Qualitative and Quantitative Methods in Libraries (QQML) 13,2: 217-241,2024

Global Trends and Knowledge Mapping in Applied Ethics Research During 2013 to 2022: A Bibliometric Analysis

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Abstract This research delves into applied ethics, an ever-evolving discipline that grapples with ethical challenges across diverse human spheres. To gain insights and track emerging patterns, this study employs bibliometric analysis on scholarly applied ethics publications. The analysis uncovers 7207 documents authored by 18461 individuals, amassing 76597 citations. Notably, 234 collaborative works between the United States and Australia underscore global knowledge exchange. English dominates, yielding 7015 publications and 76349 citations. Noteworthy journals include the Journal of Agricultural and Environmental Ethics with 499 publications and a Journal Impact Factor (JIF) of 2.37, while the Marine Ecology Progress series attains a peak JIF of 12.59. Articles lead in publication type (6253 instances, 69133 citations), with Hagendorff's "The Ethics of AI Ethics: An Evaluation of Guidelines" emerging as a frontrunner with 310 citations from the journal Minds and Machines (2020). "Ethics" emerges as a primary keyword, accompanied by a growing mention of "artificial intelligence," signaling the prominence of environmental ethics and the budding field of AI ethics. Recurring terms like conservation, behavior, climate change, ethics, and management underscore their significance. Collaborative endeavors between Australia and the USA yield 234 publications, demonstrating cross-continental scholarly synergy. These findings guide researchers, policymakers, and practitioners in recognizing crucial domains, fostering interdisciplinary collaboration, and addressing pressing ethical concerns across diverse realms.

Keywords: Applied ethics, Bibliometrics, Web of Science, Trend analysis, Citation analysis, Code of conduct

Received: 23.8.2023 Accepted: 1.5.2024 ISSN 2241-1925

1. Introduction

Applied ethics, often referred to as practical ethics, involves the application of ethical principles or moral codes of behavior to address real-world moral dilemmas encountered by individuals or professionals within various domains. It serves as a bridge between ethical theories and their practical implementation in professional contexts (Beyleveld & Brownsword, 2001). As societal preferences have shifted from a focus on essential principles to individualistic choices over time, the role of choice has gained prominence in decision-making processes. In this regard, three key elements—intention, motive, and purpose—have emerged as crucial considerations in ethical decision-making.

Professionals across diverse fields with distinct responsibilities are tasked with aligning their intentions, motives, and purposes with ethical guidelines to make ethically sound decisions (Davis & Stark, 2001). The realm of applied ethics encompasses various branches, including biomedical ethics, animal ethics, environmental ethics, business ethics, artificial intelligence ethics, media ethics, professional ethics, management ethics, corporate ethics and ethics in technology (Holmes, 2019). As contemporary society continues to be shaped by technological advancements and emerging disciplines, a novel branch of applied ethics has emerged to guide professionals in these fields, aiding them in ethical decision-making and dilemma resolution (Machina, 2018).

Bibliometrics stands as an emerging and integral facet of research, drawing its roots from various domains of human knowledge. Over the past few decades, Bibliometrics has evolved into an indispensable tool for shaping science policies and managing research endeavors. It plays a pivotal role in the compilation of science indicators, relying heavily on publication and citation statistics, as well as employing more advanced Bibliometric techniques. By employing mathematical and statistical calculations, Bibliometrics offers a quantitative evaluation of publication patterns, encompassing both macro and micro communication, along with detailed authorship analysis (Roy & Basak, 2013).

In essence, Bibliometrics serves as a quantitative instrument for appraising the influence of scholarly communication, enabling the measurement of article and journal impact factors and the tracking of authors' contributions to the academic landscape (Ball, 2017). Through Bibliometric analysis, one can discern the evolving dynamics of specific subject fields and their research trends. The field of Bibliometrics itself is in a constant state of evolution, founded on fundamental laws and theories such as Zip’s law, Lotka’s law, Bradford’s law, Price’s law, and concepts like the Matthew effect, the cumulative advantage of research, and the social network theory of co-authorship. These principles collectively form the backbone of this ever-evolving discipline.

In the realm of applied ethics research, a wide spectrum of focuses exists, necessitating ongoing inquiry to delineate the relevance and scope of specific subjects. Given the prolific and interdisciplinary nature of research in domains like bioethics, environmental ethics, business ethics, and technology ethics, it is reasonable to anticipate shifts in outputs, methodologies, and thematic categorizations (Tanesini, 2020).

Given the myriad variables that could influence studies in applied ethics, it is imperative for scholars and educators in philosophy and applied ethics to remain attuned to emerging trends, frontiers, and focal areas (Sadler, 2017). A methodical content analysis of established publications can offer insights into the current state and significance of research within the field and related domains (Gonzalez-Martinez & Herrero-Solana, 2021). The present study employs both content analysis and bibliometric methods to examine the evolution of trends in applied ethics research from 2013 to 2022.

2. Literature Review

The landscape of applied ethics research has undergone a notable transformation since its emergence as a separate branch of philosophy in the mid-20th century. In earlier epochs, topics falling under the umbrella of applied ethics were integrated within the broader scope of philosophy itself, lacking a distinct category dedicated to their exploration. This shift in focus and classification mirrors the intellectual trajectory traced by esteemed philosophers across different epochs, from the venerable figures of Socrates, Plato, and Aristotle to the proponents of utilitarian ethics, such as Bentham and Mill. Their philosophical insights laid the groundwork for the evolution of applied ethics (Smith, 2008). Immanuel Kant's deontological framework, with its fundamental concepts of duty, goodwill, and categorical imperatives, has furnished guiding principles that inform decision-making within various professional contexts. However, a discernible and significant gap has persistently existed between the theoretical formulations proposed by these moral philosophers and their practical applications.

