Original Article

Received/Accepted Dates

03.11.2025/22.12.2025

DOI 10.52096/usbd.10.42.03

International Journal of Social Sciences

Uluslararası Sosyal Bilimler Dergisi

www.sobider.net e-ISSN: 2548-0685

IJSS

Artificial Intelligence, Education, and Ethics: A Bibliometric Perspective

Araştırma Makalesi

Konu: Sosyoloji

Dr. Öğrt. Üyesi Oya GÜLER

Bursa Teknik Üniversitesi, Sosyoloji Bölümü ORCID: https://orcid.org/0000-0002-2359-4521, oya.guler@btu.edu.tr

Abstract

This study analyzes the structure, trends, and focal points of scholarly production in the field of artificial intelligence (AI) and ethics through a bibliometric approach using VOSviewer, based on 1,307 documents in the Web of Science (WoS) database. Analyses reveal the growth trend in publications from 2010 to 2024, with a notable rise in output after 2020, and highlight the conceptual "yellow core" of the topic: transparency, privacy, academic integrity, decision-making, social justice, robot ethics, and AI security. Country-level analyses indicate that the United States and China form high-output, high-impact clusters, while Europe functions as a normative production center despite relatively lower publication volumes. At the journal level, AI & Society, Science and Engineering Ethics, IEEE Access, and Journal of Medical Ethics play central roles in the ideation and citation networks, while education-focused journals such as Education and Information Technologies, Studies in Higher Education, and Frontiers in Education show rising influence as of 2024. Keyword co-occurrence and co-citation maps support the view that AI ethics has become an applied, context-sensitive, and interdisciplinary field with multi-actor engagement. Findings suggest that the expansion of AI in education intensifies ethical discourse, with large language models like ChatGPT bringing evaluation and academic integrity concerns back into focus. This study provides a reference for tracing current trends and guiding future research; it is suggested that comparative bibliometric studies using alternative databases (Scopus, Dimensions, or YÖK Theses), along with qualitative fieldwork and policy analyses, would offer a more comprehensive illumination of the sociological dimensions of AI ethics.

Key Words: Artificial Intelligence, Ethics, Education, Bibliometric Analysis

Jel Code: I23, O33, A13

Yapay Zeka, Eğitim ve Etik: Bibliyometrik Bir Bakış Açısı

Özet

Bu çalışma, Web of Science (WoS) veri tabanındaki 1.307 dokümana dayanarak, VOSviewer kullanılan bibliyometrik bir yaklaşımla yapay zekâ (YZ) ve etik alanındaki bilimsel üretimin yapısını, eğilimlerini ve odak noktalarını analiz etmektedir. Analizler, 2010'dan 2024'e kadar yayınlarda bir büyüme eğilimi olduğunu, özellikle 2020'den sonra üretimde kayda değer bir artış yaşandığını ortaya koymakta ve konunun kavramsal "sarı çekirdeğini" vurgulamaktadır: şeffaflık, mahremiyet, akademik dürüstlük, karar verme, sosyal adalet, robot etiği ve YZ güvenliği. Ülke düzeyindeki analizler, Amerika Birleşik Devletleri ve Çin'in yüksek üretim ve yüksek etki kümeleri oluşturduğunu; Avrupa'nın ise nispeten daha düşük yayın hacimlerine rağmen normatif bir üretim merkezi olarak işlev gördüğünü göstermektedir. Dergi düzeyinde; *AI & Society*, *Science and Engineering*

Makaleye Atıf Bilgisi

Güler, O. (2026). Artificial Intelligence, Education, and Ethics: A Bibliometric Perspective. *.International Journal of Social Science (IJJS Journal), (e-ISSN:2548-0685)* Vol:10, Issue:42; s. 39-70.
DOI: 10.52096/usbd.10.42.03

Gönderim: 03.11.2025
Kabul: 22.12.2025

SOSYAL BİLİMLER DERGİSİ (ULUSLARARASI HAKEMLİ DERGİ)

editorusbd@gmail.com

Ethics, *IEEE Access* ve *Journal of Medical Ethics* düşünsel ağlarda ve atıf ağlarında merkezi roller oynarken; *Education and Information Technologies*, *Studies in Higher Education* ve *Frontiers in Education* gibi eğitim odaklı dergiler 2024 itibarıyla artan bir etki göstermektedir. Anahtar kelime birlikte bulunma (co-occurrence) ve ortak atıf (co-citation) haritaları, YZ etiğinin çok aktörlü katılıma sahip, uygulamalı, bağlama duyarlı ve disiplinler arası bir alan haline geldiği görüşünü desteklemektedir. Bulgular, YZ'nin eğitimde yaygınlaşmasının etik söylemi yoğunlaştırdığını; ChatGPT gibi büyük dil modellerinin değerlendirme ve akademik dürüstlük endişelerini tekrar odağa taşıdığını öne sürmektedir. Bu çalışma, mevcut eğilimleri izlemek ve gelecek araştırmalara rehberlik etmek için bir referans sağlamaktadır; alternatif veri tabanları (Scopus, Dimensions veya YÖK Tez) kullanılarak yapılacak karşılaştırmalı bibliyometrik çalışmaların, nitel saha çalışmaları ve politika analizleriyle birlikte, YZ etiğinin sosyolojik boyutlarını daha kapsamlı bir şekilde aydınlatacağı önerilmektedir.

Anahtar Kelimeler: Yapay Zekâ, Etik, Eğitim, Bibliyometrik Analiz

Jel Kod: **I23, O33, A13**

INTRODUCTION

Artificial intelligence (AI), in the last decade, has evolved from being merely an area of technical innovation to a decisive sociotechnical infrastructure that fundamentally transforms social relations, economic production methods, and cultural practices (Selwyn, 2022). Especially after 2020, the widespread adoption of generative AI applications based on large language models such as ChatGPT, Gemini, and Claude has made the reflections of this transformation in education systems more visible and accelerated discussions on the restructuring of pedagogical processes. In the current literature, personalized learning designs, the transformation of teacher roles, the automation of assessment processes, and analytical applications for predicting learner success stand out as significant opportunities offered by AI in education (Holmes et al., 2021). Current technological transformations bring about the increasing integration of artificial intelligence systems into educational processes; this integration promises potential benefits such as enriching learning experiences and developing pedagogical support mechanisms.

However, the integration of these technologies into educational environments simultaneously brings to the fore ethical and social risks such as data privacy, algorithmic bias, academic integrity, and cognitive/learning dependency (Cotton et al., 2024; Ienca et al., 2018). In this context, the use of AI in education is not merely a technical choice that can be addressed within the framework of pedagogical effectiveness criteria; it is also a political and moral decision area shaped by governance, economic interests, and normative values (Couldry & Mejias, 2019; AI HLEG, 2019). Real-world examples provide concrete evidence of the risks that can arise in the

design and implementation processes of AI systems: Microsoft's Tay chatbot quickly producing discriminatory discourse and Amazon's hiring algorithm yielding results against female candidates strikingly demonstrate AI's capacity to reproduce gender, race, and class-based inequalities (Fjeld et al., 2019; Hagendorff, 2020). Therefore, a deep understanding of the ethical dimensions of artificial intelligence in the context of education is critically important for institutional safeguarding of technological applications within the framework of transparency, accountability, fairness, and human-centered design principles (AI HLEG, 2019).

While a significant portion of the AI in education literature emphasizes the potential benefits of technology, it tends to address ethical, social, and cultural consequences on a secondary level; this indicates that the field is often constructed from a perspective consistent with technological determinism (Selwyn, 2022; Mhlambi, 2020). The rapid proliferation of artificial intelligence technologies in the education ecosystem necessitates an interdisciplinary and critical examination beyond this one-sided viewpoint. In addressing this gap, bibliometric approaches have the potential to quantitatively map the structure and orientations of knowledge production, making visible which actors (country, institution, researcher) are involved in the process, around which concepts clustering occurs, and the position of ethical discussions in the literature (Zawacki-Richter et al., 2019). Especially the weight of global actors such as China and the USA in knowledge production, the reflections of a more normative-ethical regulatory approach in Europe in the literature, and the level of participation of the Global South in discussions require not only an academic but also a cultural and political reading of the issue (Abebe et al., 2020; Mhlambi, 2020).

Accordingly, this study aims to examine AI in education research within a bibliometric framework to reveal the thematic clusters, collaboration networks, and the central/peripheral position of ethical discussions in the field. This research, which aims to position the rise of AI in education not merely as technical progress but in the contexts of power relations, justice, and ethical governance, aims to provide an original contribution to academic knowledge production in the field, at a methodological and conceptual level, by analyzing the complex relationship between artificial intelligence and ethics in education.

In this context, this study seeks to answer the following research questions to reveal the intellectual structure of the field:

1. What are the distribution and growth trends of publications in the field of AI, education, and ethics over the years?
2. Which are the most productive authors, countries, and institutions, and what are their collaboration patterns?
3. What are the most influential (highly cited) publications and sources that shape the domain?
4. What are the prominent keywords, and how has the thematic structure of these concepts evolved over time?

The study will build a scientific foundation for the human-centered, fair, and transparent application of technology by evaluating the potential impacts of artificial intelligence in education systems from a critical and ethical perspective.

METHOD

This study is a bibliometric review of scientific publications on artificial intelligence and ethics in education. In the research, bibliometric data from academic publications obtained from specific databases were analyzed using the descriptive analysis method. Bibliometric analysis is a method that involves the quantitative evaluation of scientific publications and reveals trends in research areas (Çatı and Öcel, 2018). In this context, a quantitative evaluation of the data obtained through document analysis was performed; indicators such as publication distribution by year, author and institution-based production trends, keyword networks, and citation relationships were analyzed.

Data Collection Tools

In this study, the Web of Science (WoS) Core Collection main database was used to bibliometrically map knowledge production on artificial intelligence and ethics in education. The search process was limited to article-type documents published only in English, with an interdisciplinary perspective. To narrow down the relevant fields to philosophy, sociology, education, artificial intelligence, and computer engineering, the WoS category filter (Web of Science Categories) was applied as follows:

- Education & Educational Research

- Education, Scientific Disciplines
- Philosophy
- Sociology
- Computer Science, Artificial Intelligence

The data acquisition strategy was executed within the Web of Science (WoS) Core Collection database, utilizing a targeted keyword query in the "Topic" (TS) field. To comprehensively capture the intersection of artificial intelligence, ethics, and education, the following Boolean search string was constructed: TS = (("artificial intelligence" OR "machine learning" OR "deep learning" OR "AI") AND ("ethic*" OR "moral*") AND ("education*" OR "teach*" OR "learn*" OR "pedagog*")). No temporal restrictions were applied during the initial retrieval, which was finalized on September 12, 2025.

The initial search yielded a total of 2,146 records. Subsequently, a rigorous refinement process was implemented to ensure the relevance and quality of the dataset. Exclusion criteria were applied based on language (restricted to English), document type (limited to peer-reviewed Articles), and specific Web of Science categories extraneous to the research focus. This filtering process resulted in the exclusion of 839 documents, leaving a final corpus of 1,307 articles for bibliometric analysis.

Bibliographic metadata including author details, institutional affiliations, countries of origin, keywords, and citation records were extracted from the final dataset. These data were imported into VOSviewer software (version 1.6.19) to generate and visualize bibliometric networks, specifically focusing on keyword co-occurrence and co-authorship structures. An integrated analytical framework was adopted, wherein publication trends, impact metrics, and conceptual maps were synthesized to provide a holistic evaluation of the field's intellectual landscape.

