differences between the two databases emphasize the importance of examining both sources for a comprehensive bibliometric analysis in the field of AI ethics. Each database better represents different journals and thus different groups of authors.

In both datasets, Oxford University ranks #1 (**Table 5**). Still, the quantity of papers from this university in WoS (404) exceeds two times the quantity in Scopus (189). This big discrepancy implies that WoS indexes Oxford University's articles more comprehensively.

The two databases differ strikingly in terms of the Technical University of Munich viewpoint. With 357 papers in WoS, it ranks second; in Scopus, it ranks ninth with just 92 papers. This implies that WoS more fairly depicts the publications of German technical universities.

Ranked highly in both databases, Stanford University and the University of Toronto clearly have regularly made major contributions to the subject of AI ethics. Stanford ranks third in WoS (272 articles) and fourth in Scopus (112 articles), while Toronto ranks fifth in WoS (242 articles) and third in Scopus (126 articles).

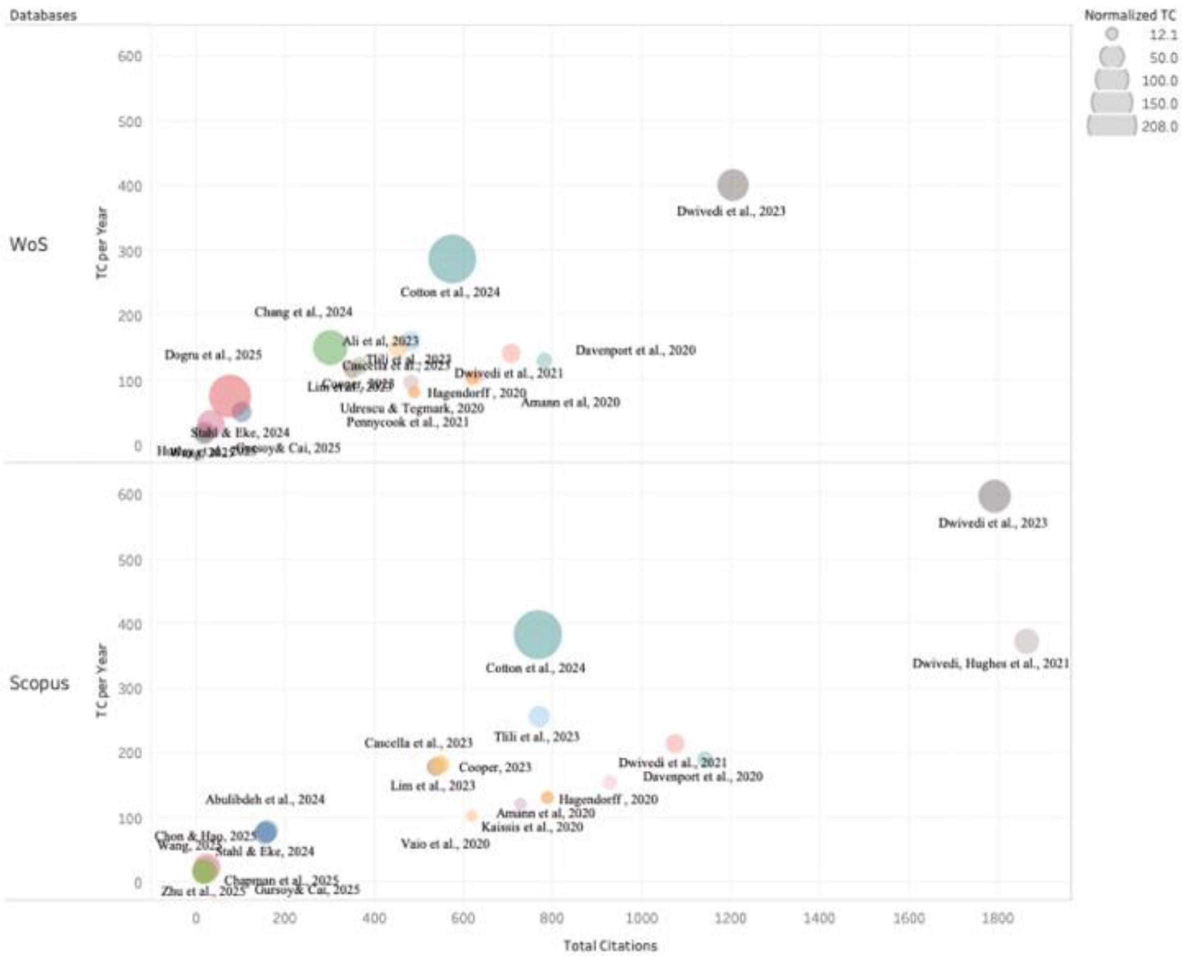

Figure 2. The most influential studies (Source: Created by the authors)

The University of California (148 articles), ranked second in Scopus, does not appear in the top ten in WoS. Similarly, the University of Granada (261 articles), ranked fourth in WoS, and Harvard School of Medicine (145 articles), ranked tenth, do not appear in Scopus' top ten. This shows that the two databases prefer different institutions and publication channels.