In the comprehensive definition posited by Petersen and Ryberg (2010), applied ethics manifests as a branch dedicated to the scrutiny of moral predicaments, practices, and policies within personal lives, professions, technology, and governance. Similarly, Tom Beauchamp (2019) characterizes applied ethics as the utilization of philosophical methodologies to address moral quandaries, practices, and policies spanning professions, technology, government, and related domains. An exemplification of this expansion is found in "A Companion to Applied Ethics" by R. G. Frey and Christopher Heath Wellman (2005), where the maturation of applied ethics is expounded upon vis-à-vis other branches of philosophy, engaging with diverse moral quandaries in domains ranging from medicine and the environment to business. In the domain of consumer ethics, Kaur, Virmani, and Shah (2023) undertook a bibliometric analysis spanning 1983 to 2022. Their analysis, utilizing Vosviewer software, unveiled the zenith of consumer ethics publications in 2021. Likewise, in the arena of bioethics, Kuklu and Sercan (2022) explored the field's synchronicity with advancements, surveying 10085 studies conducted from 1975 to 2019. Employing bibliometric methods bolstered by the Web of Science core collection database, the authors discerned trends across various parameters like geographic regions, journals, and publication years, exemplifying the salience of bibliometric analysis as a preeminent quantitative research tool. Further exemplifying this approach, Van der Sluis, de Greef, and Bonekamp (2022)

probed the extent to which published works on animal breeding studies address ethical and societal considerations. Their investigation, spanning the years since 1990, unveiled an escalating trajectory of publications, peaking in 2010. Shifting focus to the domain of healthcare and artificial intelligence (AI), Saheb and Carpenter (2021) scrutinized the burgeoning role of AI in healthcare delivery. Their study not only identified influential contributors, nations, works, sources, and institutions in this domain but also outlined twelve pivotal medical issues entwined with AI's application in healthcare. Significantly, the study underscored the necessity for more rigorous ethical frameworks and guidelines governing AI's integration in healthcare. In a related vein, Chien-Wei Chuang, Ariana Chang, Mingchih Chen, Maria John P. Selvamani, and Ben-Chang Shi (2022) engaged in an in-depth analysis of AI and ethics, delving into the facets of AI that have garnered heightened attention. Their exploration, anchored in the Microsoft Academic Graph Collection Data Set, unearthed crucial perspectives and concerns within the expansive realm of AI. Collectively, these scholarly endeavors shed light on the dynamic evolution and multifaceted dimensions of applied ethics, elucidating its progression from foundational philosophical tenets to the intricate dilemmas posed by contemporary domains such as healthcare and artificial intelligence.

3. Research Objectives

This paper seeks to accomplish the following objectives as outlined below:

1. Explore the research trends and assess the impact of citations within the field of Applied Ethics on a global scale between the years 2013 and 2022.
2. Analyze the annual growth rate and track the trends in citations for research related to Applied Ethics spanning the years 2013 to 2022.
3. Determine the most prolific authors who have contributed to publications in the field of applied ethics from 2013 to 2022.
4. Identify the country that has displayed the highest level of collaboration in producing research within the domain of applied ethics on a global scale.
5. Uncover the most relevant sources that have been frequently referenced and consulted within publications focused on applied ethics.
6. Detect patterns in authorship, collaboration, and co-authorship within publications related to Applied Ethics during the timeframe of 2013 to 2022.
7. Investigate and highlight the emerging and popular subjects and themes within the realm of applied ethics as evidenced by recent publications.
8. Identify and showcase the research papers that have received the highest number of citations within the field of Applied Ethics.
9. Determine the leading subfields or branches that constitute the major areas of focus within the broader scope of applied ethics.

4. Research Methodology

Methods: The research process commenced with an initial and comprehensive search aimed at identifying pertinent research publications within the domain of applied ethics. To effectively narrow down the search, specific keywords were utilized, with a focus on TS= ("applied ethics.") Furthermore, a defined time frame spanning from 2013 to 2022 was established to ensure the relevance of the retrieved materials. The search criteria encompassed variations such as TS = ("AI ethics,") OR ("Animal ethics,") OR (“biomedical ethics”) OR ("corporate ethics,") OR ("environmental ethics,") OR ("legal ethics,") OR (ethics in technology) OR (“management ethics”) OR (“business ethics) OR (“media ethics”) ("professional ethics"). This meticulous approach was undertaken to encompass a diverse array of ethical sub domains.

Database Consulted: The invaluable data for this research endeavor was extracted from the renowned Web of Science database, all editions (SCI-EXPANDED, SSCI, AHCI, CPCI-S, CPCI-SSH,BKCI-S, BKCI-SSH,ESCI) which is an integral component of Clarivate Analytics PLC. This database is an extensive collection of bibliographic citations, encompassing a wide spectrum of document types such as articles, research papers, proceeding papers, books, book chapters across subject domains. The utilization of such a comprehensive resource facilitated a holistic exploration of the chosen research area.

Date of Data Extraction: The process of data extraction was meticulously carried out at Rabindra Bharati University, dated 30.05.2023 ensuring the accuracy and integrity of the collected information. This institutional context provided a conducive environment for the careful retrieval of relevant data.

Software: A suite of advanced software tools was harnessed to facilitate various stages of the research process. Notably, MS Excel was employed for its versatility in managing and organizing the extracted data. Additionally, specialized software such as Java-based VoSViewer, Biblioshiny, and ScientoPY played pivotal roles in visualizing and analyzing the retrieved information. These tools collectively enabled a comprehensive and insightful exploration of the research landscape.

Scope: Bibliometric analysis serves as a robust tool for charting the intellectual terrain within a specific domain. In light of the emergence of new branches of applied ethics with global significance, it becomes crucial to uncover and delineate the developmental trajectory of this field, offering valuable guidance to researchers and individuals with a vested interest. A comprehensive bibliometric analysis of applied ethics can unveil key insights, including research trends, the impact of research papers, notable authors, influential journals, and the most frequently referenced sources within the domain. These insights not only inform decision-making processes but also have a direct impact on research funding allocation.

Data Analysis: Following the application of visualization software to the data gleaned from the Web of Science database, the compilation phase ensued. This entailed the meticulous organization and arrangement of the acquired data into coherent tables and figures. Subsequently, the interpretation of these visual aids commenced, allowing for a profound understanding of the trends, patterns, and

insights encapsulated within the research publications. The interpretation process, characterized by its analytical rigor, played a pivotal role in deriving meaningful conclusions from the amassed data, thereby contributing to a nuanced comprehension of the field of applied ethics.