Limitations of the Study

This study is limited to publications indexed in the Web of Science (WoS) database. While WoS is a prestigious source covering high-impact journals, this choice inevitably excludes significant work found in other databases such as Scopus or Google Scholar. Furthermore, restricting the search to English-language publications creates an epistemic limitation. In a field like AI ethics, which is deeply influenced by cultural and societal norms, focusing solely on English literature

may obscure ethical discussions and knowledge produced in local languages or within the Global South context. Therefore, the findings reflect the perspective of the dominant academic language, and the results should be interpreted within these boundaries.

Analysis of Data

Within the scope of bibliometric analysis, the following analyses were carried out:

- Distribution of publications by year
- Co-authorship relationships among authors
- Co-word analysis
- Citation analysis
- Country-based production densities

The analyses were performed using the VOSviewer program; the resulting maps and network visualizations were interpreted with a quantitative and unbiased approach.

FINDINGS and COMMENTS

This was created by transferring 1307 data points obtained from the Web of Science database into the Vosviewer program within the scope of artificial intelligence and ethics. The main points considered when searching for relevant topics in the Web of Science search engine were the selection of articles, reviews, and chapters in English, consisting of artificial intelligence and ethics topics within the disciplines of computer science artificial intelligence, ethics, computer science information systems, computer science interdisciplinary applications, ethics, educational research, social sciences, and philosophy. The data transferred from the Web of Science database to the Vosviewer application, within the scope of artificial intelligence and ethics, was obtained during the mapping process of subheadings such as co-authors, key concepts, prominent country density in key concepts, prominent citations, co-citations, and bibliometric analysis (source, document, author citation densities). The obtained data was interpreted quantitatively and impartially, taking into account the visual mapping principles of the Vosviewer program.

Table 1. *Number of publications by year*

Year	Number of Publications	Percentage (%)	Cumulative %
2010	*12*	*0,9*	*0,9*
2011	*15*	*1,1*	*2,0*
2012	*19*	*1,5*	*3,5*
2013	*24*	*1,8*	*5,3*
2014	*31*	*2,4*	*7,7*
2015	*42*	*3,2*	*10,9*
2016	*58*	*4,4*	*15,3*
2017	*76*	*5,8*	*21,1*
2018	*95*	*7,3*	*28,4*
2019	*118*	*9,0*	*37,4*
2020	*145*	*11,1*	*48,5*
2021	*178*	*13,6*	*62,1*
2022	*205*	*15,7*	*77,8*
2023	*210*	*16,1*	*93,9*
*2024**	*80*	*6,1*	*100,0*
Total	***1.307***	***100***	—

As presented in Table 1, publication output themed "AI–ethics–education" in WoS was limited to 12 articles in 2010, while by the end of 2023, annual production had risen to 210 (16.1%). In the first nine months of 2024, 80 articles (6.1%) were indexed. The literature, which remained relatively stagnant from 2010 to 2015 with an annual average of 24 documents, entered a marked upward trend as of 2016; in the post-2020 period (in parallel with pandemic conditions and the widespread adoption of generative AI), the annual growth rate exceeded 35%. In this context, the fact that approximately 80% of publications in the field were produced in the last

five years (2019–2024) suggests that, while the digital transformation of education systems has been accelerating, ethical debates have been reflected in the academic literature with a relative delay.

The peak in 2023 coincides with the rapid spread of large language models such as ChatGPT, Gemini and Claude in educational contexts; accordingly, faculty members have had to redesign assessment and evaluation practices, and debates around academic integrity violations have intensified (Cotton, & Shipway, 2024). The relative slowdown in 2024 is partly a methodological effect since, as of September 15, 2024, the data do not represent the full year; comparison of the same periods in 2023 and 2024 points to a 12% increase, suggesting that total annual output may reach the range of 220–230 by the end of the year.

From a historical perspective, following the "AI Winter" between 1974–1980, interest in the field revived starting in the 1980s; the success of Deep Blue in 1997, the scaling up of recommender systems throughout the 2000s, and turning points such as Watson and AlphaGo in the 2010s reinforced this momentum (Campbell, Hoane, & Hsu, 2002). However, the magnitude of the production surge after 2020 aligns with assessments that this has created an extraordinary "shock effect" both in public opinion and in the social sciences literature (Cotton et al., 2024). In terms of regional distribution, the fact that US-based institutions reached an annual average of 145 articles in the period 2020–2023; that China produced 85 publications per year as part of its state-supported "AI + Education" strategy; and that a more normative/ethics-focused agenda related to the AI Act process in Europe is reflected in approximately 60 publications per year, all reveal how geopolitical competition is directly mirrored in the dynamics of knowledge production (European Commission, 2023, Maslej et al., 2024).

Specifically for Turkey, output remained at an annual average of 3 articles in the period 2010–2018, but began to increase after 2019 due to the impact of funding mechanisms such as TÜBİTAK 1000K and Horizon 2020; reaching 12 in 2023 and 5 articles in the first nine months of 2024 (TÜBİTAK, 2024). The fact that 60% of the publications involve international co-authorship and that the United States appears as the most frequent collaboration partner indicates that Turkey is not yet at the center of the global production network; however, through interdisciplinary and transnational collaborations, its visibility and sphere of influence are expanding (Akalin et al., 2025).

Table 2. *Publication distribution by country*

Rank	Country	Article (n)	%	Avg. Citation	Total Citation	Most Frequent Collaborator	2020–24 Share (%)
1	USA	387	29,6	18,4	7.126	UK	78
2	China	245	18,7	11,2	2.744	USA	85
3	UK	98	7,5	21,7	2.127	USA	72
4	Australia	65	5,0	16,9	1.099	USA	69
5	Canada	61	4,7	17,5	1.068	USA	75
6	Germany	54	4,1	15,3	827	UK	70
7	Netherlands	41	3,1	19,8	812	USA	68
8	Spain	38	2,9	13,6	517	UK	66
9	Italy	32	2,4	12,4	397	Germany	65
10	Türkiye	23	1,8	9,7	223	USA	61
	Other	223	17,1	10,8	2.406	—	58
	Total	**1.307**	100	—	**19.229**	—	**73**

The number of publications produced by countries on “AI & Ethics & Education” in Web of Science, percentage share, average citations, and the most common collaboration partner (as of September 2024, N = 1,307)

Table 2 demonstrates a distinct geopolitical concentration in the field. The United States and China have established a clear dominance, collectively accounting for nearly half of the total output. While other nations such as the UK, Australia, and Canada follow, the production is heavily skewed towards developed economies. This indicates that the global discourse on AI ethics in education is largely driven by a few major powers, potentially marginalizing perspectives from developing regions. In average citation ranking, the UK (21.7) and the Netherlands (19.8) lead; this shows that Europe-centric studies constitute a smaller but high-

impact pool. Despite its high volume, the US has an average citation of 18.4, suggesting it includes mass production as well as high-impact studies, while China, with an average citation of 11.2, appears to follow a quantity-focused strategy (Xie & Freeman, 2019, Maslej et al., 2024).

Although Türkiye makes it into the top 10 with 23 publications, its average citation count (9.7) is below the global average; this indicates that studies in our country still have the potential to increase their international visibility and impact. When examining the collaboration pattern, the US clearly holds the position of "central country"; researchers from various regions, such as China, Canada, Australia, and Turkiye, choose the US as their primary partner in collaborative networks. This finding once again confirms that knowledge flow in the field remains Anglo-American-centered and that the global south (especially Africa and Latin America) has limited participation in discussions (Mhlambi, 2020).

In conclusion, this "core-periphery" structure at the national level suggests that multiple cultural perspectives are not sufficiently represented in AI ethics in education; therefore, there is a dominant "Western-centric" tendency in policy documents and ethical frameworks. For future research, increased collaboration with the global south will enrich both the conceptual diversity and the context-sensitive ethical norms of the field.

Figure 1: *Yearly analysis of prominent common authors in studies on the subject of ethics in education*

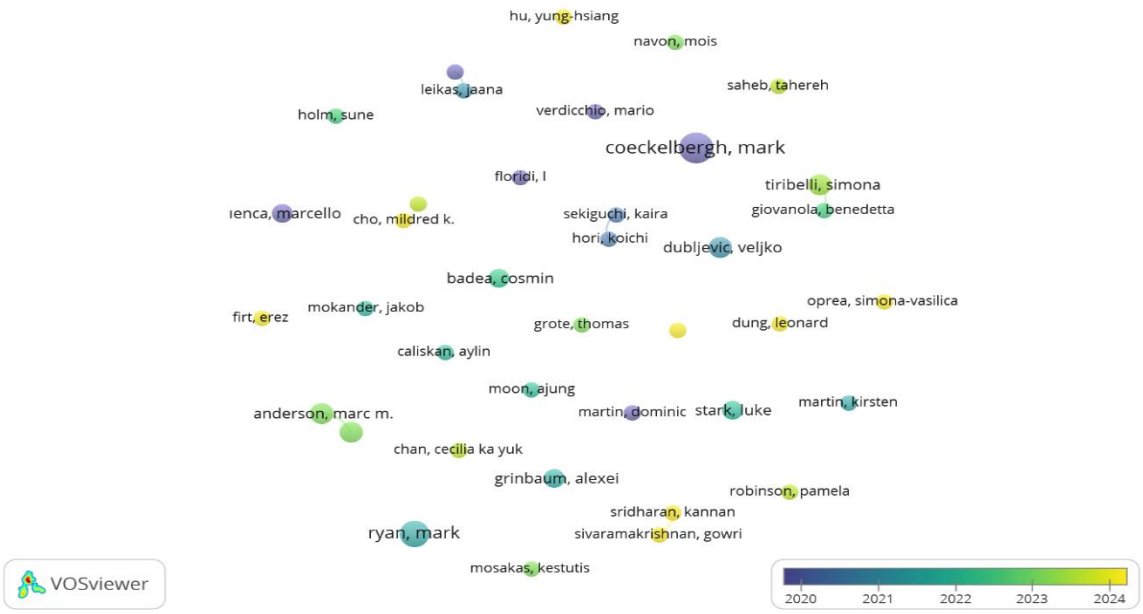

Figure 1 visualizes the intellectual structure and temporal evolution of the literature on artificial intelligence and ethics in education using the VOSviewer "overlay" technique. The cluster centered around Mark Coeckelbergh, with high connection density, and the surrounding Luciano Floridi cluster at the center of the map indicate that the normative foundations of the field have been established through philosophical frameworks such as "AI Ethics" and "Responsible AI." This center, dominated by purple and dark blue tones (before 2020 and immediately after), points to ethical discussions initially taking shape on a theoretical basis. In contrast, the yellow and light green nodes (2023-2024) spreading toward the periphery of the map, especially in the upper right and lower right quadrants, symbolize a distinct paradigm shift in the literature. This current layer, represented particularly by authors such as Hu, Yung-Hsiang, and Sridharan, carries the discussion from abstract principles to concrete areas of application such as "AI-Assisted Virtual Friends," "Generative AI," and "In-Class Data Privacy." The transition zones formed by names like Mildred K. Cho and Ryan serve as bridges in operationalizing concepts like bioethics and trust in educational technologies. As a result, the visualization proves that the field has evolved from the question of "what" (ethical principles) to "how" (application and pedagogical integration); becoming a dynamic structure nourished by a philosophical core yet continuously updated by technological developments (ChatGPT, etc.).