In terms of geographical distribution, the institutions in the lists are mostly from North America, Europe and Asia-Pacific. In particular, the National University of Singapore and Monash University (Australia) appear on both lists, emphasizing the importance of the Asia-Pacific region in AI ethics research. While Delft University of Technology is ranked ninth in WoS (157 articles), it does not appear in the top ten list of Scopus. In contrast, University College London, ranked fifth in Scopus (108 articles), does not appear in the WoS top ten list.

The databases WoS and Scopus have quite different citation styles. Many of the same papers show more Scopus citations. For instance, Dwivedi et al.'s (2023) research has 1,204 citations in WoS, but Scopus shows this number in 1,791. This difference is due to the different journal coverage and indexing policies of the two databases.

When the most cited studies are analyzed, it is seen that the studies of Dwivedi et al. (2023) stand out in both databases (**Figure 2**). Especially in the Scopus database, Dwivedi et al. (2021) study ranks at the top with 1,863 citations, while this study is not included in the list in WoS. This situation clearly reveals the differences in the coverage of the databases.

When annual citation averages are analyzed, Cotton et al. (2024) show a remarkable performance in both databases. This study stands out with an annual average of 287 citations in WoS and 383 citations in Scopus, receiving a large number of citations in a short period of time. This shows the growing impact of work in the field of AI and education.