5. Result and Analysis

Description	Results
Time span	2013:2022
Sources (Journals, Books)	1809
Documents	7207
Total Citation	76597
Annual Growth Rate %	-26.07
Document Average Age	5.33
Average Citations Per Doc.	10.63
References	269333
Document Content	
Keywords Plus (ID)	13601
Author's Keywords (DE)	17375
Authors	18461
Authors of Single-authored documents	1633
Authors Collaboration	
Single-authored Docs.	2019
Co-Authors per Docs.	3.83
International Co-Authorship %	22.2

Table (1): Main information about applied ethics data

The table (1) summarizes the key data extracted from the Web of Science concerning applied ethics research during the period of 2013 to 2022. It presents valuable insights into the extent and nature of research activities in this domain. A total of 1,809 sources, including journals and books, were referenced or used as part of the research. The study involved the analysis of 7,207 documents, which could be research papers, articles, or other forms of written content. A substantial number of 76,597 citations were made throughout the documents, indicating the extensive use of previous research and literature to support the study. The annual growth rate is calculated at -26.07%. This could mean that the number of documents or citations decreased on average each year during the study period. The average age of the documents analyzed is 5.33 years. This indicates that the documents used in the study are relatively recent. Each document, on average, has received 10.63 citations. This indicates the level of impact and recognition of the research presented in the documents. A total of 269,333 references were cited or used in the analyzed documents, highlighting

the depth of research and the extent to which other works were consulted. The dataset includes 13,601 additional keywords used to further categorize or describe the content of the documents. There are 17,375 specific keywords provided by the authors to describe the content of the documents. The study involves the work of 18,461 authors collectively. Among the documents, 1,633 were single-authored, indicating the work of individual authors. A total of 2,019 documents were authored by a single individual. On average, each document has 3.83 co-authors, suggesting a significant level of collaboration among researchers. 22.2% of the co-authorship involves international collaboration, indicating that authors from different countries worked together on the documents. Overall, these results provide insights into the research landscape during the specified time frame, including the sources used, the extent of collaboration among authors, and the impact of the research based on citations and references. The negative annual growth rate suggests a potential decline in the number of documents or citations over the years, but other factors such as the quality of research and changes in publication trends could also contribute to this trend.

5.1. Types of Applied Ethics publication

Rank	Document types	TP	TC	TC/TP	Citation sum within h-core	h-index
1	Article	6253	69133	11.06	11294	80
2	Editorial Material	294	1516	5.16	1137	14
3	Book Review	270	9	0.03	1	1
4	Review	265	5121	19.32	3257	38
5	Proceedings Paper	53	689	13.00	476	15
6	Meeting Abstract	21	0	0.00	0	0
7	News Item	15	0	0.00	0	0
8	Correction	14	3	0.21	2	1
9	Letter	12	56	4.67	50	2
10	Book Chapter	3	6	2.00	4	1
11	Biographical-Item	3	0	0.00	0	0
12	Data Paper	2	8	4.00	8	1
13	Retracted Publication	1	5	5.00	5	1
14	Publication with Expression of Concern	1	51	51.00	51	1

Table (2): Types of research publication in Applied Ethics between 2013 and 2022

This data table (2) appears to be related to the types of documents published in a specific journal or academic publication. Articles are the most common document type with a significant number of publications (6253) and citations (69133), resulting in high average citations per publication (11.06) and contributing significantly to the h-core citations and h-index of the journal. Review articles also have a substantial impact with a high average citations per publication (19.32), indicating their importance in the journal's citation network. Editorial Material and Proceedings Papers have moderate numbers of publications and citations, contributing to the overall scholarly content of the journal. Letters, Book Chapters, and Data Papers have fewer publications and citations but still contribute to the diversity of content within the journal. Biographical Items, Meeting Abstracts, News Items, Retracted Publications, and Publications with Expression of Concern have minimal publications and citations, likely representing specialized or less common content types. Overall, this data provides insight into the publication landscape of the journal, highlighting the diversity of document types and their respective impacts within the scholarly community.

5.2. Yearly growth and Citation trends in Applied Ethics research between 2013 and 2022

Year	TP	TC	TC/TP	Citation sum within h-core	h-index
2013	700	10100	14.43	3111	46
2014	654	10340	15.81	3409	46
2015	713	11490	16.12	4312	45
2016	674	9453	14.03	3679	41
2017	683	7365	10.78	2332	34
2018	684	7897	11.55	3058	36
2019	749	7919	10.57	3306	37
2020	773	6231	8.06	2554	33
2021	829	4549	5.49	1456	28
2022	748	1253	1.68	232	12

Table (3): Yearly growth and Citation trends in Applied Ethics research between 2013 and 2022

The data presented in Table (3) provides an insightful view of the consistent growth trajectory within the domain of research papers centered on applied ethics, spanning the period from 2013 to 2022. An in-depth analysis of the data reveals intriguing trends that shed light on the evolution of this field. Notably, the pinnacle of publication activity occurs in 2021, characterized by a remarkable publication count of 829 papers, complemented by a substantial

citation tally of 4549 and an impressive h-index of 28. Equally striking is the exceptional performance of 2015, which boasts an extraordinary citation count of 11490. This notable accomplishment translates to a TC/TP ratio of 16.12, supported by a total publication count of 713. Further examination of the data unveils that both 2013 and 2014 share the distinction of achieving the highest h-index, each with respective publication counts of 700 and 654. An intriguing anomaly is observed in the year 2016, characterized by a contrasting pattern of the lowest publication count, compensated by a noteworthy citation count of 9453.