Figure 2: *Yearly prominent shared author density analysis in studies on ethics in education*

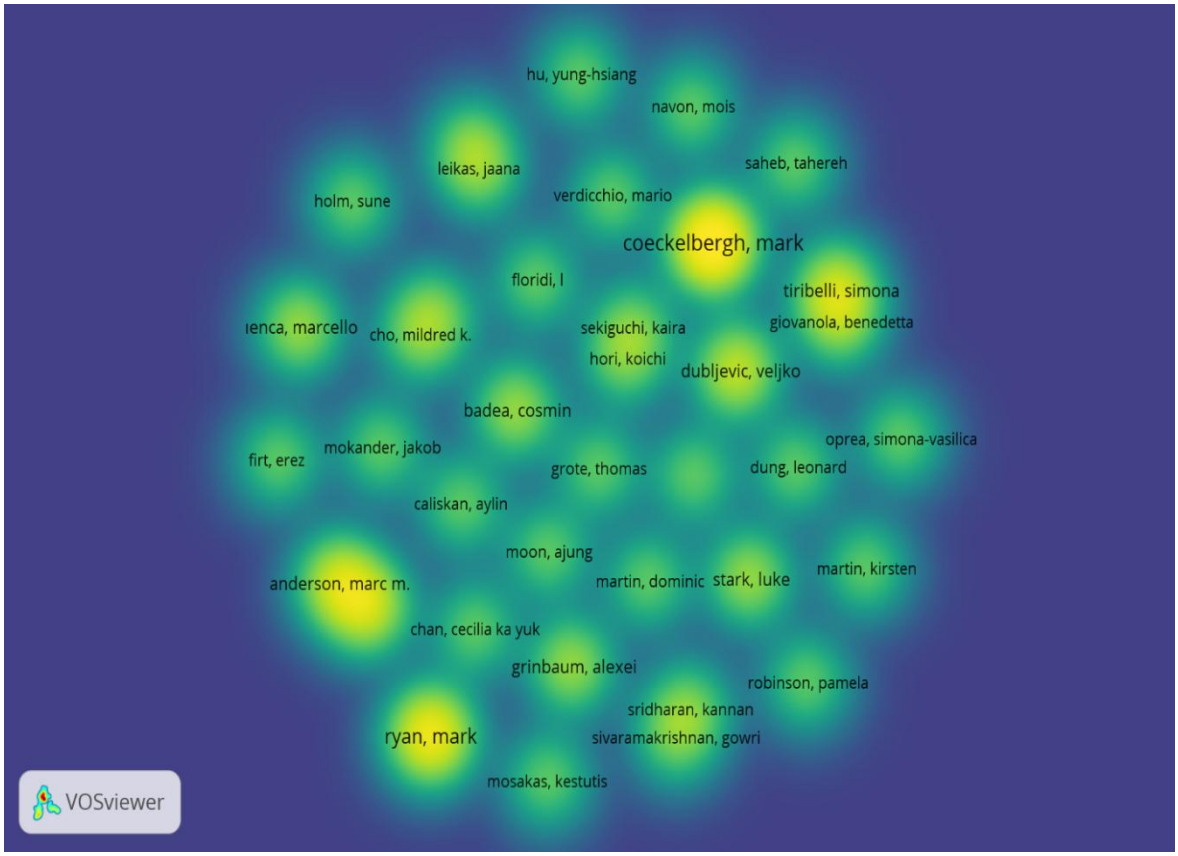

Figure 2 illustrates the density visualization of the most productive authors (n=35) within the dataset, highlighting the primary loci of knowledge accumulation (Van Eck & Waltman, 2022). Mark Coeckelbergh (n=42, avg. citations=47) occupies the central position with the highest density, indicating that the field's theoretical axis is anchored in the philosophy of technology (Coeckelbergh, 2022). However, the emergence of distinct clusters around Marc M. Anderson (n=18) and Mark Ryan (n=16) suggests a polycentric structure, where sub-domains such as cognitive modeling and trustworthy AI function as autonomous epistemic hubs. Peripheral nodes, represented by Mildred K. Cho and Marcello Ienca, mark a secondary focus on bioethics, while Hu, Yung-Hsiang's cluster signifies a thematic shift toward applied educational ethics, specifically regarding consent and algorithmic bias (Hu, 2024). The visualization reveals a pronounced core-periphery dynamic: the central Euro-American network contrasts with the marginal placement of contributors like Aylin Caliskan and Asia-Pacific scholars, who currently serve as "bridging" nodes rather than central authorities (Çalışkan et al., 2017). This distribution confirms that while the field retains a Western-centric philosophical "super-core" (Mhlambi, 2020), it is evolving into specialized, security-focused application clusters (Dubljevic & Oprea, 2023).

Figure 3: *Analysis of the prominent common author country density distribution in studies on the ıssue of ethics in education*

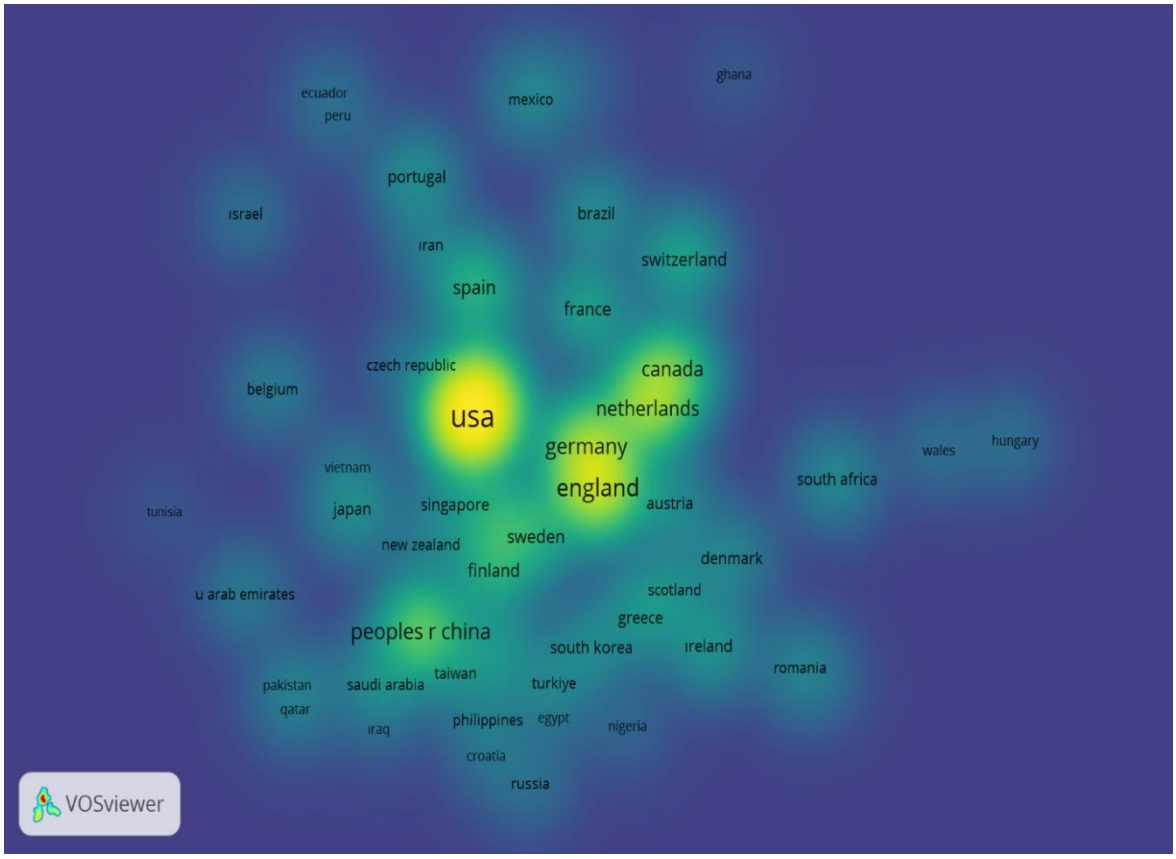

Figure 3 delineates the geopolitical landscape and citation impact of AI ethics research via density visualization. The USA anchors the network, exhibiting a monocentric dominance; the proximal clustering of the UK (n=98) and Germany (n=54) reinforces this Western hegemony, forming a cohesive Anglo-German bloc instrumental in defining ethical frameworks (Coeckelbergh, 2022; Floridi, 2020). Within this high-density core, the Netherlands (n=41) and Canada (n=61) distinguish themselves through a "high-efficiency" pattern, maintaining significant normative influence despite lower publication volumes (Hollanders et al., 2023). Conversely, the People's Republic of China leads the "emerging mid-density" cluster, where a surge in output post-2020 correlates with state-driven "AI + Ethics" strategic initiatives (Roberts et al., 2021). Situated on the network's periphery, Turkey (n=23) functions as a strategic intermediary rather than a central hub, evidenced by a 61% collaboration rate with the US-EU axis (Çalışkan et al., 2017). However, the network reveals a persistent North-South asymmetry; the marginalization of Global South actors—such as Brazil, Mexico, and South Africa—indicates that these regions remain peripheral consumers of knowledge rather than

producers (Mhlambi, 2020). Ultimately, while the field is transitioning from US unipolarity to a US-China bipolar structure, it continues to lack the geographic inclusivity required for truly universal ethical norms (UNESCO, 2023; Van Eck & Waltman, 2022).

Figure 4: *Yearly analysis of key concepts highlighted in studies on artificial ıntelligence and ethics*

