

Artificial Intelligence ethics: A bibliometric analysis

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Abstract: *This study presents a bibliometric analysis of studies indexed in Web of Science using the keyword "Artificial Intelligence Ethics" with VosViewer. The aim of the analysis is to determine the keywords with the highest frequency of use in studies on "Artificial Intelligence Ethics" and to determine which studies and journals are cited the most. The most striking keyword in the study findings is seen to be "Transparency". The countries with the highest number of citations in the study area are England and the United States. The study shows that the journals "Big Data & Society and AI & Society" contain important studies on "Artificial Intelligence Ethics".*

Keywords: Artificial Intelligence Ethics, Ethical Artificial Intelligence, Artificial Intelligence Research Trends, Bibliometric Analysis.

1. Introduction

Today, Artificial Intelligence (AI) has transformed our daily lives, economy, and industries (Vinothkumar & Karunamurthy, 2023). AI continues to impact industries and sectors worldwide, defined by efficiency, streamlined decision-making, and progress (Javaid et al., 2022). AI technology is being used in scientific research (Xu et al., 2021), healthcare (Abduljabbar et al., 2019; Alowais et al., 2023) and education (Chen et al., 2020; Ouyang et al., 2021),

Artificial intelligence is also effective in the healthcare sector. With the integration of artificial intelligence in healthcare services, improvements are being made in reducing medical errors, improving patient outcomes, and increasing the overall quality of care (Davenport & Glaser, 2022). With the support of artificial intelligence, systems have gained the ability to analyze large data sets, make accurate predictions, and identify patterns. Tools used with artificial intelligence support help develop complex medical procedures and make informed decisions (Soferman, 2019). Therefore, healthcare services provide an advantage in providing more personalized and effective treatments (Alowais et al., 2023).

The financial sector also uses artificial intelligence most efficiently. It is used to detect fraudulent activities, facilitate trade, and manage risk (El Hajj et al., 2023).

Due to the wide range of uses of artificial intelligence systems, ethical use and social impacts have now become a topic of discussion. Technology is becoming more integrated into our daily lives and decision-making processes. Thus, unethical values have begun to be used in many ways and can lead to unfair treatment (Schwartz, 2022).

Another ethical issue is personal privacy. AI systems generally rely on large amounts of data, some of which may be sensitive or personal. Thus, the use of data raises ethical concerns about how the data used is collected, stored, and shared. If data is not protected or if AI systems are used for monitoring purposes, the issue of violating individuals' privacy arises. Organizations should develop strict rules for data protection and highlight the ethical implications of how AI systems use personal information (Kesikinbora, 2019; Murphy, 2021).

Studies have shown that research on AI ethics has increased in the last 20 years, which shows that ethical issues are increasing in AI (Galiana et al., 2024; González et al., 2024).

This study expands the current study by examining national contributions to AI ethics, which has become a focal point for researchers, policy makers and practitioners. It is very important to address the ethical impacts of AI technologies and to align their development with social and cultural values. This study analyzes the citations of authors, the concurrency of a keyword, the bibliographic matching of documents, the bibliographic matching of sources and the bibliographic matching of countries by providing a bibliometric analysis. Thus, it aims to contribute to studies on AI ethics. The ethics revealed by AI technologies require a comprehensive understanding of current studies and current trends. This study aims to make a meaningful contribution by examining innovations, thematic changes and leading authors in artificial intelligence ethics.

2. Method

This study aims to perform bibliometric mapping analysis on articles published on Artificial Intelligence Ethics. Web of Science database was chosen as a literature source to perform bibliometric mapping analysis. The research was conducted with the keywords "Artificial Intelligence Ethics". Keywords were entered in the subject section using the advanced search function and no specific time period was used. The bibliometric mapping analysis covers articles published in all years. A total of 197 published articles on Artificial Intelligence Ethics were accessed (Access date: July 2024). Then, the full records and cited references were stored in a tab-delimited (Win) file format. downloaded and the file was loaded into the VOSViewer program.