Interestingly, the year 2022 emerges as an outlier in the dataset, exhibiting the lowest citation count among all the years under scrutiny. This particular year stands apart due to its less favorable TC/TP ratio of 1.68 and a modest h-index of 12, indicating a comparatively restrained impact within the realm of applied ethics research

5.3. Most relevant source in the realm of Applied Ethics

Rank	Sources	TP	TC	TC/TP	JIF	h_index	Publisher	Country
1	Journal of Agricultural & Environmental Ethics	499	5116	10.25	2.37	35	Springer	Netherlands
2	Environmental Ethics	347	479	1.38	0.47	9	Environmental Philosophy Inc	USA
3	Journal of Media Ethics	235	638	2.71	1.15	14	Routledge Journals, Taylor & Francis Ltd	USA
4	Neural Regeneration Research	121	826	6.83	6.05	14	Wolters Kluwer Medknow Publications	China
5	Wildlife Research	116	1208	10.41	2.17	18	CSIRO Publishing	Australia
6	Journal of Medical Ethics	110	759	6.90	5.93	15	BMJ Publishing Group	UK
7	Marine Ecology Progress Series	92	1158	12.59	2.91	18	Inter-Research	Germany
8	Australian Mammalogy	81	464	5.73	1.17	11	CSIR Publishing	Australia
9	Australian	74	473	6.39	1.07	11	CSIR	Australia

	Journal of Zoology						Publishing	
10	Journal of Mass Media Ethics	74	415	5.61	0.59	10	Routledge Journals, Taylor & Francis Ltd	USA

Table (4): Top 10 most relevant source in Applied Ethics between 2013-2022

TP = total publication; TC = total citations; TC/TP = average citation per publication; JIF=journal impact factor.

The landscape of applied ethics between the years 2013 and 2022 is illuminated by a comprehensive table (Table 4) highlighting the most impactful and relevant sources in this dynamic field. With an impressive total publication count of 499, this table stands as a testament to the extensive scholarly discourse that has unfolded over this period. Leading the pack is the Journal of Agricultural and Environmental Ethics, emerging as the forerunner with a remarkable Journal Impact Factor (JIF) of 2.37, further substantiated by an astonishing 499 publications and a substantial 5116 citations. This journal's significant contributions underscore its pivotal role in shaping the discourse of applied ethics. While the Marine Ecology Progress series boasts the highest JIF at an impressive 12.59, securing its prominence in the field, it is the Journal of Agricultural and Environmental Ethics that takes center stage in terms of total citations and publications. This juxtaposition between JIF and citations signifies the nuanced interplay between influence and reach within scholarly circles. Occupying the second slot in this curated list of pertinent sources is Environmental Ethics. Although it bears the lowest JIF at 0.47, its substantial 347 publications and 479 citation mentions showcase its undeniable impact. This serves as a reminder that quantitative metrics alone cannot fully encapsulate the profound influence that a source might wield within the field.

The third place is secured by the Journal of Media Ethics, flaunting an h-index of 14 and a JIF of 1.15. This journal, accompanied by a total of 235 publications and a noteworthy 638 citations, substantiates its vital role in fostering ethical discussions within the realm of media. Navigating further down the table, the fourth position is claimed by Neural Regeneration Research, its h-index of 14 and 121 total publications accompanied by a commendable 6.83 TC/TP ratio. This speaks to the intricate relationship between research output and its subsequent impact on the scientific community. Wildlife research assumes the fifth position, commanding a JIF of 2.17 and boasting the highest Total Citation per publication (TC/IP) ratio at an impressive 10.41. This is closely trailed by the Journal of Agricultural and Environmental Ethics, with a commendable TC/IP ratio of 10.25. In contrast, Environmental Ethics holds the lowest TC/IP ratio at 1.38, serving as a reminder of the multifaceted nature of scholarly impact.

Intriguingly, an analysis of the geographical origin of these influential sources reveals patterns of scholarly contribution. Australia and the United Kingdom emerge as notable contributors, each accounting for 30 percent of the

publications in the three journals hailing from their respective nations. Meanwhile, China, the UK, Germany, and the Netherlands each present a distinct journal, emblematic of the globalized nature of applied ethics discourse. In essence, this curated table serves as a compelling snapshot of the intricate web of influence, impact, and geographical collaboration that characterizes the field of applied ethics during the span of 2013 to 2022.

5.4. Prolific authors in the study of Applied Ethics

Rank	Author	Affiliations	Country	TP	TC	TC/TP	h_index
1	Shine r	University of Sydney	Australia	45	575	12.78	14
2	Wang y	Nantong University	China	38	359	9.45	10
3	Heupel mr	James Cook University	Australia	35	682	19.49	16
4	Plaisance pl	Colorado State University	USA	34	32	0.94	2
5	Simpfendorfer ca	James Cook University	Australia	32	606	18.94	14
6	Lavers jl	University of Tasmania	Australia	28	535	19.11	11
7	Chilvers bl	University of Otago	New Zealand	28	283	10.11	9
8	Fleming pa	Murdoch University	Australia	28	185	6.61	8
9	Li j	Dezhou University	China	25	499	19.96	11
10	Zhang y	Tongji University	China	25	477	19.08	10

Table (5): Top 10 most productive authors in applied ethics publications between 2013 and 2022

Table (5) stands as a testament to the scholarly prowess of the field's leading contributors. This tableau provides an insightful overview of the top ten authors who have significantly shaped the landscape of applied ethics, encapsulating their prolificacy, influence, and institutional affiliations.

At the pinnacle of this academic hierarchy is Shine R., a luminary hailing from the distinguished University of Sydney, Australia. With an impressive oeuvre consisting of 45 meticulously crafted publications, Shine R. has cemented their position as a trailblazer in the domain of Applied Ethics. These works have garnered a notable 575 citations, underscoring the profound impact of their contributions. Noteworthy, too, is the remarkable average citation per publication, which stands at an impressive 12.78, a testament to the enduring relevance of Shine R.'s insights. Further substantiating their scholarly eminence,

Shine R. boasts an h-index of 14, an accolade denoting the depth and breadth of their influence.

Wang Y., a scholar hailing from the esteemed Nantong University in China, emerges as the second most prolific figure in this constellation of academic luminaries. Wang Y.'s intellectual tapestry comprises 38 scholarly works, each a thread interwoven into the rich fabric of Applied Ethics. These contributions have been met with recognition in the form of 359 citations, a testament to the resonance of Wang Y.'s ideas within the scholarly community. The average citation per publication, a noteworthy 9.45, further underscores the enduring significance of Wang Y.'s work. Anchoring their academic profile is an h-index of 10, a testament to the scholarly ripples generated by their endeavors.

