

Historical Overview of Ethical Concerns in Artificial Intelligence.

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Abstract

Artificial Intelligence (AI) is one of the most transformative forces of the Fourth Industrial Revolution (FIR). Benefits of AI outweigh its potential risk associated with, however, a holistic approach to AI ethical values could be the pillar in the FIR. The purpose of this bibliometrics analysis of previous peer-reviewed articles is to explore the insights and trends in AI ethical concerns. From the Web of Science Core Collection database, a total of 1676 peer reviewed articles published from 1950 to 2019 were systematically identified, gathered, and analyzed using Clarivate Analytics® Citation Report and Analysis tools. The findings show that there is increased sense of urgency in AI ethics research from the beginning of year 2015 compared to previous 65 years (1950-2014) research. The study shows that USA and UK are the biggest contributors to AI ethic research of 45% publications authored between them, while South America, Africa, and Asia together published only a 15% of 1676 articles. The study reveals that medical, surgery, radiology, and philosophy research areas are performing par with computer & information technology in AI ethic research and their journals are emerging as the most cited journals in AI ethics research. The study urges the need to promote and accelerate AI ethics research in the low performing regions by collaboration between top performing countries and industries. The study provides greater insights for publishers, editors, researchers, and funding agencies for better decision making in AI ethics research.

Introduction

Russell and Norvig (2016) asserted the need and moral responsibility to redirect research towards AI ethical domain is the key to responsible technology development. Because authors cautioned that AI technology likely to bring more negative impact to FIR. They justify that many new technologies such as nuclear weapon have had unintended negative impact on humanity and a threat of global destruction; the modern combustion engine vehicles polluted air and contributed to the global warming. Therefore, it would be the moral responsibility of workers in the field to redirect their research towards AI ethics. Bostrom (2003) proposed that AI ethical consideration such as human-friendly motivation is crucial to advanced artificial intelligence (superintelligence) research and development because superintelligence could vastly outperform human intellectual superiority.

In a latest study in 2018 (Young-Joo & Ji-Young) conducted a text mining approach to collected text data from EBSCO database covering the ethical issues in AI (between 1994 and 2016). The study discovered the 'Strong signal' the AI ethical issues that have received significant attention recently and 'Weak signal' including the AI ethical issues considered to be the potential future problems. However, our study could be the first attempt to understand comprehensive scope of the global scholarly research on AI ethical issues in different spectrum.

The objective of this research is to analyze the ethical, moral, trustworthy, human-centric, and regulatory ('Ethics' domain) scope within AI, robot, machine, and superintelligence ('AI' domain). To do this, by collecting and analyzing research conducted in these two domains combined, the present study attempt to provides an overall understanding of AI ethics with the aim of covering a comprehensive spectrum of the peer reviewed publications and study concludes with recommendations.

Methodology

Web of Science Core Collection (WSCC) is the world's most trusted and leading citation database explore the complete network of citations underpinning the significant research in any field. WSCC platform consisting of several literature search databases providing resource for scientific and scholarly research. It is a systematic collection in over 250 science, social sciences, and humanities disciplines of over 20,000 high-quality peer-reviewed scholarly journals, over 180,000 conference proceedings, and over 80,000 books from around the world. The unique feature of WSCC is that all the journals included in the collection are indexed cover-to-cover. Comprehensive coverage with over 100 years explores the complete network of more than one billion citations references providing significant support for any field of research. Figure 1 summarizes the process of peer review articles selection and analysis. Searched queries formed