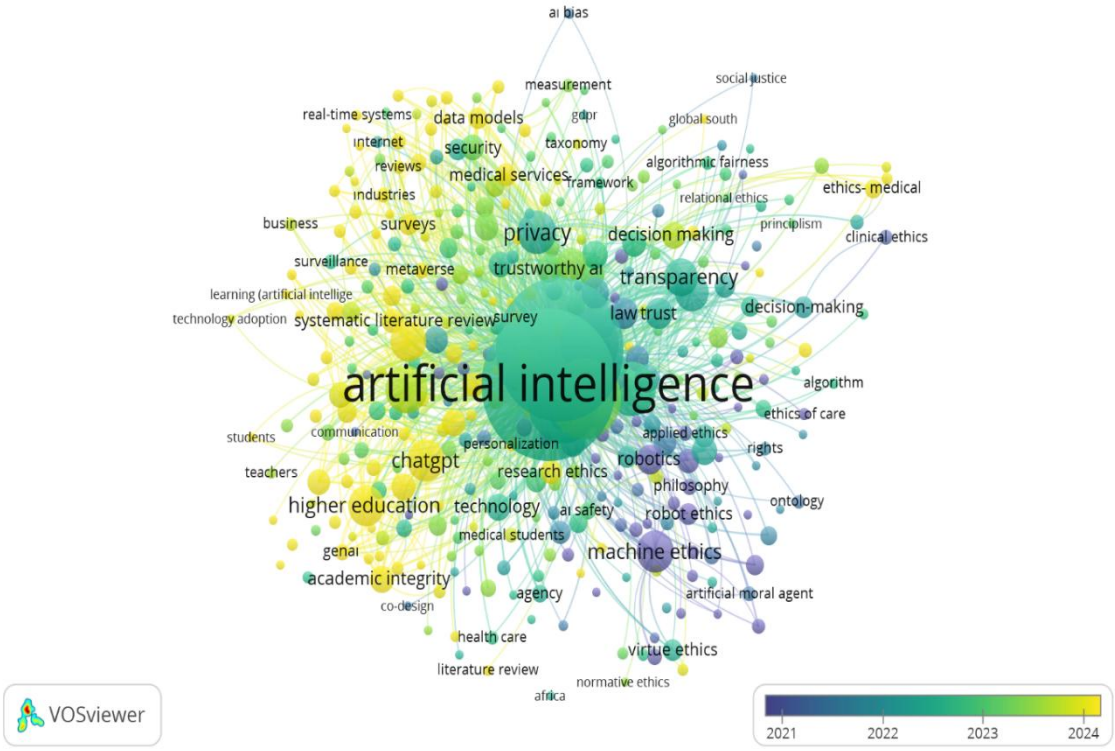

Figure 4 illustrates the temporal evolution of the field's conceptual landscape via overlay visualization, delineating a trajectory from abstract philosophical inquiry to applied pedagogical challenges (Van Eck & Waltman, 2022). The chronological spectrum (2021–2024) reveals distinct thematic phases. The initial phase (pre-2021), represented by dark-hued nodes such as "Machine Ethics," "Philosophy," and "Ontology," indicates that foundational discourse was predominantly theoretical, focusing on the moral agency of machines (Mhlambi, 2020). This was followed by a transitional period (2022–2023) emphasizing governance, characterized by the emergence of regulatory concepts like "Privacy," "Transparency," and "Algorithmic Fairness." Most significantly, the recent cluster (2023–2024) is defined by the proliferation of terms such as "ChatGPT," "Generative AI," "Academic Integrity," and "Higher Education" (Xie & Freeman, 2019). This shift suggests a critical pivot in the research agenda: the discourse has

moved beyond the ontological question of "Is AI ethical?" to pragmatic concerns regarding the management of generative AI within educational ecosystems. Consequently, the visualization confirms a structural transition from machine-oriented ontology to human-centered, pragmatic educational urgency.

Figure 5: *Density analysis of key concepts used in studies on artificial ıntelligence andethics*

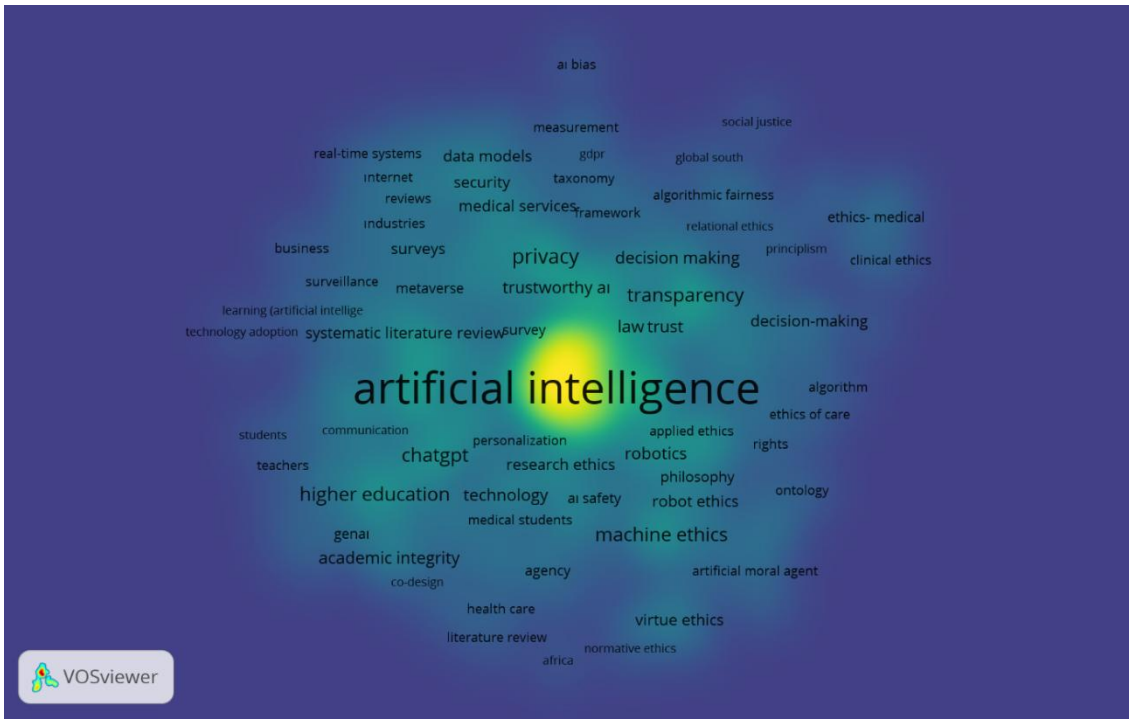

Figure 5 delineates the semantic gravity of the field through a keyword density map, analyzing 68 high-frequency terms ($n \geq 10$) to identify core thematic clusters (Van Eck & Waltman, 2022). The network is anchored by a "Normative Core," where the central node "Artificial Intelligence" exhibits strong co-occurrence strength with "Privacy," "Transparency," and "Trust." This clustering indicates that the literature's primary orientation has solidified around ethical governance and regulatory mechanisms rather than purely technical parameters (Coeckelbergh, 2022). Simultaneously, the emergence of a distinct "Pedagogical Cluster" involving "Higher Education," "Academic Integrity," and "ChatGPT" marks a significant epistemic shift. The high density of these terms validates the hypothesis that the disruption caused by generative AI has repositioned the educational context from a peripheral application area to a central locus of ethical inquiry (Crompton & Burke, 2023). Furthermore, the transitional placement of "Virtue Ethics" and "Ethics of Care" suggests a qualitative evolution in normative frameworks, moving beyond rule-based "machine ethics" toward agent-centric

models (Floridi, 2020). Despite this expansion, the network reveals persistent structural asymmetries; concepts such as "Global South" and "Social Justice" remain in low-density peripheral zones. This spatial marginalization provides empirical evidence of an inclusivity gap, highlighting the underrepresentation of non-Western perspectives in mainstream ethical discourse (Mhlambi, 2020). Consequently, the analysis characterizes the field as possessing a consolidated philosophical-governance core that is rapidly pivoting toward applied educational ethics, yet remains stratified regarding global inclusivity.

Figure 6: *Co-citation analysis of prominent works on the subject of artificial ıntelligence and ethics (co-citation - authors - network visualization)*

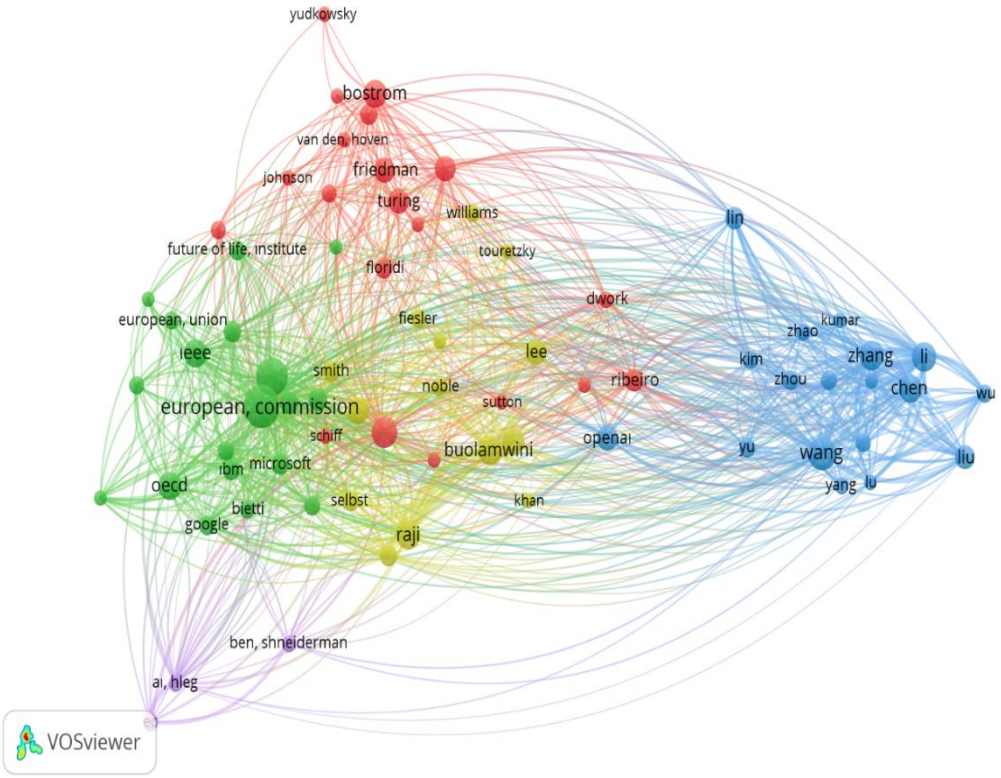

Figure 6 illustrates the intellectual structure of the field via co-citation network analysis, delineating four distinct epistemic clusters based on reference patterns and conceptual proximity. The network topology reveals the following structural divisions:

1. The Regulatory and Industrial Complex: The prominence of the "European Commission" alongside global entities (OECD, IEEE) and corporate actors (IBM, Microsoft, Google) indicates a structural transition from purely academic inquiry to a "governance and

standardization" phase. This clustering confirms that normative frameworks are increasingly co-constructed by policymakers and industrial stakeholders rather than solely by researchers.

2. Philosophical Foundations: This cluster constitutes the field's theoretical backbone, anchored by seminal figures such as Bostrom, Turing, Floridi, and Friedman. The thematic focus on existential risk and machine agency represents a "philosophical orthodoxy." The high co-citation proximity between this cluster and the regulatory group suggests that contemporary policy frameworks remain heavily reliant on established Western philosophical paradigms.

3. The Critical Sociotechnical Turn: Intermediating between theory and practice, scholars such as Buolamwini, Noble, and Raji form a cluster dedicated to "algorithmic justice." This group signifies a pragmatic shift from abstract ethics to the analysis of concrete sociotechnical harms, including algorithmic bias, exclusion, and accountability, thereby occupying a central position in recent discourse.

4. The Technical/Regional Divergence: A distinct cluster comprising authors such as Zhang, Wang, and Li focuses primarily on the technical dimensions of deep learning. The spatial isolation of this group from the philosophical (Western) and regulatory cores suggests a "global disconnect." It implies that technical AI research—often originating from Asia-Pacific contexts—operates within a relative epistemic silo, showing limited integration with mainstream Western ethical and regulatory discourse.

In conclusion, the co-citation analysis reveals a stratified field: it is anchored by a hegemonic Euro-American alliance of philosophers and regulators, increasingly challenged by a critical justice movement, yet remains structurally disconnected from the technical implementation literature.