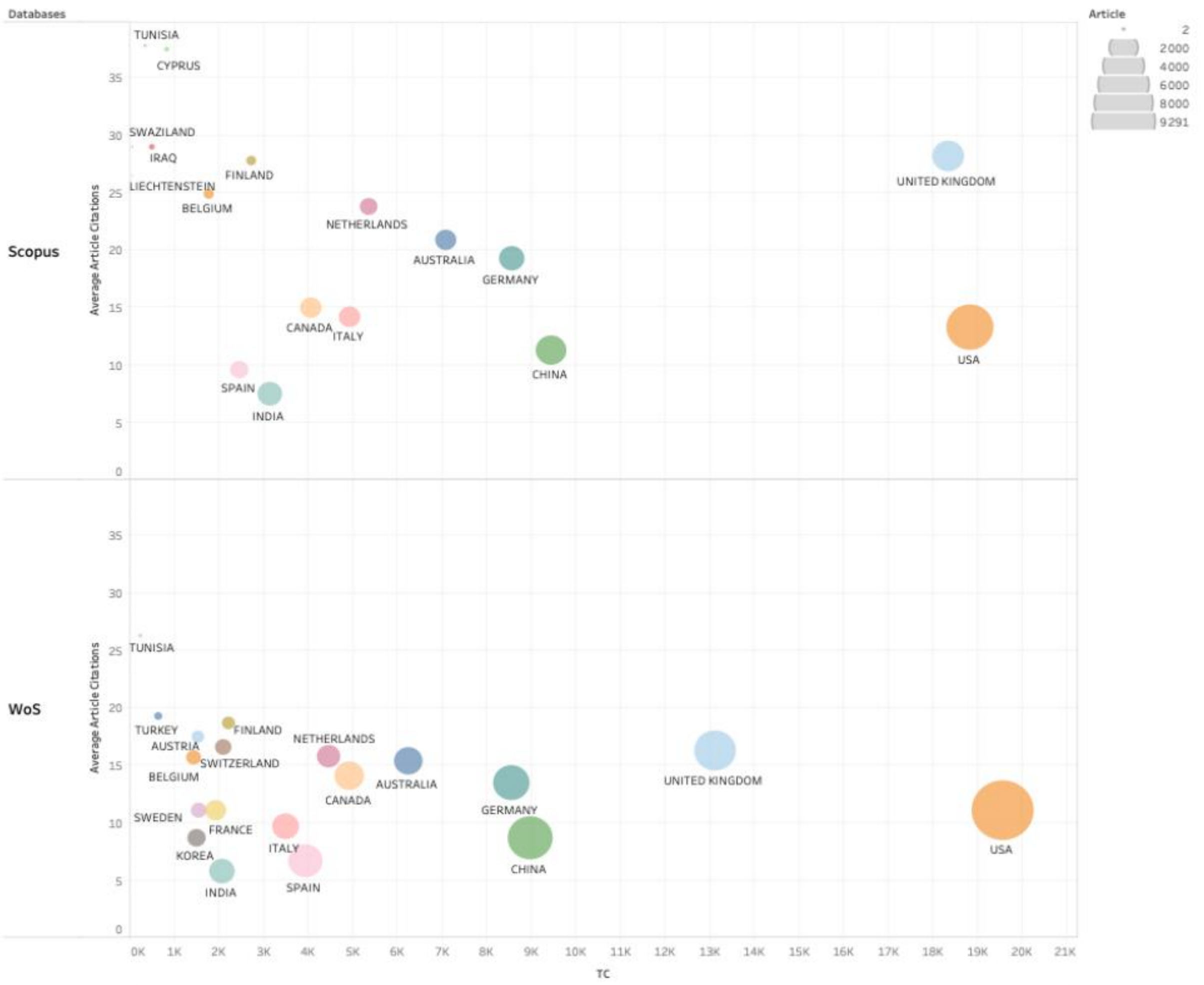

Figure 3. Citation and production based on countries (Source: Created by the authors)

Looking at the normalized citation values, the study by Dogru et al. (2024) published in 2025 has the highest impact with a value of 159,136 in WoS. In Scopus, the study by Cotton et al. (2024) stands out with 207.976. This difference suggests that the normalized values of newly published studies may be higher, but there are also differences in evaluation between databases.

When 2025 publications are compared, Gursoy and Cai's study stands out with high normalized citation values in both databases (WoS: 67.898, Scopus: 67.263). This similarity suggests that both databases assess the impact of current research in a related manner.

Regarding AI ethics and society impact, the enormous number of publications published between 2020 and 2025 shows the growing importance of this topic in academic output. Variations in database references further highlight the significance of obtaining data from different sources in bibliometric research.

The way the number of articles and citation averages relate shows the most obvious variation between the two databases (**Figure 3**). With 9291 articles, the USA leads clearly in WoS, but in Scopus, this figure falls to 5,378. In contrast, the UK has almost caught up with the USA in total citations (18,328 citations), despite having fewer articles in Scopus (2,455 articles). This can be explained by the fact that the UK's average article citation count in Scopus (28.2) is much higher than that of the USA (13.3).

China, despite ranking third in both databases, published nearly twice as many articles in WoS (4,851 articles) than in Scopus (2,265 articles). By contrast, in both databases, China's average citation counts are somewhat low (WoS: 8.7, Scopus: 11.3).

With 2855 articles in WoS and just 803 items classified in Scopus, Spain's situation is very noteworthy, displaying great productivity in WoS. Furthermore, Spain's quite low average number of citations in WoS (6.7) points to variations in the quantity-quality balance.

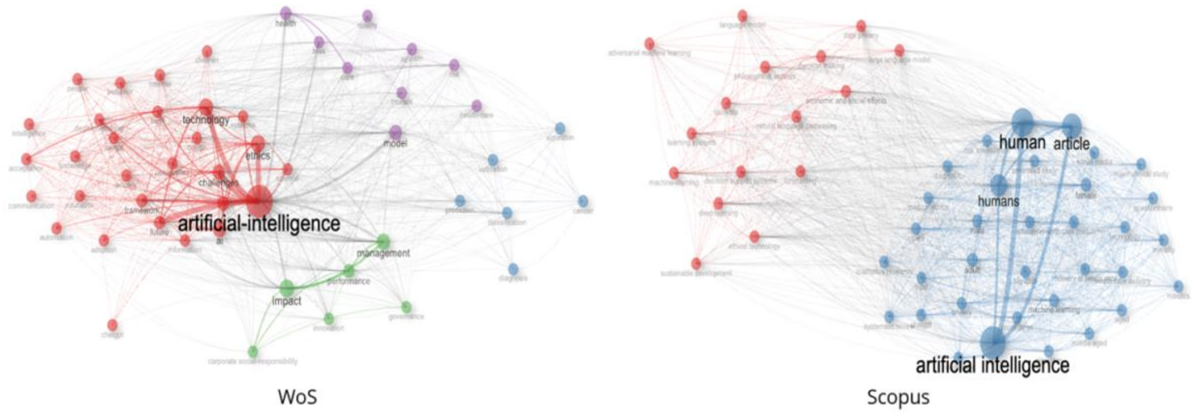

Figure 4. Co-keyword clusters (Source: Created by the authors)

Some of the smaller countries have noticeably high average citation values in Scopus. For example, Tunisia (37.8), Cyprus (37.5), Iraq (29), and Swaziland (29) have published a small number of high-impact articles. These countries either have lower values in WoS or are not listed.

Finland is characterized by high citation averages in both databases (WoS: 18.7, Scopus: 27.8). This suggests that Finland produces relatively few but high-impact studies. India, despite its high number of articles, has low average citation values in both databases (WoS: 5.8, Scopus: 7.5). This emphasizes that quantity is not always directly proportional to quality and impact.