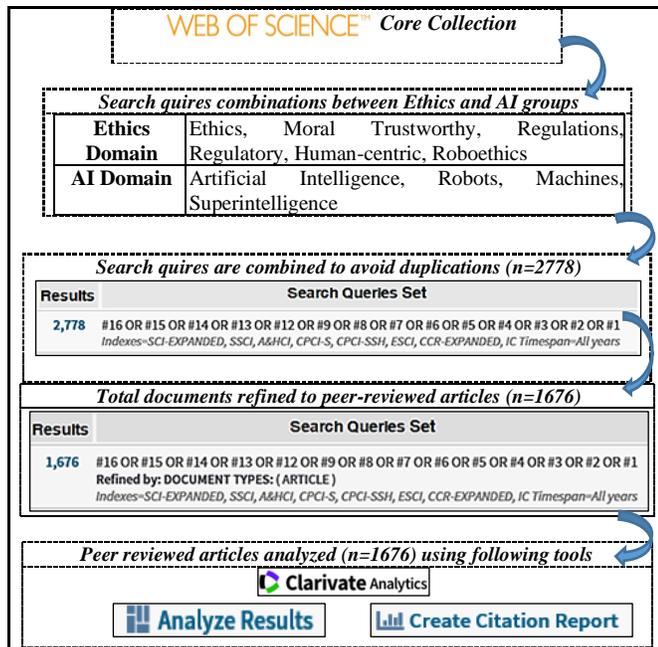


Fig. 1 Schematic of the Research Methodology

using field tags, Boolean operators, parentheses, and query sets to run the Web of WSCC 'Advanced Search'. TS (Topic Searches) finds title, abstract, author keywords, Keywords Plus®.1 TS=(Artificial AND intelligence* AND ethic*) finds records containing the terms Artificial and intelligence (or intelligences) and Ethic (or Ethics) in the Abstract, Title, and/or Keywords fields of a record. Advanced Search enables you to form and combine search sets to finds all records and remove any duplications and combine the results to obtain the total peer reviewed articles (n=1676) from.

Finding and Discussion

The Fig. 2. Shows the total number of publications between 1950-2019. For the purpose of simplifying the graph the only two studies (Manicas, 1966; Williams, 1950) found between 1950-1982 are not shown in the graph. During the last decade a 738% (2009-18) increase in publications compared to previous decade's (1999-08) 133%. Overall of 1717% increase during last two decades. The total number of articles published (754) during the last 65 years and the number of articles (922) published from 2015 onwards give clear indication of urgency of research in the area of AI ethics. (Lettvin, Maturana, McCulloch, & Pitts, 1959) work is widely considered as the first work on AI (Russell & Norvig,

2016), since this work on AI over the next four decade there were no significant importance given to the AI ethical consideration.

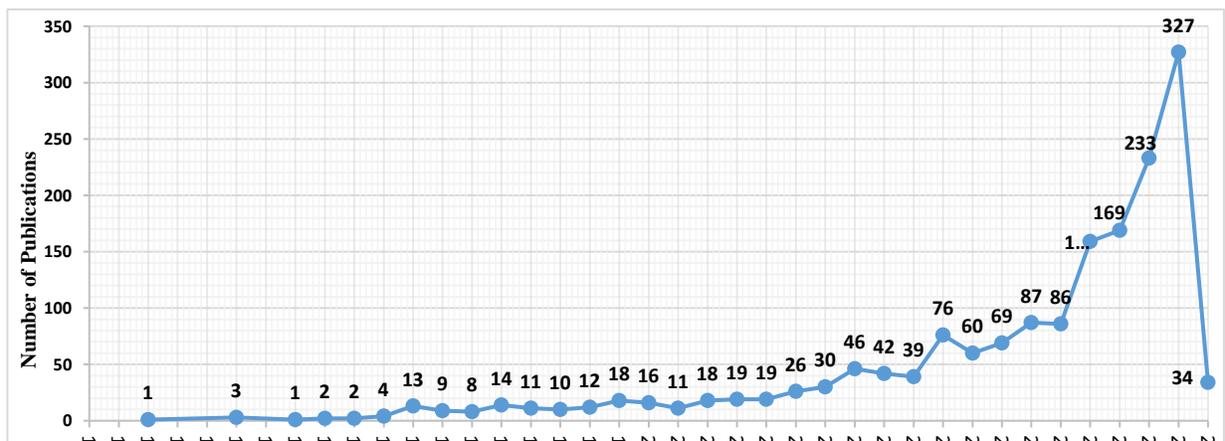


Fig. 2. Published papers between 1950-2019 related to AI Ethics.*Only two papers (Manicas, 1966; Williams, 1950) found between 1950-1982 are not shown in the Fig.2

¹ KeyWords Plus® are index terms automatically generated Web of Science from the titles of cited articles. KeyWords Plus terms must appear more than once in the bibliography and are ordered from multi-word phrases to single terms. KeyWords Plus augments traditional keyword or title retrieval.