Venturing down this academic trajectory, our gaze falls upon Heupel MR, an architect of knowledge from James Cook University in Australia. Heupel MR's intellectual edifice comprises 35 publications, each a cornerstone within the construct of Applied Ethics. These works have not only captured the attention of the academic echelons but have also amassed a remarkable 682 citations, a testament to their resonance within the scholarly discourse. The average citation per publication, an astonishing 19.49, is a testament to the scholarly magnetism inherent in Heupel MR's ideas. Emblematic of their influence is an h-index of 16, a testament to the lasting impact of their scholarly pursuits.

Meanwhile, Zhang Y., a scholar hailing from the venerable halls of Tongji University, China, occupies a unique niche within this pantheon of intellectual giants. With a corpus of 25 publications, Zhang Y. has contributed substantively to the fabric of Applied Ethics. These contributions have elicited 477 citations, reflective of the scholarly reverberations they have engendered. Notably, the average citation per publication stands at a commendable 19.08, speaking to the enduring relevance of Zhang Y.'s insights. Anchoring their academic profile is an h-index of 10, a testament to the scholarly waves they have incited.

An overarching trend is discernible within this constellation of scholarly luminaries, as noted in the final contextual thread. A global tapestry is being woven, with threads of influence spanning continents. China, the United States, New Zealand, and Australia emerge as the fertile grounds nurturing the germination of knowledge within the field of Applied Ethics. This international confluence underscores the far-reaching impact of Applied Ethics and the shared commitment of scholars to unravel its intricate fabric.

5.5 Mapping the co-occurrence of author keywords:

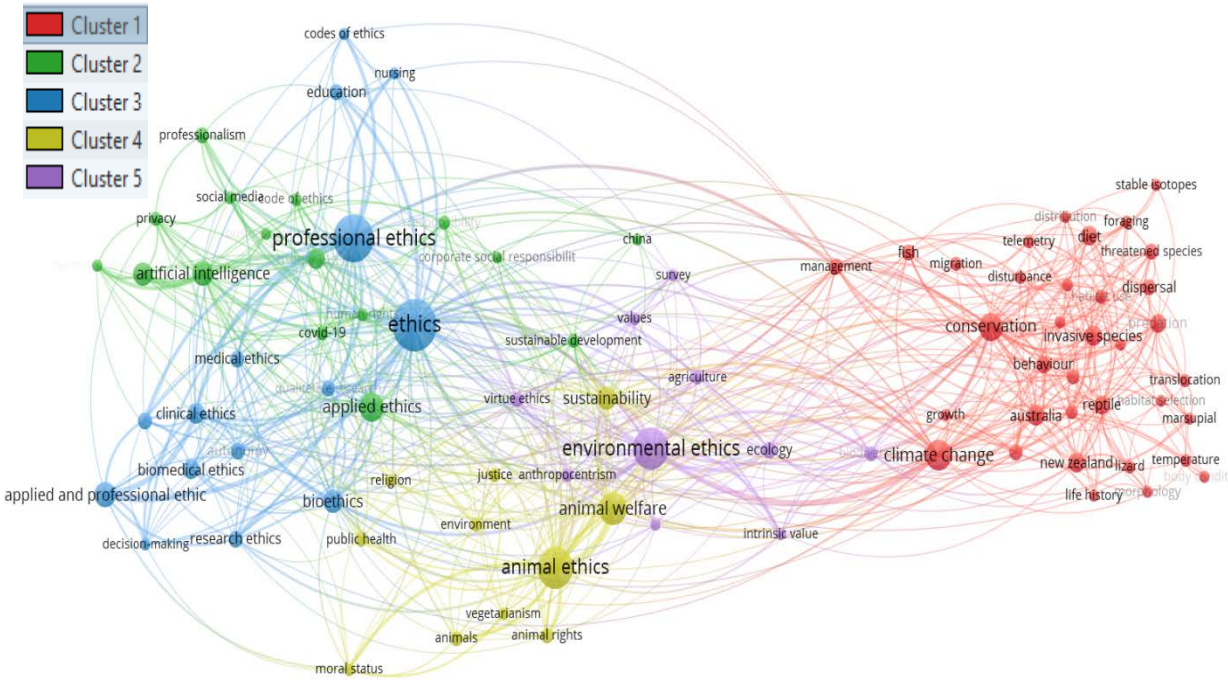


Figure (1): Visualizing co-occurrence of author keywords using VoSViewer Software

In the realm of research and analysis, a crucial aspect involves identifying patterns and relationships among various elements. This process often entails delving into "types of analysis" to uncover insights and utilizing "author keywords" as a fundamental "unit of analysis". To quantify these relationships, two counting methods are commonly employed: full counting or fractional counting. In this specific study, a rigorous approach has been taken, necessitating a minimum occurrence of 20 instances for a particular keyword to be considered for analysis. Among a substantial pool of 17,375 keywords, only 88 managed to meet this stringent threshold. These 88 keywords are at the heart of the investigation, as they represent the focal points for further analysis.

The crux of this endeavor lies in the calculation of co-occurrence links among these selected keywords. For each of the 88 chosen keywords, their interactions and connections with other keywords will be meticulously gauged. This assessment involves quantifying the total strength of co-occurrence links, essentially measuring the intensity of their relationships within the context of the study. As the analytical gears turn, the keywords will be ranked based on the total link strength they exhibit. This ranking process allows for the identification of the most significant keywords within the network of relationships. The paramount goal is to unravel the keywords that wield the greatest influence and

connection with their counterparts. Upon conducting the comprehensive analysis, a multitude of findings surfaced. A grand total of 87 full items were discovered, showcasing the depth of the study's exploration. Furthermore, the examination led to the identification of 5 distinct clusters, each representing a unique group of interconnected keywords.

The complexity of these relationships manifested in a staggering 695 links that were established among the keywords. These links paint a vivid picture of the intricate web of connections that exists within the realm of the study. The cumulative strength of all these co-occurrence links amounts to 1707, underlining the rich tapestry of interactions that define the landscape of keywords and their interplay. This meticulous analysis underscores the interwoven nature of research keywords and their relationships. It highlights the prominence of certain keywords and their profound influence.