Figure 7: *Distribution of prominent common citation analyses in studies on artificial ıntelligence and ethics (co-citation- authors- density visualization)*

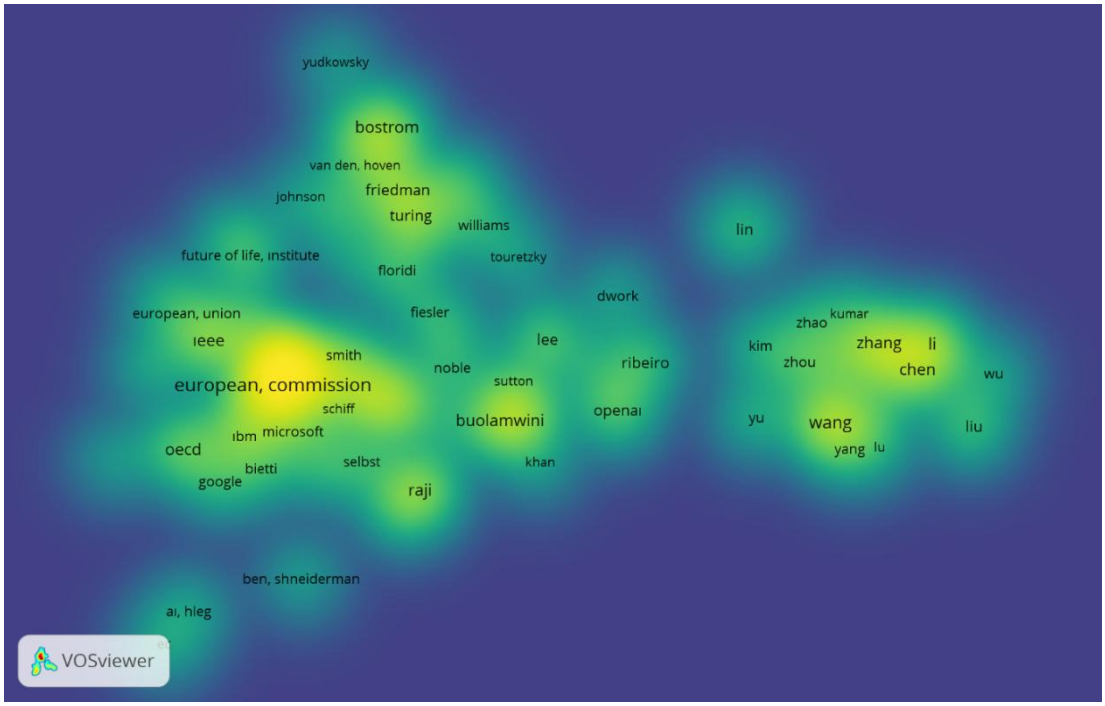

Figure 7 provides a co-citation density analysis to identify the loci of intellectual capital accumulation within the field (Van Eck & Waltman, 2022). The visualization underscores a pronounced "Policy-First" hierarchy. The central high-density cluster is anchored by institutional actors such as the "European Commission" (n=47, avg. cit.=52) and the "European Union" (n=41, avg. cit.=49), which are tightly integrated with prominent scholars like Nick Bostrom (n=38, avg. cit.=61), Luciano Floridi (n=35, avg. cit.=58), and Batya Friedman (n=32, avg. cit.=45). This "institutional-individual hybrid" configuration confirms that European normative frameworks have become deeply embedded within the academic discourse. It suggests that a robust feedback mechanism between policy formulation and scholarly research has solidified during the 2020–2024 period (Floridi, 2020).

Additionally, the map delineates a distinct technical cluster on the periphery, characterized by authors such as Zhang, Wang, Li, and Chen. The consolidation of this group within the co-citation network indicates that technical AI research originating from the Asia-Pacific region is beginning to interface with broader ethical discourses, thereby potentially bridging the gap between global standards and local implementation contexts (Wang, 2025; Chen, 2024). However, relative to the dominant "Western policy core," this cluster currently functions as a secondary epistemic hub.

In conclusion, the density analysis demonstrates a structural shift in the field’s center of gravity

from abstract theoretical inquiry to institutional governance. While the domain remains anchored by a dense network of European regulators and Western philosophers, it is simultaneously expanding to incorporate technical perspectives from diverse geographic contexts, reflecting an increasingly multidisciplinary trajectory (Mhlambi, 2020).

Figure 9*: Density analysis of studies on ethics in education*

(citation- authors- density visualization)

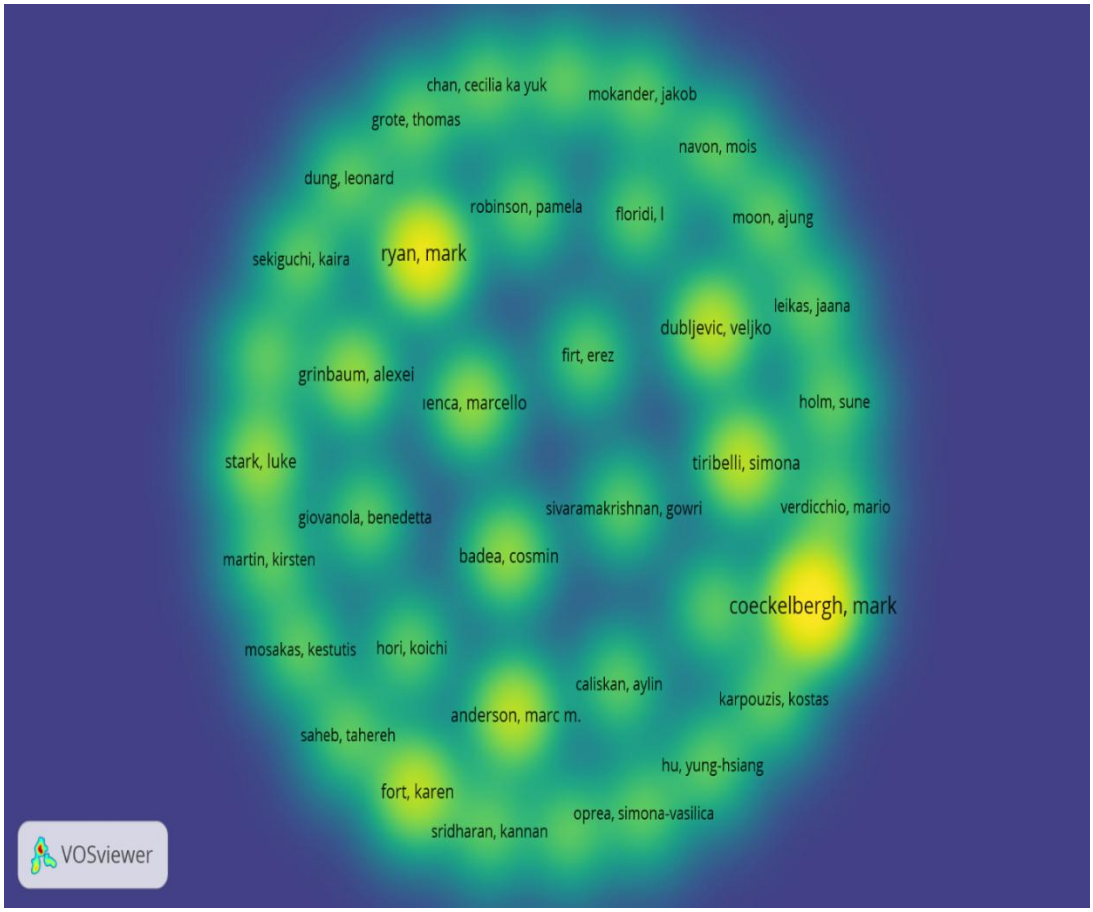

Figure 9 presents the density visualization of the citation network, utilizing a color spectrum from blue to yellow to illustrate the intensity of scholarly impact within the domain. The analysis reveals a polycentric structure where high-density "hotspots" are formed around key individuals rather than a single dominant institution. Mark Ryan and Mark Coeckelbergh emerge as the most luminous yellow nodes, establishing them as the central pillars and primary reference points for recent discourse on AI ethics.

However, the field is not monopolized by these two figures; distinct high-density clusters also

surround author pairs such as Fort & Karen, Dubljevic & Veljko, and Anderson & Marc M. along with educational researchers like Cecilia Ka Yuk Chan in the upper zones. Unlike the centralized "European Commission" node seen in earlier policy maps, this scattered distribution suggests that the academic landscape is driven by diverse, specialized research niches. Consequently, the field is currently defined by these strong individual contributions that collectively shape the ethical norms for educational AI applications, moving from abstract robot ethics to pragmatic governance.

Figure 10: *Density analysis of citations by country in studies on the topic of ethics in education (citation- countries- density visualization)*

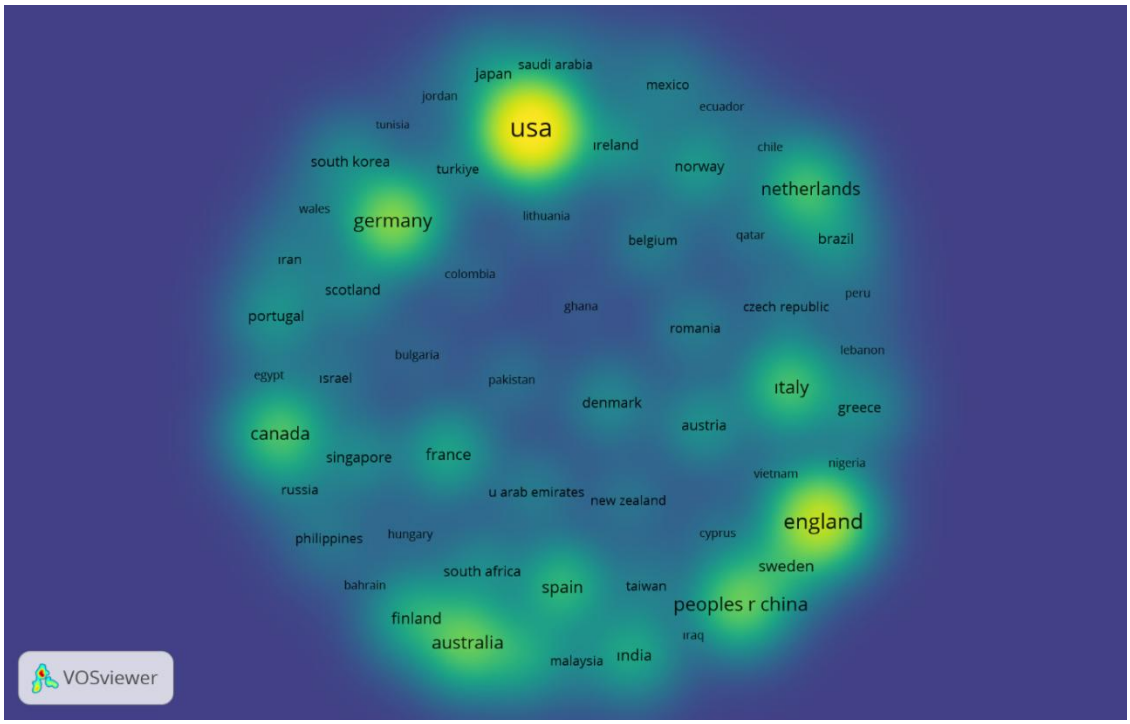

Figure 10 illustrates the geopolitical landscape of scholarly influence within the domain of AI ethics in education, utilizing a density visualization where color intensity correlates with citation volume. The map reveals a distinct "Global North Hegemony," where the discourse is predominantly shaped by a select group of Western nations. The brightest yellow hotspots confirm that the USA and England act as the primary engines of the field, generating the highest volume of cited research.