For bibliometric analysis, the VOSViewer program was used to reveal the network visualization of authors' citation analysis, the co-occurrence of keywords, and the bibliometric matching of documents, sources, and countries. The data analysis procedure was carried out by two researchers.

This study aims to identify studies that include the use of "Artificial Intelligence Ethics", to determine trends in studies to be conducted in this direction, to guide researchers, the most cited researchers in this field, the studies that use the most keywords, the countries that publish the most, keywords that will shed light on researchers' studies and help them publish in this field, and bibliographic coupling of documents have been included.

3. Findings

3.1 Citation of authors

When analyzing in VosViewer, "the minimum number of documents of an author" was determined as 2. "The minimum number of citations of an author" was determined as 0, and 5 of 149 authors meet the thresholds. Figure 1 and Table 1 show the most cited authors.

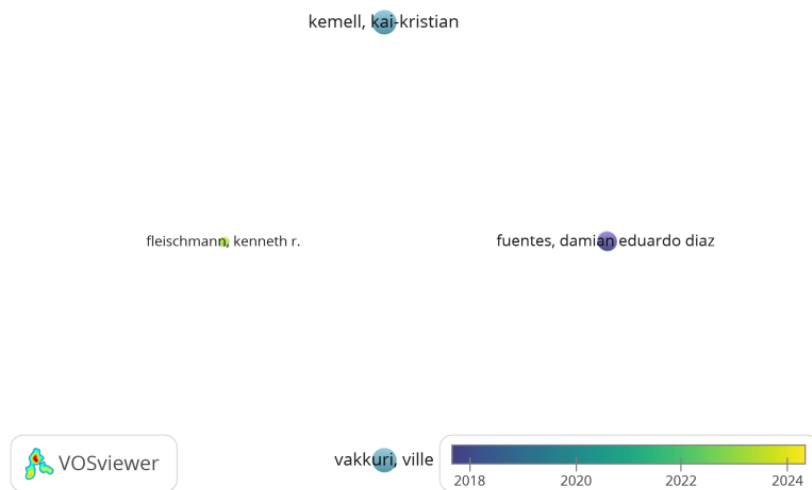


Figure 1. "Graph generated with VosViewer for citation of authors"

Table 1. Table of citations of authors

Author	Documents	Citations	Total link strength
fleischmann, kenneth r.	2	4	0
fuentes, damian eduardo diaz	2	1	2
kemell, kai-kristian	2	35	0
toro, federico grasso	2	1	2
vakkuri, ville	2	35	0

3.2 Co-occurrence-all keywords

While performing the analysis in VosViewer, the "minimum number of occurrences of a keyword" was determined as 5. Among the 193 keywords, 5 meet the thresholds.

In Figure 2 and Table 2, it shows Co-occurrence-all keywords.

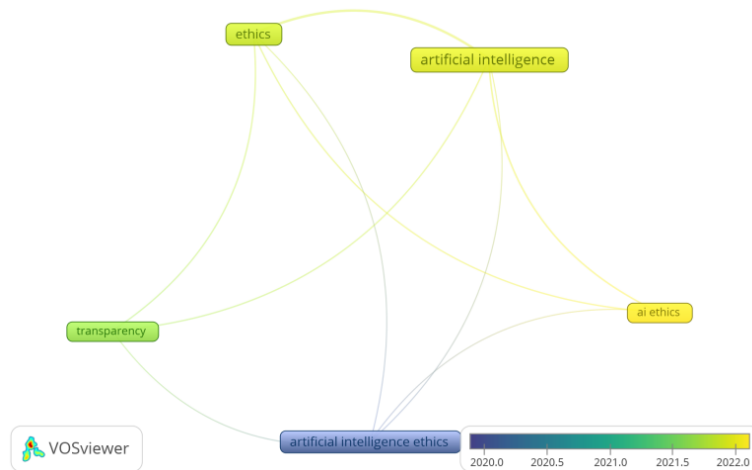


Figure 2. Graph generated with VosViewer for "co-occurrence-all keywords"

Table 2. Table for "co-occurrence-all keywords"

Keyword	Occurrences	Total link strength
AI Ethics	5	6
Artificial Intelligence	21	17
Artificial Intelligence Ethics	12	4
Ethics	14	16
Transparency	5	5

3.3 Bibliographic coupling of documents

During the analysis, the minimum number of citations of a document was determined as 10, and only 12 out of 50 documents meet the threshold. In Figure 3 and Table 3 shows that "bibliographic coupling of documents".