5.6 Author keywords analysis:

Figure 1 illustrates the organization of five distinct clusters using the VoSViewer software, each capturing specific thematic areas within a larger body of research or data. These clusters reveal patterns in the distribution of keywords, shedding light on prevalent topics within the dataset. Let's delve into the context of each cluster:

Cluster 1 Conservation and Wildlife Management:

This cluster is characterized by keywords related to the ecological and biological aspects of conservation, wildlife, and ecosystem management. It includes subjects like climate change's impact on Australia, invasive species management, reptile behavior, survival strategies, habitat use, and more. Researchers in this cluster likely study topics such as endangered species, habitat preservation, and the effects of climate change on wildlife.

Cluster 2 Ethical Considerations in AI and Business:

The second cluster focuses on ethical matters linked to artificial intelligence (AI), business practices, and societal responsibilities. This group encompasses discussions around AI ethics, corporate social responsibility, privacy concerns, and human rights implications. Researchers within this cluster explore the ethical dimensions of emerging technologies and their impact on various aspects of society and business.

Cluster 3 Bioethics and Research Ethics:

Keywords in this cluster emphasize ethical considerations in various forms of research, particularly in the field of biomedicine and healthcare. Topics include autonomy, informed consent, codes of ethics, decision-making, and professional conduct. Researchers in this cluster likely delve into the ethical frameworks guiding research practices and the treatment of human subjects.

Cluster 4 Ethical Concerns in Animal Welfare and Environment:

Cluster 4 revolves around ethical aspects related to animals, environmental justice, and sustainability. The keywords suggest a focus on animal rights, welfare, and their moral status, as well as broader concerns regarding environmental sustainability. Researchers in this cluster may explore ethical

dilemmas associated with animal treatment, biodiversity loss, and the interconnectedness of environmental and ethical considerations.

Cluster 5 Agriculture, Ecology and Environmental Values:
The final cluster centers on themes surrounding agriculture, ecology, and intrinsic environmental values. Keywords such as biodiversity, environmental ethics, and virtue ethics indicate a focus on the moral dimensions of environmental practices, including agriculture, biotechnology, and ecological surveys. Researchers within this cluster likely investigate the ethical underpinnings of human interaction with the environment.
Additionally, the dataset's most frequently occurring author keywords provide a snapshot of the most prominent terms across all clusters. Terms like ethics, professional ethics, environmental ethics, and animal ethics suggest that ethical considerations are a prevalent and cross-cutting theme throughout the dataset. This analysis highlights the diversity of ethical topics being explored in the academic or research context represented by the dataset.

5.7 Author's Keyword Distribution

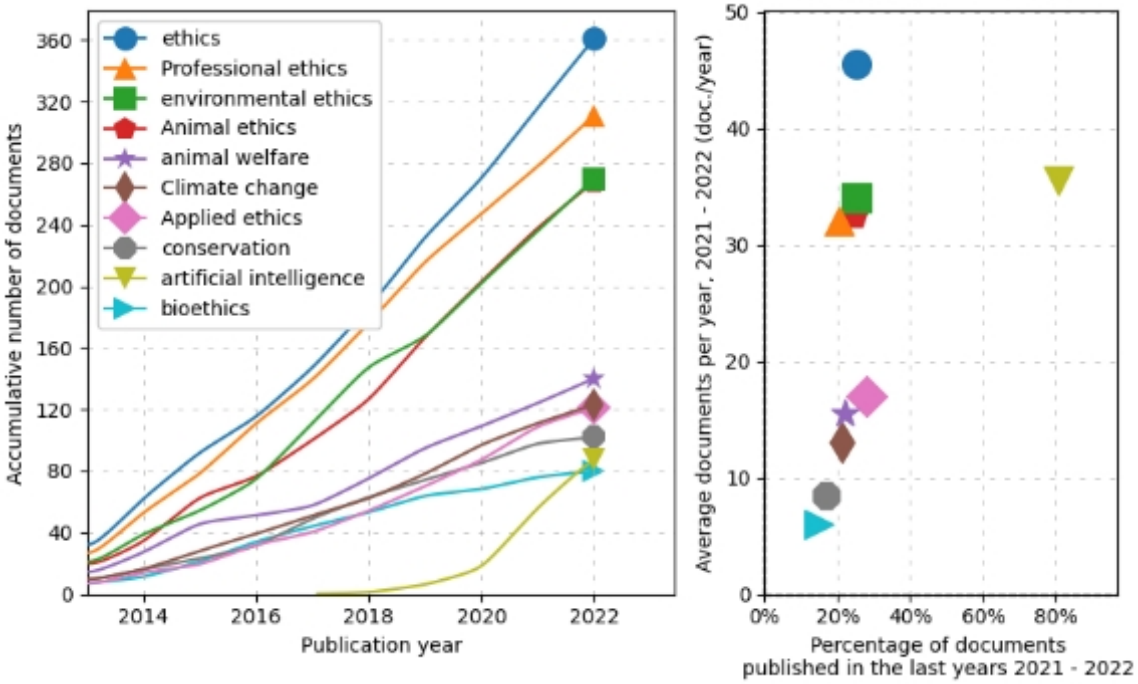


Figure (2): Author's Keyword Distribution

The figure (2) presented below illustrates the most frequently utilized author-designated terms, depicted with distinct shapes for clarity. On the left-hand side of the illustration, pertinent details concerning these keywords and their

respective frequencies are provided. Notably, the term "ethics" emerges as the predominant keyword across research endeavors, tallying an impressive 360 occurrences. In the subsequent position, "professional ethics" is featured with a count of 340 appearances. Similarly, the term "ethics" reappears and is noted to be present 320 times within the documents. "Animal ethics" garners a noteworthy mention, cropping up 300 times in the corpus. Tracking behind is "animal welfare," registering a frequency of 280 instances. Sequentially, the sequence unfolds with "Climate change" (n = 260), followed by "applied ethics" (n = 240), "conservation" (n = 220), "artificial intelligence" (n = 200), and "bioethics" (n = 180), each substantiated by the figure's depiction.