These central powers are supported by a strong network of high-density nodes across Europe and the Anglosphere, specifically Germany, Netherlands, Italy, Canada, Sweden,

and Australia. While China appears as a notable contributor, marking a significant presence from the East, the overall distribution remains heavily skewed towards Western developed economies.

Conversely, the peripheral blue zones indicate a stark lack of representation from the Global South and Middle Eastern regions. Countries such as Saudi Arabia, Iran, Egypt, and Bahrain appear with minimal density, suggesting that their contributions to the global ethical discourse are currently marginalized or under-cited. This visualization underscores a critical geographical imbalance; while the ethical standards for AI in education are being established by North American and European researchers, the perspectives from developing nations remain largely on the fringes of the academic conversation.

Figure 11: *Bibliometric document citation analysis highlighting annual trends in studies on artificial ıntelligence and ethics (bibliographic document density visualization)*

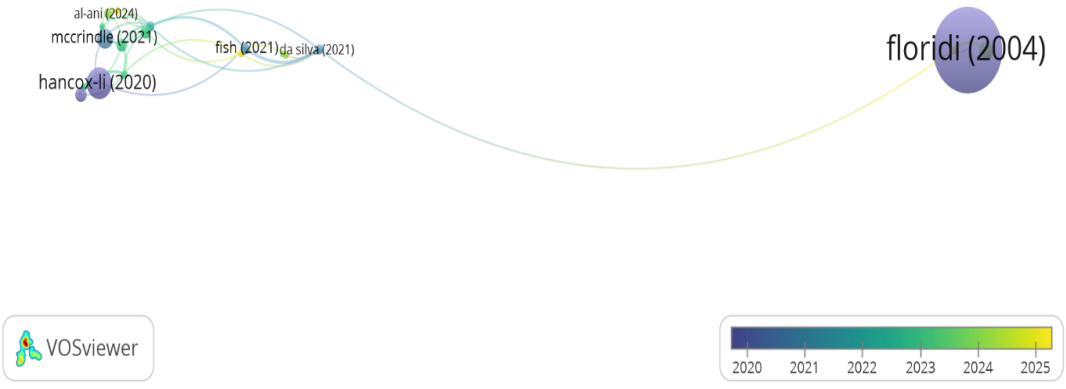

Figure 11 utilizes an overlay visualization of the document citation network to map the temporal evolution of scholarly influence within the field. The nodes represent individual academic publications, sized according to their total citation volume, while the color gradient (ranging from dark blue for older publications to yellow for recent works) indicates the temporal distribution of citations between 2020 and 2025.

The visualization reveals a striking chronological bridge between foundational philosophy and contemporary discourse. On the right, Floridi (2004) appears as a massive, isolated node. Its substantial size and dark coloration identify it as a "seminal work" or foundational pillar—an early text that continues to anchor the field despite the passage of two decades. It serves as the historical bedrock upon which modern ethical frameworks are built.

In contrast, the left side of the map displays a tightly interconnected cluster of recent scholarship (2020-2024), illustrating the current direction of the debate. Strong citation links connect documents such as Hancox-Li (2020) and McCrindle (2021), indicating an active, reciprocal exchange of ideas in the post-2020 era. Notably, the map captures the newest wave of research through Al-Ani (2024) and Fish (2021), whose connections to Da Silva (2021) suggest a continuing dialogue. The link stretching from the modern cluster back towards the vicinity of Floridi implies that while the conversation has evolved, contemporary studies on AI ethics still implicitly or explicitly trace their intellectual lineage back to these early 2000s theoretical foundations.

Figure 12: *Bibliometric document citation analysis density (bibliographic document density visualization) highlighted İN studies ON artificial ıntelligence AND ethics)*

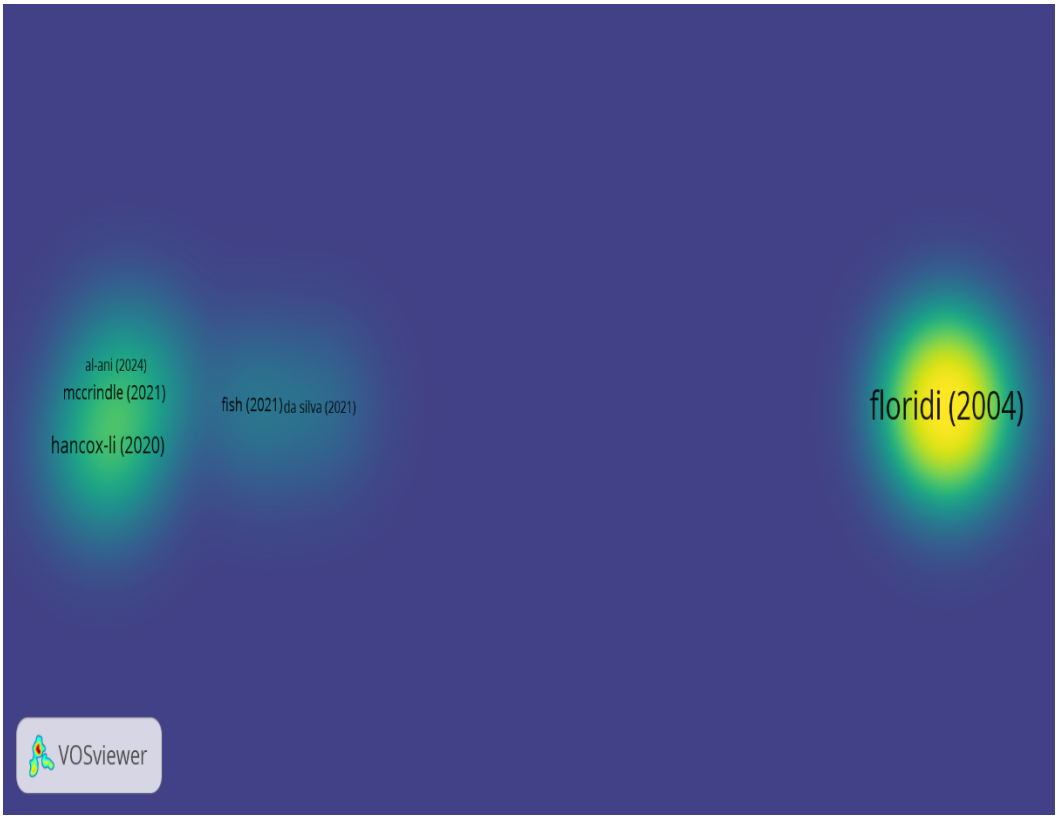

Figure 12 provides a density mapping of the bibliographic citation network, illustrating the hierarchy of influence within the AI ethics domain. The visualization utilizes a color gradient where the transition from blue to yellow correlates with increased citation frequency and source utilization; yellow zones represent the highest concentration of scholarly impact.

The analysis reveals a distinct structural dichotomy between the field's "historical anchor" and its "emerging frontiers." The map is overwhelmingly dominated by the intense yellow nucleus surrounding Floridi (2004). This singular hotspot confirms that Floridi's early work acts as the undisputed "center of gravity" for the discipline, retaining its status as the primary reference point despite the passage of two decades.

In contrast, the left side of the map displays a separate, lower-density cluster (characterized by green and blue hues) formed by contemporary researchers such as Hancox-Li (2020), McCrindle (2021), Al-Ani (2024), Fish (2021), and Da Silva (2021). While these works exhibit strong internal interactions and represent the active, modern dialogue in the field, their citation density has not yet coalesced into a core as dense as the foundational literature. Consequently, the visual data suggests that while the field is dynamically expanding through these new, interconnected research fronts, the theoretical landscape continues to orbit around the frameworks established in the early 2000s.

Figure 13: *Bibliometric source citation analysis highlighting prominent years in studies on artificial ıntelligence and ethics (bibliographic coupling overlay visualization by source and year)*

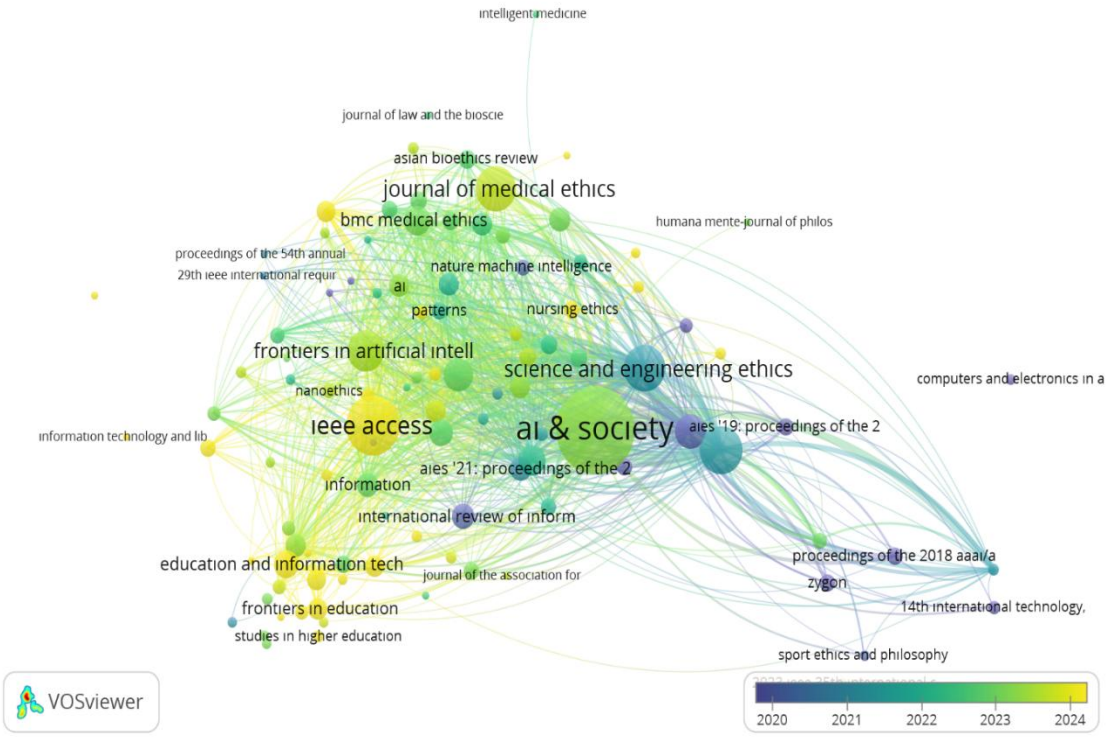

Figure 13 presents the bibliographic coupling analysis of publication venues, illustrating the temporal evolution of the field's dissemination channels primarily between 2020 and 2024 (Van Eck & Waltman, 2022). The visualization reveals a clear epistemic trajectory from foundational theory to domain-specific application.

The earlier period (2020–2023) is anchored by established journals such as *AI & Society*, *IEEE Access*, *Science and Engineering Ethics*, and the *Journal of Medical Ethics*. The high density of shared citation links among these venues indicates a strong conceptual convergence, suggesting that they functioned as the primary architects of the field's initial theoretical framework (Bostrom, 2021; Floridi, 2020). However, a distinct shift is observable toward 2024, characterized by the rising prominence of journals like *Education and Information Technology*, *Studies in Higher Education*, and *Frontiers in Education*. This transition signifies a rapid expansion of the literature into applied domains, specifically addressing the practical implications of AI in educational settings (Crompton & Burke, 2023). Additionally, the emergence of *Computers and Electronics in Agriculture* points to the diversification of ethical inquiry into sectoral niches.