In network analysis, two key metrics were used to assess keyword positions within the co-keyword networks. Betweenness centrality measures the extent to which a keyword serves as a bridge connecting different clusters or thematic groups within the network; a high betweenness value indicates that the keyword occupies a strategic intermediary position, linking otherwise disconnected research themes (Freeman, 1977). PageRank, originally developed for ranking web pages, evaluates the importance of a keyword based on the number and quality of its connections; a keyword linked to other highly connected keywords receives a higher PageRank score, reflecting its overall influence within the network (Brin & Page, 1998). Together, these metrics provide complementary insights: betweenness centrality reveals structural bridging roles, while PageRank captures diffuse thematic influence.

With a betweenness value of 105.74, "artificial-intelligence" is by far the most important notion in the WoS network (**Figure 4**). This indicates that AI fills in as a link between all other keywords. Additionally striking with high betweenness values are concepts like "impact," "management," and "technology." The clustering in WoS seems to be more balanced, with concepts distributed in 4 different clusters.

In the Scopus network, the concept of "artificial intelligence" is again in the most central position with a betweenness value of 52.75, but lower than in WoS. It is noteworthy that the terms "human" and "article" also have very high betweenness values in Scopus. This indicates that the literature in Scopus focuses more on human-AI interaction.

In terms of cluster structure, while there are 2 main clusters in Scopus, there are 4 clusters in WoS. The second cluster in Scopus is much larger and more comprehensive and includes many concepts in the field of health and medicine: "humans", 'female', 'male', 'aged', 'health care', 'diagnosis'. This suggests that Scopus indexes the health sciences literature more comprehensively.

An interesting difference is that "ChatGPT" has very low betweenness (0) and PageRank (0.00522645) in WoS, whereas it is more centralized in Scopus (betweenness: 0.51371039, PageRank: 0.01192568). This suggests that Scopus reflects current technological developments faster.

In WoS, the concept of "ethics" is in cluster 1 and has a high betweenness value (12.87), while in Scopus it is in cluster 2 and has a lower betweenness value (1.16). This suggests that ethics plays a more central role in the literature on WoS. When the closeness values are analyzed, it is seen that the values in Scopus are generally higher than those in WoS. This indicates that concepts are closer and more interconnected in the Scopus network. For example, the concepts "artificial intelligence", "human" and "decision making" have the highest values in Scopus with a proximity value of 0.02040816.

Figure 5. Thematic map based on keywords (Source: Created by the authors)

In sum, the results of the network analysis between the two databases emphasize different aspects of the AI ethics literature: WoS focuses more on technology, ethics, and management, while Scopus focuses more on health sciences, human-machine interaction, and more recent technological developments. These differences emphasize the importance of reviewing both databases for a comprehensive literature analysis.

The thematic maps generated through co-word analysis reveal the strategic positioning of research themes across four quadrants, each representing a distinct developmental stage: engine themes (upper right; high centrality and high density), niche themes (upper left; low centrality but high density), core themes (lower right; high centrality but low density), and emerging or declining themes (lower left; low centrality and low density) (Cobo et al., 2011) (**Figure 5**).

Engine Themes

In the WoS database, the concepts of "AI", "ethics", and 'ai' are located in the "engine themes" quadrant. This position demonstrates not only the strong centrality of these concepts within the intellectual structure of the field but also their high level of intrinsic thematic coherence, suggesting that they form the established and methodologically entrenched core of AI ethics research. This arrangement demonstrates that key concerns about AI and ethics continue to be the subject of academic scrutiny and are deeply rooted in the conceptual core of the discipline. The same concept exhibits high centrality in the Scopus database. However, they rank slightly lower on the intensity axis, suggesting that they are still important organizing nodes in the broader research landscape, but their internal thematic development is not as strong as in WoS. The prominence of these keywords as engine themes is in line with the general academic consensus that the ethical governance of AI is emerging as a critical interdisciplinary issue, driven by increasing debates on algorithmic justice, transparency and accountability, especially as AI systems are increasingly used in high-risk sectors such as healthcare, criminal justice and financial services (Hagendorff, 2020; Jobin et al., 2019).

Niche Themes

In the upper left quadrant of the WoS thematic map, the concepts of "deep learning," "education," and "data models" are positioned as niche themes, indicating that although these topics possess a relatively high degree of internal development and conceptual maturity, they remain weakly connected to the broader structure of AI ethics scholarship because of their comparatively low centrality. Such a configuration suggests that these research areas, while internally coherent and methodologically well developed, have not yet been fully integrated into the wider ethical discourse surrounding AI. This pattern is especially striking in the case of deep learning because, despite the increasing recognition that the opacity, limited interpretability, and black box character of deep learning systems constitute major ethical challenges in themselves, the thematic map implies that technical machine learning research and ethical or social inquiry continue, to a considerable extent, to evolve along parallel yet insufficiently intersecting trajectories. Accordingly, the niche placement of these themes may be interpreted as evidence of a broader fragmentation within the field, in which highly specialized technical advances are not always accompanied by equally robust engagement with their ethical and societal implications.