On the right-hand side of the figure, the illustration provides a visual representation of the research domain's growth trajectory spanning from 2021 to 2022. A discernible insight from this aspect of the illustration is that the term "ethics" reigns supreme, commanding the most significant frequency of appearance amongst all other keywords. Additionally, the illustration accentuates a discernible surge in the utilization of the term "artificial intelligence" within scholarly documents, indicating an evident escalation in its occurrence during the recent years.

5.8 Authorship Trends in Applied Ethics Publications from 2013–2022

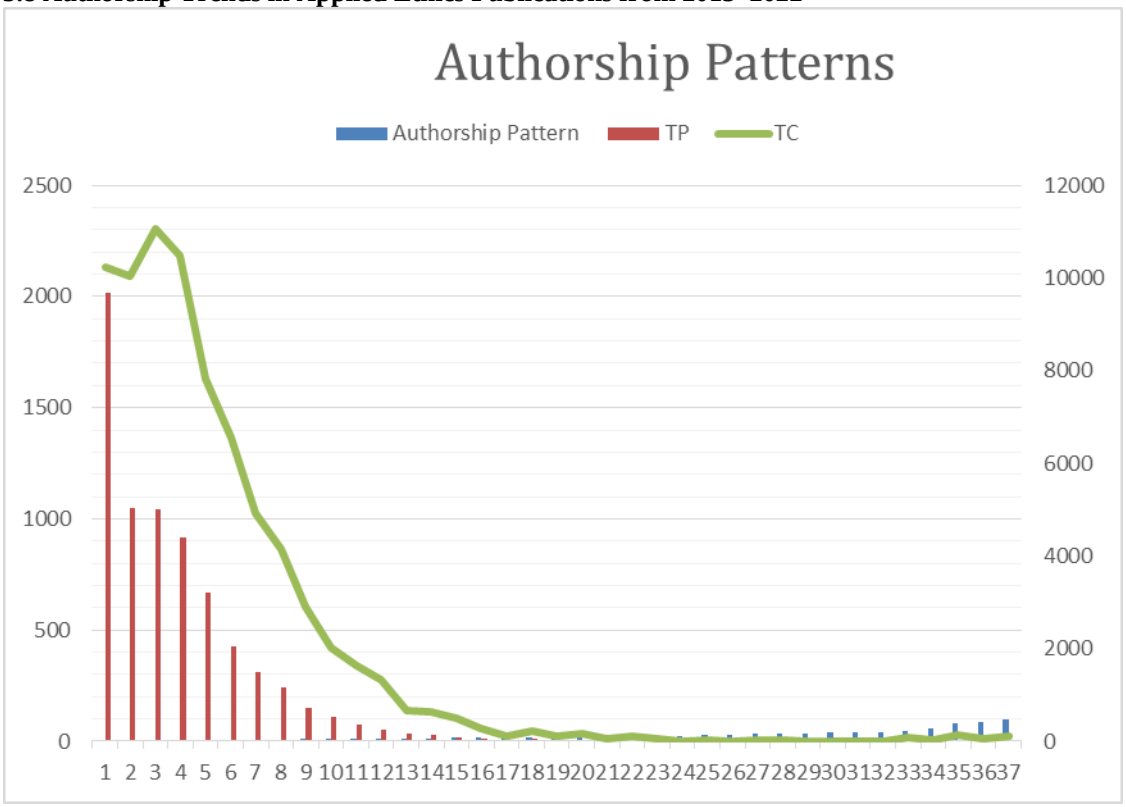


Figure (3): Authorship Pattern

Figure 3 provides a visual representation of the patterns of authorship within the realm of applied ethics publications spanning the years 2013 to 2022. In this analysis, a comprehensive collection of 7202 documents was gathered and scrutinized. These documents collectively involved a total of 18461 distinct authors. Notably, among these documents were instances where a single author took the lead. One intriguing finding pertains to the single-authored documents from the year 2019. These documents exhibited a TC/TP ratio of 5.07, indicating a noteworthy level of scholarly engagement. Moreover, the cumulative count of citations amassed by these documents reached an impressive 10233. The specific number of single-authors responsible for these works was 1633. Further exploration of the data highlights a document with the identifier 82, which displayed the highest TC/TP ratio at 148, showcasing a particularly impactful contribution within this landscape. Similarly, document number 3 emerged with the highest overall citation count among all entries. In terms of the sheer volume of publications, document number 2 secured a notable position, occupying the second spot with a total of 1047 publications. This observation underscores the diverse and multifaceted nature of the applied ethics discourse during the period under study.

5.9 Subject Category Distribution:

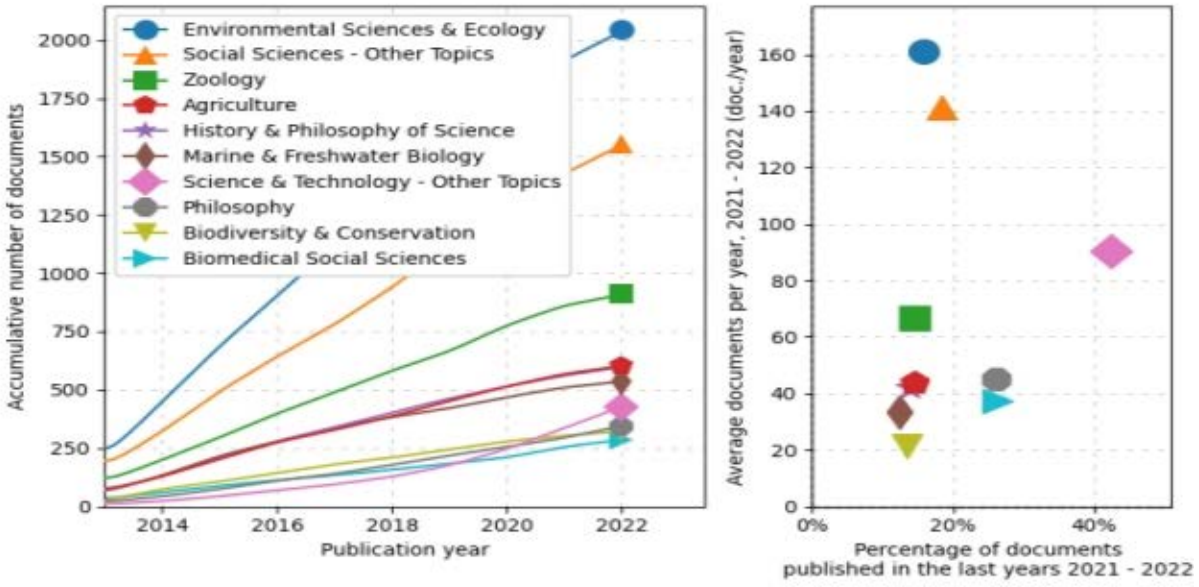


Figure (4): Subject Category Distribution

Applied ethics has expanded its reach beyond the confines of moral philosophy and ventured into various other fields with practical applications. This shift is evident in the distribution of subjects within applied ethics between 2021 and