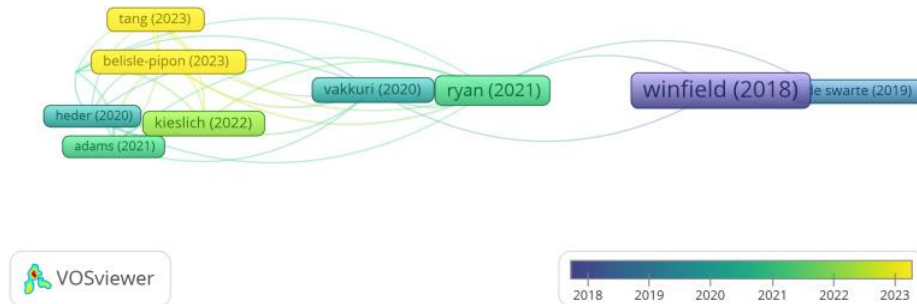


Figure 3. Graph generated with VosViewer for bibliographic coupling of documents

Table 3. Table for bibliographic coupling of documents

Document	Citations	Total link strength
hooker (2018)	19	3
belisle-pipon (2023)	16	16
vakkuri (2020)	34	10
tang (2023)	20	9
de swarte (2019)	21	1
ryan (2021)	70	11
adams (2021)	12	11
heder (2020)	11	11
kieslich (2022)	31	13
birhane (2023)	43	0
shih (2021)	11	12
winfield (2018)	169	3

3.4 Bibliographic coupling of sources

When analyzing with VosViewer, the "minimum number of documents of a source" was set to 2. The "minimum number of citations of a source" was set to 0. 4 out of 46 sources meet the thresholds. Figure 4 and Table 4 are presented as the most important sources.

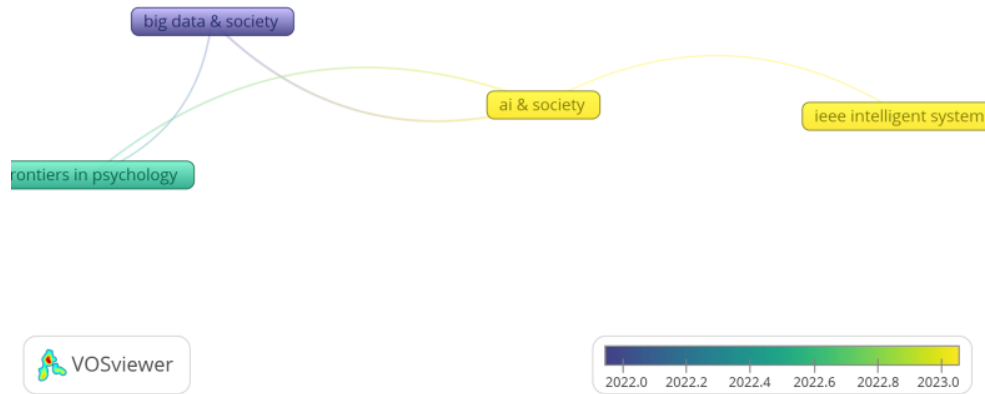


Figure 4. Graph generated with VosViewer for bibliographic coupling of sources

Table 4. Table for bibliographic coupling of sources

Source	Documents	Citations	Total link strength
AI & Society	2	20	16
Big Data & Society	2	36	13
Frontiers in Psychology	2	8	9
IEEE Intelligent Systems	2	4	2

3.5 Bibliographic coupling of countries

While performing the analysis, the "minimum number of published documents in a country" was selected as 5, while the "minimum number of citations of a country" was selected as 0. 5 out of 25 countries meet the thresholds. Figure 5 and Table 5 show the countries with the most citations.