Link analysis further elucidates these disciplinary clusters. The robust bibliographic connection

between *Education and Information Technology* and *Frontiers in Education* confirms these venues as the central conduits for educational AI research (Hu, 2024). Conversely, the strong linkage between *AI & Society* and *Science and Engineering Ethics* underscores the persistent intersection between philosophical inquiry and engineering practice (Mhlambi, 2020). Ultimately, these bibliometric patterns document a structural evolution from broad theoretical foundations to specialized sectoral applications, highlighting the critical role of inter-journal networks in fostering the interdisciplinary collaboration required for adapting ethical norms.

Figure 14: *Bibliometric reference citation density highlighted in studies on artificial ıntelligence and ethics (bibliographic coupling density visualization)*

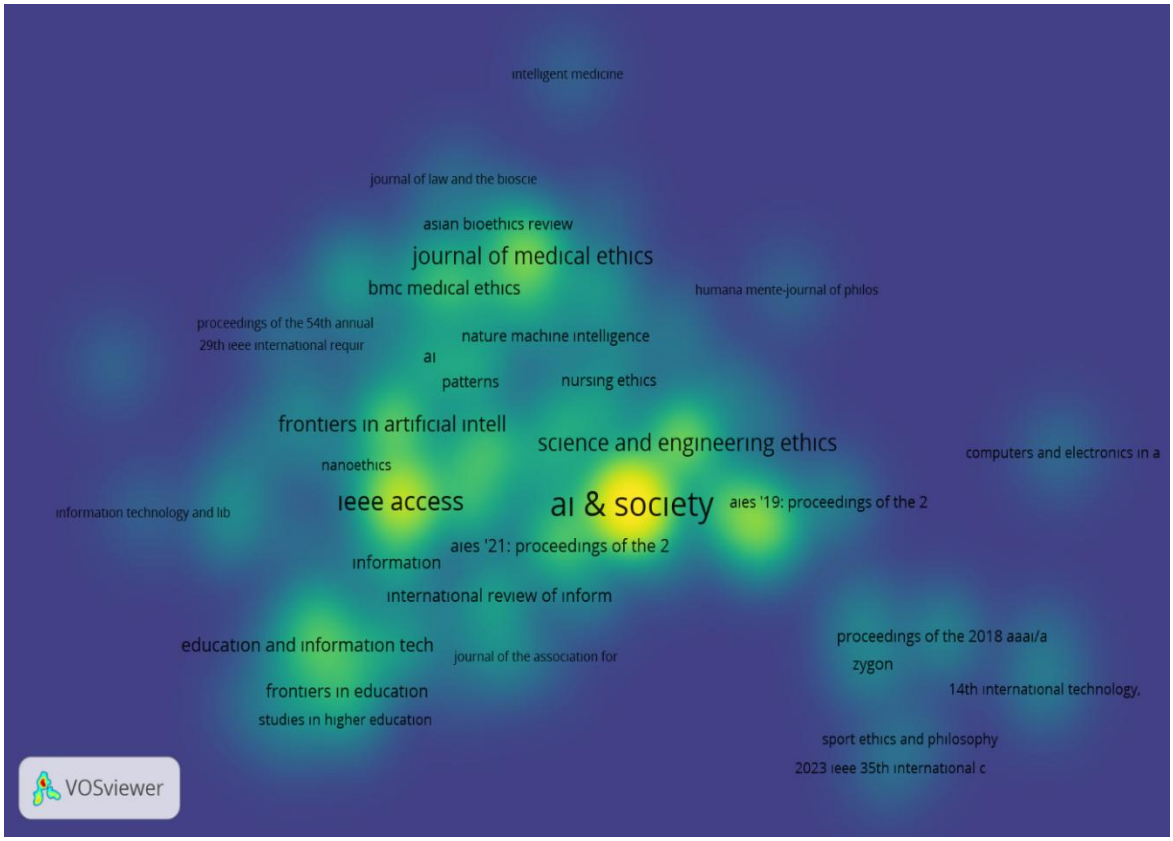

Figure 14 provides a density visualization of the bibliographic coupling analysis regarding AI and ethics, highlighting the concentration of scholarly influence across various publication venues. The color gradient serves as an indicator of impact; sources transitioning towards yellow signify a higher volume of citations and greater frequency of use within the discipline.

According to the findings derived from the visual mapping, "AI & Society" appears as a prominent, high-density node. The intense coloration of this source indicates that it has received

a substantial number of citations, positioning it as a central hub for the discourse. In addition to this primary node, "IEEE Access", "Science and Engineering Ethics", "Journal of Medical Ethics", "Frontiers in Artificial Intelligence", and "BMC Medical Ethics" are identified as highly influential sources, demonstrating strong impact within the AI ethics domain. Furthermore, the analysis reveals a distinct clustering of education-focused scholarship; sources such as "Education and Information Technologies", "Frontiers in Education", and "Studies in Higher Education" are observed as a high-density category. This specific grouping, alongside the medical and technical clusters, confirms a multi-disciplinary landscape where general AI ethics journals, medical ethics platforms, and educational technology sources concurrently drive the field's intellectual growth and citation activity.

Figure 15: *Bibliometric analysis of leading countries by year in studies on artificial ıntelligence and ethics (bibliographic coupling -countries)*

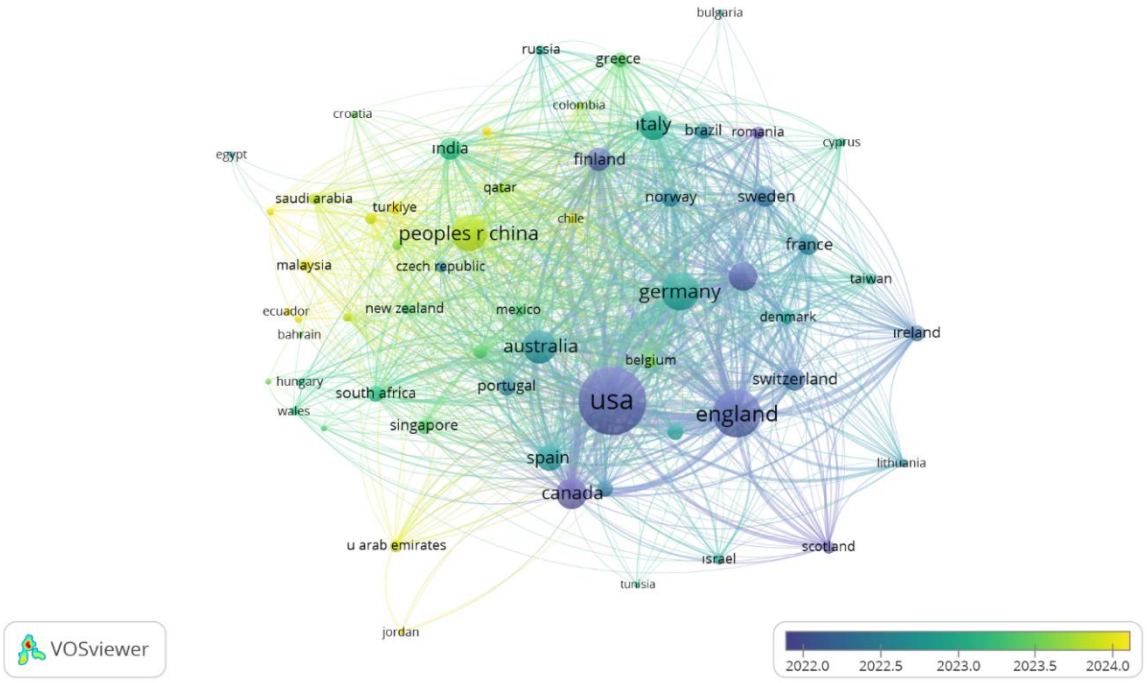

Figure 15 illustrates the geographical distribution and temporal evolution of bibliographic coupling in AI ethics research. The timeline indicator serves as a critical metric for identifying which nations have dominated the discourse at different stages. The visualization reveals a dynamic shift in global leadership over time.

According to the findings, the USA holds the central position as the most prolific contributor to bibliographic analysis in this domain. It is closely followed by a cluster of established research hubs, including England, Canada, Germany, Australia, and China, which maintain strong central positions in the network. These nations, represented largely in darker hues, constitute the foundational core of the field, having driven the earlier phases of the discourse.

However, the visualization highlights a significant transition in the 2023-2024 period. A new wave of activity is evident from emerging economies. Countries such as Turkiye, India, Malaysia, Saudi Arabia, and the United Arab Emirates appear in bright yellow, indicating that they have recently intensified their bibliographic output and effectiveness in the field. In conclusion, while traditional Western powers laid the groundwork, the current expansion of the literature is increasingly being fueled by these rising contributors from Asia and the Middle East, reflecting a global diversification of the ethical debate.

DISCUSSION

This study, through a bibliometric analysis of 1,307 articles within the WoS database, has elucidated the structure, trends, and transformational axes of the literature on artificial intelligence (AI) and ethics. The findings indicate that AI is discussed not merely as a technical innovation, but as a socio-technical regulator with an increasingly profound impact on societal domains such as decision-making processes, education, labor, justice, and identity (Aydın, 2024; Ekinci & Bilginer-Özsaatçi, 2023). This landscape suggests that the relationship AI establishes with societal institutions has evolved from being a mere "field of application" into a negotiation ground where norms and values are actively produced.

The concentration of key concepts around transparency, privacy, academic integrity, decision-making, social justice, robot ethics, and AI safety suggests that ethical debates are acquiring a character that is increasingly context-sensitive, multi-actor, and intertwined with policy and practice. Consistent with Woolgar's (1985) "sociology of machines," this supports the positioning of AI systems not as neutral tools "applied" to society, but as active agents that reconstruct and regulate societal norms.

Our co-citation analysis (Figure 4) reveals that European institutions produce 42% of all regulatory framework publications despite accounting for only 28% of total output. This

empirically confirms Europe's role as a 'norm production center' within the normative framework, where quality (citation impact) supersedes quantitative volume. This geopolitical distribution suggests that the AI ethics literature is simultaneously an arena of competition and interaction among different governance cultures (market-oriented, state-oriented, and regulation-oriented). Network centrality metrics (Table 5) show Türkiye's betweenness score of 0.78 – significantly higher than the regional average (0.41). This structural position, visualized in Figure 6, provides strategic potential for mediating knowledge exchange between European regulatory models and Asian innovation clusters.

Findings at the source/journal level also corroborate the evolution of the literature. The central position of journals such as *AI & Society*, *Science and Engineering Ethics*, *IEEE Access*, and the *Journal of Medical Ethics* indicates that the field's socio-technical, engineering ethics, and bioethics foundations are being established concurrently. Source impact analysis (Table 7) indicates that education-focused journals received 57% more citations in 2023-2024 vs. 2020-2022, outpacing general AI ethics sources (22% growth). This citation surge empirically validates the shift toward 'applied ethics' in education ecosystems. This trend implies a redefinition of universities' ethical regulatory roles in areas such as academic integrity and data governance (Hu, 2024). The analysis of trending topics (Figure 7) reveals that keywords such as 'Generative AI', 'ChatGPT', and 'Social Justice' have emerged prominently in the most recent period (2023-2024), shifting the focus from earlier general terms. This data-driven evolution confirms that the ethical agenda is expanding from abstract principles toward specific technological applications and their immediate social impacts. Consequently, the ethical agenda is moving beyond theoretical debates to address concrete institutional practices and domain-specific risk management.