Core Themes

In both databases, "ChatGPT" and "generative AI" are situated within the core themes region, located in the lower right quadrant and characterized by high centrality together with relatively low density, a pattern which indicates that these topics are already highly relevant to the field and strongly connected to its wider thematic structure, yet have not attained the same degree of internal conceptual consolidation as more mature lines of inquiry. This positioning is fully consistent with the recent emergence and rapid diffusion of generative AI technologies, whose novelty has produced an expansive and fast growing body of scholarship that nevertheless remains in a comparatively early stage of thematic stabilization. The rapid integration of ChatGPT into educational and academic settings has led to a significant increase in publications examining its effects on academic integrity, writing practices, authorship, assessment, and knowledge production, thereby making this topic one of the most prominent current issues in the literature (Adhikari et al., 2025; Eleftheriou et al., 2025). One of the major differences between the two databases is that Scopus positions "higher education" as a primary theme alongside "ChatGPT" and "generative AI." In WoS, however, "education" occupies a more transitional position between the rising or declining quadrant and the main quadrant. This difference suggests that Scopus more clearly highlights the growing connection between AI ethics and education research. This may be due to its broader or faster indexing of education-related journals. The concentration of AI ethics research in higher education can be explained by several interrelated factors. These include the role of universities as primary venues for the adoption and normalization of AI tools by students and researchers; the tension between AI-supported learning and academic integrity, which creates immediate regulatory and pedagogical pressures; and the fact that higher education institutions are among the first to develop official guidelines for the responsible and effective use of AI (Cotton et al., 2024; Jarrah et al., 2023).

Emerging or Declining Themes

In Scopus, the concepts of "responsibility" and "machine ethics" appear in or near the lower left quadrant, which is typically associated with themes that are either only beginning to emerge or gradually losing prominence within the broader field, and this placement therefore suggests an ambiguous yet analytically significant status for these topics. One possible explanation for this trend is that academic interest may be moving away from abstract and mostly philosophical discussions about machine ethics and toward more practical, governance-focused, and policy-relevant issues related to the oversight and regulation of real-world AI systems. In WoS, conceptually related terms also appear closer to the edges of the thematic map. This supports the idea that the field as a whole may be moving away from basic ethical theorization and toward more practical, institutionally based, and empirically based forms of research. This does not necessarily imply that responsibility and machine ethics have become unimportant, but rather that they may increasingly function as background normative frameworks while more immediate questions of implementation, governance, and accountability take precedence in current research agendas.

Taken together, the thematic maps derived from both databases illuminate the principal structural dynamics of the AI ethics field while simultaneously revealing meaningful database-specific differences in the way emerging and transitional themes are represented. The positioning of generative AI as a central yet still underdeveloped thematic cluster underscores the need for sustained and methodologically diverse research capable of examining not only the technical functions of these systems but also their ethical, social, and educational impacts. The differences between WoS and Scopus—particularly regarding the visibility of education and higher education within these themes—demonstrate how crucial it is to utilize multiple bibliographic databases to obtain a more comprehensive and nuanced picture of the field's intellectual structure, developmental trends, and new horizons.

First, it is noteworthy that the researcher "Wang, Y." has a central position in both databases. While "Wang, Y." has the highest link strength with a betweenness value of 136.59 in the WoS database, he is one of the most influential researchers with a value of 108.52 in Scopus. This shows that Wang, Y. is an important name that acts as a bridge in the field of AI ethics (**Figure 6**). One of the most obvious differences between the two databases is their clustering structure. While researchers are divided into 7 clusters in WoS, 12 different clusters are formed in Scopus. This suggests that the Scopus database reflects a broader research network or a more fragmented research community in the subject area.

WoS Scopus

Figure 6. Collaboration network (Source: Created by the authors)

While Zhang, J. is the most influential name in cluster 4 with a betweenness value of 74.31 in the WoS database, he is the leader of cluster 5 with a value of 105.99 in Scopus. This difference between the two databases indicates that the researcher works with different research groups in different publication environments.

An interesting point is that Floridi, L. has a betweenness value of 0 in both databases. This indicates that the researcher works in isolation within his own cluster and has no direct connection with other research clusters. However, when PageRank values are compared, it is understood that it has a much higher impact in Scopus (0.0194) than in WoS (0.0035).

While researchers such as Kumar, A., and Kumar, S. appear prominently only in the Scopus database, names such as Moral-Garcia, S., and Abellan, J. stand out only in WoS with a closeness value of 1.0. This suggests that some researchers prefer certain publication databases.