However, in 1950 (Williams) call for attention that advancement of technology should merely not celebrated but how these technology including gadget and resources impact the community and the minds of people should seriously be taken into consideration. Similarly, Manicas (1966) too raising the concern of adapting robots to the moral community.

Among the twenty of the most popular journals for AI ethical publications, the interesting fact is that these top journals are not just directly related to computer and technology alone they are including journals with the background of medical, radiology, surgery, philosophy, and business are increasingly concentrating on AI ethics. Table -1 highlights a total of 615 (36%) of the total articles were published from North America and in Europe Britain (248) and Germany (104) remain the highest publishing countries. However, it is worthy to note here that MENA and Asian countries are publishing considerably lower compared North America and Europe.

WSSC are assigned to at least one Web of Science Category (WSC) and each WSC is mapped to one Research Areas. Therefore, Research Areas and WSC are interrelated. Research Areas provides more broader perspective while WSC is narrow and specific. Computer Science as the top Research Area on contrast the most popular WSC indicates as Ethics. Similarly, Engineering is the third most popular Research Area however Computer Science Artificial Intelligence is the third most popular WSC.

Table-I Total number of publications in AI ethics by countries (1950-2019)

#	Country	Peer-reviewed articles records	% of total peer-reviewed articles (n-1676)
1	USA	502	30.0%
2	UK	248	14.8%
3	Canada	113	6.7%
4	Germany	104	6.2%
5	Netherland	83	5.0%
6	Italy	81	4.8%
7	Australia	76	4.5%
8	France	63	3.8%
9	Spain	60	3.6%
10	China	51	3.0%
11	Switzerland	38	2.3%
12	Japan	33	2.0%
13	India	32	1.9%
14	Sweden	32	1.9%
15	Belgium	26	1.6%
16	Brazil	26	1.6%
17	Russia	24	1.4%
18	Scotland	23	1.4%
19	Taiwan	20	1.2%
20	Turkey	20	1.2%
	Other countries	21	1.3%
	Total	1676	100%

An interesting finding is that surgery is one of the top categories in citing AI ethics articles other fields including orthopedics, geography, radiology, philosophy, and neuroscience are some the other areas curious about the ethical issues in AI. More interestingly finding shows that AI ethics are increasingly cited by non-computer and non-AI related journals.

Finding shows that the top 100 (6%) of 1676 publications dominating 50% (8000+ citations) of the overall citations (16,000+ citations) this provides the clue that the top 100 publications have major impact on AI ethics research. Among top 100 articles USA and England authored 62 articles and citation of these articles too increased at a rate of 469% over the period of 2009-18.

Conclusion

The study shows that AI ethics is a increasing concern for areas including medical, radiology, surgery, philosophy, and business. The study assists publishers and editors to identify the position of the journal's influence in the wider research world and to plan their publishing strategy accordingly. Study also helps researchers to present their contribution by identifying the best-fit journals in which to publish and enable funding agencies to track bibliometric and citation patterns to support funding strategy decisions. The Table-I clearly highlights that over 82% of global articles are published in North America and Europe. Rest of the world with 20% where China (51) is leading. In general Africa, South America, and Asia contribution towards global publications are far low compared to North America and

Europe. Excluding the Europe the contribution to publication of articles of USA is alone greater than rest of the world put together. Finding gives the clue that Asia, Africa,

and South America's contribution to the AI ethic research requires a significant improvement. The region; Middle East and countries such as China and India are investing and funding towards super computer and quantum computers development however these regions required to pose same interest in AI ethics research and publications. This study also recommends that researchers, publishers, and funding agencies should prioritize their works to be more associated with WSSC than Research Areas which helps AI ethics research publications to be more precise and focused in the research spectrum.

Limitation and further research

Results are preliminary and more comparison with similar studies in the literature required with meta-analysis review. In the next investigation, it will be useful to extend the study to answer more questions in related areas and deeper semantic analysis to understand what in detail was proposed and presented in the previous work, and broaden the analysis into relevant areas, economy, law, psychology, society, privacy, security, government, and other major areas.

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