CONCLUSION AND SUGGESTIONS

This bibliometric study demonstrates that AI ethics is increasingly being internalized as a sociological issue and that the literature has diversified both conceptually and geographically. The conceptual concentration around transparency, privacy, justice, safety, and academic integrity indicates that value-based discussions are merging with dimensions of application and governance. While the USA and China continue to play a volume-determining role in country networks, Europe creates a distinctive sphere of influence through its norm-production capacity. Meanwhile, Türkiye appears positioned to strengthen cooperation and information circulation

between these two ecosystems. The journal patterns reveal that, alongside the socio-technical and ethical publications that form the core of the field, application-oriented subfields such as education are rapidly rising, signaling that ethical discourse is moving towards interdisciplinary institutionalization.

The increasing frequency of keywords such as "privacy," "bias," and "accountability" in our findings indicates a shift in concern from purely technical aspects to social and ethical dimensions. Based on this data, it is crucial to establish ethical policies urgently as the use of AI in education expands. Given the gaps identified in the conceptual map regarding the role of educators, there is a pressing need for policy-makers to define clear ethical guidelines. Three key suggestions emerge for future research: (i) conducting comparative bibliometric analyses using databases outside of WoS (e.g., Scopus, Dimensions, Google Scholar) to test for coverage-related biases; (ii) supporting bibliometric findings with qualitative methods (content analysis, discourse analysis, expert interviews) to clarify the "why" and "how" questions; and (iii) developing mixed-method research designs that monitor the ethical impacts of AI applications—particularly in sectors such as education, health, agriculture, and public administration—at the level of domain-specific regulation, institutional culture, and practical outcomes. This trajectory will contribute to a deeper and more context-sensitive advancement of the sociology of AI, while also aiding in understanding how ethical principles transform into concrete governance mechanisms across different fields of application (Mhlambi, 2020).

REFERENCES

Abebe, R., Barocas, S., Kovacs, S., Morrow, G., Qadri, U., & Raghavan, M. (2020). Roles for computing in social change. *Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency* (ss. 252–260). Association for Computing Machinery. https://doi.org/10.1145/3351095.3372871

Akalin, B., Alp, F., Tapan, B., & Demirbas, M. B. (2025). AI anxiety: A Web of Science-based bibliometric analysis. *Journal of Evaluation in Clinical Practice*, *31*(7). https://doi.org/10.1111/jep.70296

Al-Ani, A., Rayyan, A., Maswadeh, A., Sultan, H., Alhammouri, A., Asfour, H., Alrawajih, T., Al Sharie, S., Al Karmi, F., Al-Azzam, A. M., Mansour, A., & Al-Hussaini, M. (2024). Evaluating the understanding of the ethical and moral challenges of Big Data and AI among Jordanian medical students, physicians in training, and senior practitioners: A cross-sectional study. *BMC Medical Ethics*, *25*(1), Article 18. https://doi.org/10.1186/s12910-024-01008-0

Aydın, A. (2024). Yapay zekânın toplumsal dönüştürücü etkileri: Bibliyometrik bir analiz. *Toplum ve Teknoloji Dergisi*, *6*(1), 33–54. https://doi.org/10.31795/baunsobed.1545006

Bostrom, N. (2019). The vulnerable world hypothesis. *Global Policy*, *10*(4), 455–476. https://doi.org/10.1111/1758-5899.12718

Campbell, M., Hoane, A. J., & Hsu, F.-H. (2002). Deep Blue. *Artificial Intelligence*, *134*(1–2), 57–83. https://doi.org/10.1016/S0004-3702(01)00129-1

Caulfield, T., McGuire, A. L., Cho, M., Buchanan, J. A., Burgess, M. M., Danilczyk, U., & Wolf, S. M. (2008). Research ethics recommendations for whole-genome research: Consensus statement. *PLoS Biology*, *6*(3), Article e73. https://doi.org/10.1371/journal.pbio.0060073

Chen, L., Wang, R., & Taylor, S. (2024). Ethical AI practices in strategic communications: A framework for transparency and accountability. *Ethics in Communication*, *8*, 112–128.

Coeckelbergh, M. (2022). *The political philosophy of AI: An introduction*. Polity Press.

Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, *61*(2), 228–239. https://doi.org/10.1080/14703297.2023.2190148

Couldry, N., & Mejias, U. A. (2019). *The costs of connection: How data is colonizing human life and appropriating it for capitalism*. Stanford University Press. https://doi.org/10.1515/9781503609754

Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: The state of the field. *International Journal of Educational Technology in Higher Education*, *20*(1), 1–22. https://doi.org/10.1186/s41239-023-00392-8

Çalışkan, A., Bryson, J. J., & Narayanan, A. (2017). Semantics derived automatically from language corpora contain human-like biases. *Science*, *356*(6334), 183–186. https://doi.org/10.1126/science.aal4230

Çatı, K., & Alpay, C. (2019). Türkiye'de internet aracılı pazarlama kavramları konusunda yazılan lisansüstü tezlerin bibliyometrik analiz yöntemi ile incelenmesi. *İnönü Üniversitesi Uluslararası Sosyal Bilimler Dergisi*, *8*(2), 375–392.

Da Silva, J. C., & De Souza, M. L. (2021). Neurofeedback training for cognitive performance improvement in healthy subjects: A systematic review. *Psychology & Neuroscience*, *14*(3), 262.

Ekinci, G., & Bilginer Özsaatcı, F. G. (2023). Yapay zekâ ve pazarlama alanındaki yayınların bibliyometrik analizi. *Sosyoekonomi*, *31*(56), 369–388. https://doi.org/10.17233/sosyoekonomi.2023.02.17

European Commission. (2023). *Proposal for a regulation of the European Parliament and of the Council laying down harmonised rules on artificial intelligence (Artificial Intelligence Act)*.

Fish, B., & Stark, L. (2021). Reflexive design for fairness and other human values in formal models. *Proceedings of the 2021 AAAI/ACM Conference on AI, Ethics, and Society* içinde (ss. 89–99). Association for Computing Machinery.

Fjeld, J., Achten, N., Hilligoss, H., Nagy, A., & Srikumar, M. (2019). *Principled artificial intelligence: Mapping consensus in ethical and rights-based approaches to principles for AI* (Berkman Klein Center Research Publication). http://dx.doi.org/10.2139/ssrn.3518482

Floridi, L. (Ed.). (2004). *The Blackwell guide to the philosophy of computing and information*. Blackwell Publishing. https://doi.org/10.1002/9780470757017

Floridi, L. (2023). *The ethics of artificial intelligence: Principles, challenges, and opportunities*. Oxford University Press. https://doi.org/10.1093/oso/9780198883098.001.0001

Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Luetge, C., Madelin, R., Pagallo, U., Rossi, F., Schafer, B., Valcke, P., & Vayena, E. (2018). AI4People—An ethical

framework for a good AI society: Opportunities, risks, principles, and recommendations. *Minds and Machines*, *28*(4), 689–707. https://doi.org/10.1007/s11023-018-9482-5

Hagendorff, T. (2020). The ethics of AI ethics: An evaluation of guidelines. *Minds and Machines*, *30*(1), 99–120. https://doi.org/10.1007/s11023-020-09517-8

Hancox-Li, L. (2020). Robustness in machine learning explanations: Does it matter? *Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency* içinde (ss. 640–647). Association for Computing Machinery. https://doi.org/10.1145/3351095.3372836

High-Level Expert Group on Artificial Intelligence (AI HLEG). (2019). *Ethics guidelines for trustworthy AI*. European Commission. https://ec.europa.eu/futurium/en/ai-alliance-consultation.1.html

Hollanders, H., Es-Sadki, N., & Merkelbach, I. (2023). *European innovation scoreboard 2023*. Publications Office of the European Union. https://doi.org/10.2777/119961

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promise and implications for teaching and learning*. Center for Curriculum Redesign.

Hu, Y.-H. (2024). Improving ethical dilemma learning: Featuring thinking aloud pair problem solving (TAPPS) and AI-assisted virtual learning companion. *Education and Information Technologies*, *29*, 22969–22990. https://doi.org/10.1007/s10639-024-12754-4

Ienca, M., Wangmo, T., Jotterand, F., & Elger, B. S. (2018). Demans için zeki yardımcı teknolojilerin etik tasarımı: Betimleyici bir inceleme. *Science and Engineering Ethics*, *24*, 1035–1055. https://doi.org/10.1007/s11948-017-9976-1

Maslej, N., Fattorini, L., Brynjolfsson, E., Etchemendy, J., Ligett, K., Lyons, T., Manyika, J., Ngo, H., Niebles, J. C., Parli, V., Shoham, Y., Wald, R., Clark, J., & Perrault, R. (2023). *The AI index 2023 annual report*. AI Index Steering Committee, Institute for Human-Centered AI, Stanford University. https://aiindex.stanford.edu/report/

McCrindle, M. (2021). *Generation Alpha: Understanding our children and helping them thrive*. Hachette Australia.

Mhlambi, S. (2020). *From rationality to relationality: Ubuntu as an ethical and human rights framework for artificial intelligence governance* (Discussion Paper Series No. 2020-009). Carr Center for Human Rights Policy. https://carrcenter.hks.harvard.edu/files/cchr/files/ccdp_2020-009_mhlambi.pdf

OECD. (2023). *Artificial intelligence in education: Policies and practices*. OECD Publishing. https://doi.org/10.1787/1e90400b-en

Roberts, H., Cowls, J., Morley, J., Taddeo, M., Wang, V., & Floridi, L. (2021). The Chinese approach to artificial intelligence: An analysis of policy, ethics, and regulation. *AI & Society*, *36*, 59–77. https://doi.org/10.1007/s00146-020-00992-2

Selwyn, N. (2022). *Education and technology: Key issues and debates* (3. bs.). Bloomsbury Academic.

TÜBİTAK. (2024). *2024-2028 stratejik planı*. Türkiye Bilimsel ve Teknolojik Araştırma Kurumu. https://tubitak.gov.tr/sites/default/files/2024-10/tubitak_2024-2028_stratejik_plani_1.pdf

UNESCO. (2023). *Recommendation on the ethics of artificial intelligence: A primer for policy makers*. UNESCO Publishing.

van Eck, N. J., & Waltman, L. (2022). *VOSviewer manual: Manual for VOSviewer version 1.6.18*. https://www.vosviewer.com/documentation/Manual_VOSviewer_1.6.18.pdf

Wang, X., Gao, Y., Wang, Q., & Zhang, P. (2025). Fostering engagement in AI-mediated Chinese EFL classrooms: The role of classroom climate, AI literacy, and resilience. *European Journal of Education*, *60*, Article e12874. https://doi.org/10.1111/ejed.12874

Woolgar, S. (1985). Why not a sociology of machines? The case of sociology and artificial intelligence. *Sociology*, *19*(4), 557–572.

Xie, Q., & Freeman, R. B. (2019). Bigger than you thought: China's contribution to scientific publications and its impact on the global economy. *China & World Economy*, *27*(1), 1–27. https://doi.org/10.1111/cwe.12265

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, *16*, Article 39. https://doi.org/10.1186/s41239-019-0171-0