Overall, the network structures in both databases show that the field of AI ethics is shaped by various research groups, but some key researchers (such as Wang, Y., Zhang, Y.) have a dominant influence on the field. The more fragmented cluster structure in Scopus suggests that this database addresses the topic from a broader perspective.

DISCUSSION

The Rapid Growth of AI Ethics Research

The results reveal the rapid expansion of the AI ethics research field in recent years. Particularly in the WoS database, the number of publications rose 108% between 2023 and 2024, then 118% in Scopus. This swift ascent substantiates the assertions posited by De la Vega Hernández et al. (2023), indicating that over the preceding five years, research in AI has exhibited exponential growth. Similarly, Gao et al. (2024) emphasized that the domain of AI ethics has undergone a tripartite evolution, culminating in the phase of “human-centered systems” from the year 2020 to the present.

Many factors help to explain this fast development. Mostly, the development of generative AI models such as ChatGPT has exposed ethical concerns in public discourse. Dwivedi et al. (2023) claim that the general acceptance of generative AI has increased the relevance of ethical questions. Moreover, the growing integration of AI in decision-making underscores the necessity for ethical assessments. As noted by Hagendorff (2020) and Ferrara (2024), challenges regarding the development of equitable and unbiased AI systems significantly influence research trajectories.

Empirical studies suggest that the field of AI ethics is garnering increasing academic attention overall. However, its swift expansion concurrently underscores the critical need for the formulation of ethical standards and regulations. Approaches that facilitate human-machine collaboration and prioritize human agency are, as Margetis et al. (2021) assert, becoming increasingly essential.

Differences Between Databases and Their Impact on Research Scope

The analysis identified remarkable differences between the WoS and Scopus databases. These differences have important implications for the scope and perception of AI ethics research. First, differences in citation patterns stand out. Articles in Scopus (13.92) have on average much more citations than those in WoS (10.3). This implies that Scopus indexes publications either with more influence or a larger readership.

Not less remarkable are the variations in disciplinary coverage between the two databases. Scopus indexes health sciences literature more widely, according to an analysis of their common word networks. This is consistent with the results of Fosso Wamba and Queiroz (2023), which show fast development of AI research in health. The greater centrality of ethics in WoS confirms the prominent role of ethical concerns in AI research, as underlined by Zhang et al. (2021).

In terms of institutional contributions, WoS is more representative of European institutions (e.g., the Technical University of Munich), while Scopus emphasizes American institutions such as the University of California. This pattern confirms the dominance of Anglo-American institutions in the field of AI ethics. Chuang et al. (2022) similarly reported that scholars from 66 countries contributed to the literature, yet the ten most productive nations accounted for approximately 94% of all publications, indicating a substantial concentration of research capacity in a limited number of countries.

Thematic mapping shows that Scopus reflects emerging themes such as "ChatGPT" and "higher education" earlier. This observation reveals differences in the speed at which the databases track current technological developments. Nonetheless, the high centrality of the ideas of "AI," "ethics," and "machine learning" in both databases confirms that the main ethical issues found by Gao et al. (2024) (transparency, explainability, privacy protection, justice and equity concerns) are of central relevance in the field of research. These variations emphasize the need to examine across both databases for a thorough bibliometric analysis in the subject of AI ethics. Every database captures several facets of the field and taken together, offers a more complete view.

A somewhat counterintuitive finding is that "ChatGPT" has a betweenness centrality of 0 in WoS but a notably higher value (0.51) in Scopus. Given that ChatGPT has been one of the most widely discussed technologies since late 2022, its peripheral position in the WoS keyword network is unexpected. This discrepancy may stem from differences in indexing speed and journal coverage between the two databases; Scopus appears to capture emerging technology-related publications more rapidly, particularly from education and social science journals that have been among the first to address generative AI. This finding has methodological implications, suggesting that researchers relying exclusively on WoS may underestimate the prominence of recent technological developments in the AI ethics discourse.

Geographical Imbalances in AI Ethics Research

The findings reveal significant geographical disparities in AI ethics research. Li and Zhang's (2024) assertions regarding the dominance of English-speaking countries are substantiated by the high productivity rankings of the USA, UK, and China in both datasets. While the USA is by far the leader with 9291 articles in WoS, it continues to be the leader with 5,378 articles in Scopus. This is in line with Chuang et al.'s (2022) observation that the top ten countries account for about 94% of total publications.

One interesting remark is the different approaches countries use to balance impact with production. Finland, for example, produces a small number of highly cited papers, suggesting in AI ethics a lack of clear correlation between quantitative output and qualitative relevance.