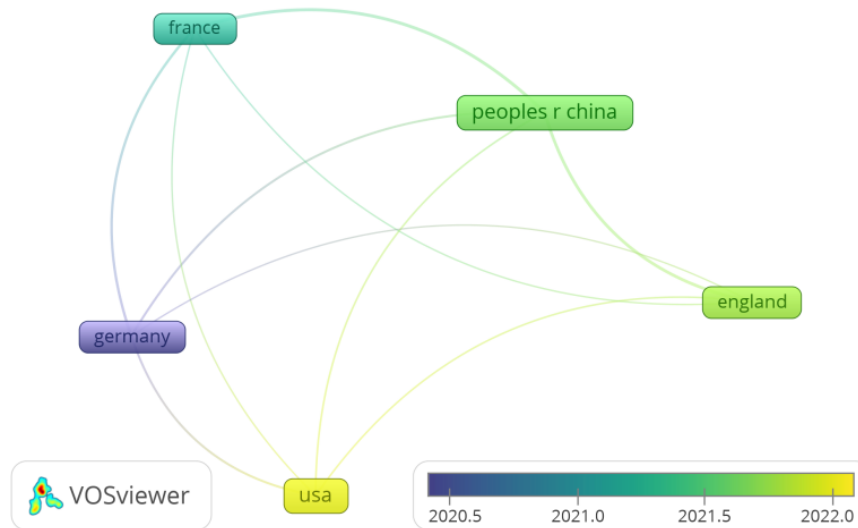


Figure 5. Graph generated with VosViewer for bibliographic coupling of countries

Table 5. Table for bibliographic coupling of countries

Country	Documents	Citations	Total link strength
England	7	294	174
France	5	27	246
Germany	7	44	183
China	10	21	338
USA	10	65	109

4. Discussion

In this study, bibliometric analysis of the studies indexed in Web of Science using the keyword “Artificial Intelligence Ethics” is presented as graphics and tables with VosViewer. When the findings are examined, it is seen that the authors of the most cited studies with the keyword “Artificial Intelligence Ethics” are Kemell, Kai-kristian (2 Documents, 35 Citations) and Vakkuri, ville (2 Documents, 35 Citations).

When "Co-occurrence-all keywords" are examined, the most frequently used keyword in the studies is transparency. This shows that studies on AI transparency are drawing attention.

According to the keyword "Artificial Intelligence Ethics", the most cited study is seen as "Ethical governance is essential to building trust in robotics and

artificial intelligence systems" by Winfield and Jirotko in 2018. The ethical governance of robots and artificial intelligence (AI) systems is examined in this study. The outlines of ethical governance in robotics and artificial intelligence (AI) systems in this context are defined as following: ethics, standards, regulations, responsible research and innovation, and public participation. Due to the scope of the study, it is thought to be guiding for researchers and, therefore, cited by other studies. In addition, it is seen that the journals with the most publications are "AI & Society, Big Data & Society, Frontiers in Psychology and IEEE Intelligent Systems".

The countries with the most publications in the relevant field are the USA, China, Germany, England, and France. Since these countries are among the leaders in technological developments, the finding that there is a high number of technology-related studies is not surprising.

5. Conclusions

The analysis revealed that the studies of "University of Helsinki Postdoctoral researcher Kai-Kristian Kemell" and "University of Vaasa Postdoctoral researcher Ville Vakkuri" made visible and effective contributions to the "Artificial Intelligence Ethics" literature; the countries most cited in the field of study were England and the United States.

In addition, "Big Data & Society and AI & Society journals are fundamental scientific resources for Artificial Intelligence Ethics. Finally, the data show that the word "Transparency" plays an important role in "Artificial Intelligence Ethics" studies. Mensah (2003) explains the role of transparency in AI as; one of the most crucial factors to be taken into account while applying AI ethically. Users of AI must be well-informed on how these systems make decisions. Therefore, a lack of knowledge on transparency may breed mistrust and hinder the adoption of AI technology by the general public.

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