The underrepresentation of developing nations suggests a deficiency in cultural diversity within international AI ethics discussions. Marko et al. (2025) highlight the heightened restrictions on AI technology access for Global South societies, supporting Capraro et al.'s (2024) claim concerning AI's potential to both worsen and alleviate existing social inequalities. Spain's substantial WoS output contrasts sharply with its lower Scopus representation, revealing regional database discrepancies. These insights are consistent with Ionescu et al. (2024), who note the preeminence of the USA, China, the UK, Canada, and Germany in this arena.

An unexpected finding concerns Finland's disproportionately high citation averages (WoS: 18.7; Scopus: 27.8) relative to its modest publication output. While most bibliometric studies assume a positive correlation between productivity and impact, Finland's case suggests an alternative research culture that prioritizes depth and quality over volume. This pattern may reflect the country's strong institutional support for interdisciplinary research and its early engagement with AI governance frameworks at the national policy level. Conversely, India's combination of high publication volume and low citation averages presents a contrasting pattern that warrants attention. One possible explanation is the rapid expansion of AI-related programs in Indian universities, which has increased output but may not yet be matched by the citation networks and international collaborations that amplify research visibility. These divergent cases challenge the assumption that productivity rankings directly reflect intellectual leadership in the field.

Importance and Current Status of Interdisciplinary Collaboration

Analysis of author collaboration networks in the field of AI ethics reveals the present condition of multidisciplinary cooperation. WoS has seven different research clusters, and Scopus has twelve, therefore underlining the multidisciplinary nature of the field. This result validates the 2022 discovery by Chuang et al. that, despite the increase in sociological research, engineering has been the discipline mostly in charge of the development of AI and ethical research since the 1980s.

Some scholars, including "Wang, Y.," in both databases, have a central point of view that suggests they are bridging the subject of AI ethics. Some powerful researchers, such "Florid, L.," have a betweenness rating of 0 in both databases, meaning they operate alone inside their own cluster and do not directly interact with other research groups.

As Griffin et al. (2025) underline, although AI developers are aware of ethical concerns, they need tools and training. This kind of situation highlights the need for interdisciplinary cooperation. Fair AI, as Alvarez et al. (2024) underline, is a complex topic needing transparency, responsibility, and human-centeredness in addition to a metric optimization task. In line with Ciobanu and Meșniță (2021), the present research mostly remains conceptual, and inter-institutional interaction mainly takes place within national or regional lines. This emphasizes the need to develop global cooperation and diverse ventures.

Emerging Research Themes and Trends

Thematic maps and keyword analysis reveal emerging themes in the field of AI ethics. The presence of "ChatGPT" and "generative AI" in the core themes region in both databases indicates that these concepts have high centrality but as yet low density in the field. Generative AI appears to present both benefits and drawbacks in research, practice, and policy, claims Dwivedi et al. (2023). Indeed, the dual nature of generative AI is well illustrated in the scholarly communication domain. Adhikari et al. (2025) demonstrated that while ChatGPT enhances academic writing productivity and reduces linguistic barriers for non-native English speakers, it simultaneously raises concerns about plagiarism, fabricated references, and the erosion of critical thinking skills, a tension that the present bibliometric findings corroborate through the positioning of "ChatGPT" as a high-centrality but low-density theme.

Other than ChatGPT and generative AI, the topic of "higher education" is rather common in Scopus, indicating that the application of AI is regarded as a key focus of research inside the educational field. This observation aligns with the conclusions drawn by Liu et al. (2024), who underscore the essential function of AI in enhancing social connectivity within online learning contexts. The growing concentration of AI ethics research in higher education is further supported by recent empirical studies. Adhikari et al. (2025) reframed ChatGPT not merely as a technological tool but as a systemic force reshaping scholarly communication, examining its simultaneous impact on productivity, inclusivity, and academic integrity. Eleftheriou et al. (2025) provided concrete evidence of these tensions at the institutional level, documenting how peer tutors in university writing centers struggle to balance ethical concerns with student support when confronted with AI-generated academic texts. These studies illustrate why higher education has emerged as a primary research site for AI ethics: universities serve as environments where the benefits and risks of generative AI converge most visibly.

The niche themes domain in WoS indicates that "deep learning," "education," and "data models" exhibit low centrality yet high intensity in these subjects. This supports the conclusion of Falvo and Cannataro (2024) that the complex and non-linear nature of deep learning models complicates the understanding of their decision-making processes, leading to their classification as “black boxes.” The niche positioning of deep learning as a theme that is internally well-developed but poorly integrated with the broader AI ethics discourse is noteworthy. For example, while extensive research exists on XAI techniques aimed at demystifying deep learning models (Vainio-Pekka et al., 2023), this technical work appears to develop in parallel rather than in dialogue with the ethical and social dimensions captured in the engine themes. Bridging this gap between technical explainability research and normative ethics scholarship represents an important avenue for future interdisciplinary collaboration.

Research into the keyword networks shows that both databases heavily rely on the concepts of “privacy” and “security”. This corroborates the assertion made by Martin and Zimmermann (2024) that AI systems engender substantial privacy concerns as they operate on exponentially increasing quantities of personal data. Similarly, the constructs of “responsibility” and “machine ethics” are situated in proximity to the emerging or declining themes domain within Scopus, indicating that these concepts are either not yet fully developed or are experiencing a decline in relevance over time.

The persistent centrality of “privacy” and “security” across both databases reflects the tangible real-world consequences of AI data practices. The enactment of regulations such as the GDPR in Europe and sector-specific frameworks like HIPAA in healthcare has generated a substantial body of research examining the intersection of legal compliance and ethical data governance (Andrieux et al., 2024; Nasir et al., 2024). Similarly, the positioning of “responsibility” near the emerging/declining boundary suggests a possible shift from abstract philosophical discussions of machine responsibility toward more applied, governance-oriented frameworks. This transition may be driven by the increasing demand from policymakers and institutions for actionable ethical guidelines rather than theoretical deliberations.

These findings suggest that the research agenda in the field of AI ethics is changing rapidly, and new ethical issues are emerging in parallel with new technological developments. Gao et al. (2024) emphasis on the need for more research on the large ethical model and AI identification systems suggests that these emerging themes may shape future research directions.

CONCLUSION

The present study performs a comprehensive bibliometric analysis of the current scholarly publications on the ethics of AI and its social dynamics. Research publications generated between 2020 and 2025 found in the Scopus and WoS databases show that the area is fast-growing and developing. Especially, the notable rise noted in both databases throughout the years 2023 to 2024 highlights the growing scholarly interaction with the ethics of AI.

The results clarify the main contributions of the USA, the UK, and China, therefore exposing clear regional differences in the study on AI ethics. This discovery suggests that the debate on global AI ethics has to include a wider range of inclusive and culturally varied points of view. Moreover, the differences in coverage between the two databases highlight the need to use several data sources to provide a comprehensive bibliometric analysis inside this field.

The thematic analysis reveals the importance of emerging themes such as “ChatGPT”, “generative AI” and “higher education” in the field. These themes show that the research agenda in the field of AI ethics is changing rapidly in parallel with technological developments. At the same time, fundamental ethical issues such as justice, transparency, privacy and human control remain central to the field.

In light of these findings, several concrete directions for future research can be identified. First, scholars should examine the role of disciplinary background as a variable shaping researchers’ engagement with AI ethics; the thematic maps from this study indicate that technical and social science communities have largely developed independent research agendas; however, it remains unclear how researchers’ primary disciplines influence the ethical frameworks they adopt. Second, future bibliometric studies should include a temporal level of detail by tracking how keyword networks and thematic positions change year over year to capture the rapid evolution of generative AI themes that emerged particularly after late 2022. Third, the distinct geographical focus of AI ethics research implies that we need to conduct comparative studies to understand how national policy environments—such as the EU AI Act, China's AI governance rules, and UNESCO's AI ethics recommendations—influence research priorities and thematic orientations in different regions of the world. Fourth, given that developing countries are still underrepresented, future research should examine the correlation between institutional research capacity, funding mechanisms, and models of international collaboration, and shed light on why some countries produce significant yet ineffective research while others achieve the opposite. Fifth, making "higher education" the central theme implies that focused studies must examine specific factors (such as students' AI literacy levels, academic staff's ethical decision-making frameworks, and institutional AI governance policies) to facilitate responsible AI integration in educational setting. Finally, the "generative AI" field, a new yet still evolving thematic area, suggests that long-term studies tracking the co-evolution of AI capabilities, ethical guidelines, and social dynamics over time will provide valuable insights into how the field matures in response to technological change.

It is hoped that this study will offer valuable insights to researchers, policymakers, and practitioners by presenting a comprehensive, dual-database bibliometric portrait of the literature on AI ethics and social dynamics. The findings emphasize that the ethical and responsible development of AI technologies requires not only sustained academic interest but also sustainable interdisciplinary dialogue, inclusive global participation, and evidence-based policy frameworks.

It is important to be aware of a few limitations. The analysis is limited to the WoS and Scopus databases; while these databases are comprehensive, they may not fully capture articles in regional journals, non-English sources, or gray literature, including policy reports and white papers. The bibliometric approach is useful for identifying structural patterns, but it does not address the content or methodological rigor of each study. Additionally, the use of keywords provided by the author and those generated by the database may lead to inconsistencies, as the various indexing methods used by WoS and Scopus can alter the frequency of keywords and how they are thematically grouped. Finally, the 2020-2025 period covers the most recent and active phase in this field, but it does not include significant studies published before 2020 that may still influence current research.

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