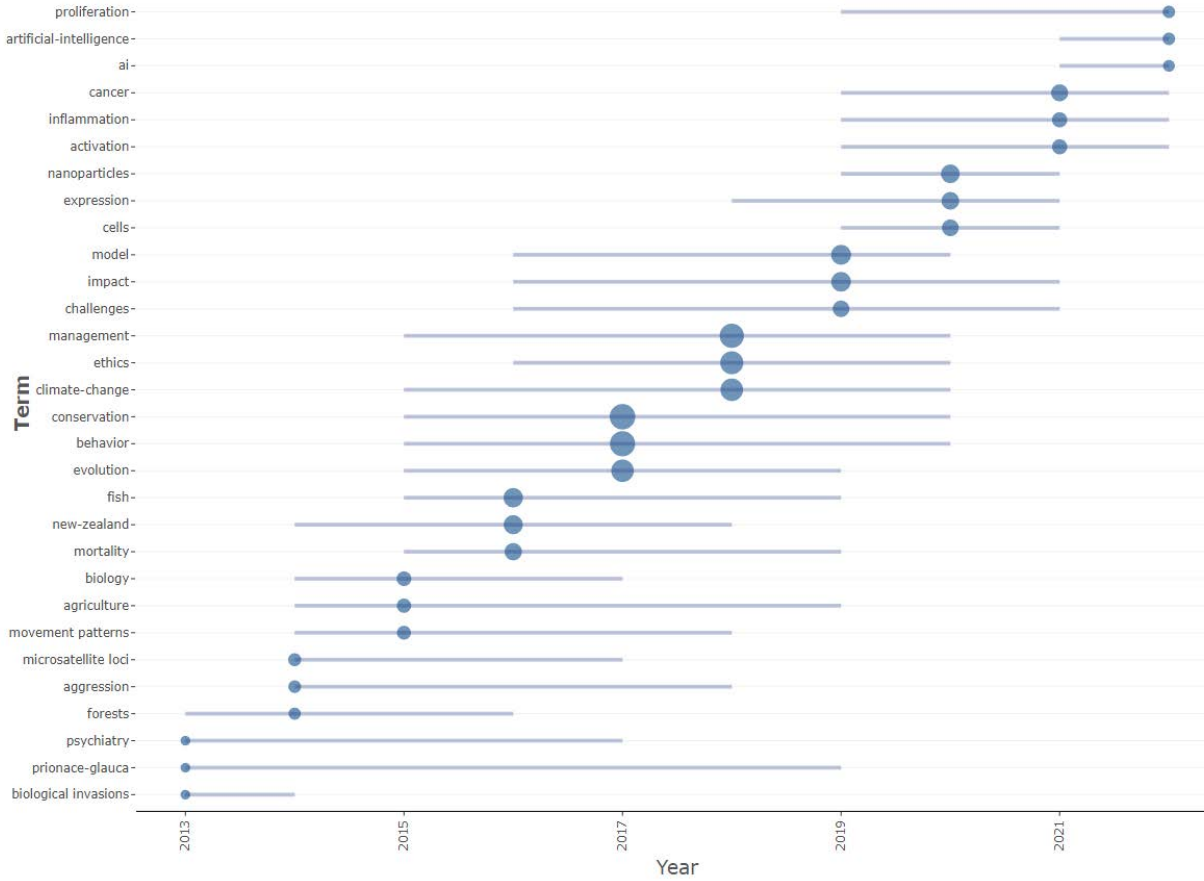
2022, as illustrated in the diagram below. Notably, the subject category that stands out the most is Environmental Science and Ecology. Within the realm of applied ethics, this particular subject area is categorized as Environmental Ethics and has witnessed a significant output of over 2000 research works.
Another key area influenced by applied ethics is Social Science, which falls under the umbrella of Social Ethics. This domain has experienced considerable growth in research, boasting more than 1750 published papers. This trend is noticeable from the depiction on the right side of the diagram, where research pertaining to Science and Technology and other related subjects (such as ethical considerations in technology) has surged noticeably in recent years.

5.10 Word Clouds in applied ethics publications

Figure (5): Word Clouds in applied ethics publications

The visual representation provided depicts a word cloud extracted from a publication in the field of applied ethics. The prominence of each word within the cloud corresponds to its frequency of appearance within the publication. Notably, the term "conservation" stands out as the most prominently featured word, occurring a total of 281 times. Similarly, the following top five words in terms of visibility have substantial frequencies as well, though they appear with slightly lesser prominence than "conservation.""Behavior" is present with a frequency of 270, "management" with 237, "ethics" with 200, and "evolution" with 185 occurrences. The figure effectively captures the recurring themes and concepts discussed in the publication, shedding light on the relative emphasis placed on each term within the context of applied ethics.

5.11 Analysis of trending topics in applied Ethics publications



Figure(6): Trending Topics in Applied Ethics

Figure 6 serves as a graphical representation of the dominant themes that have garnered significant attention in the realm of Applied Ethics publications from 2013 to 2022. Notably, one of the standout subjects is "conservation," which exhibits the highest frequency of occurrence, amounting to 281 instances between the years 2015 and 2020. Further noteworthy topics include "behavior" with a frequency of 270, "management" with a frequency of 237, "ethics" with a frequency of 200, and "evolution" with a frequency of 185.

Within the visualization, the more prominently displayed data points correspond to the most prominent subjects in the field of environmental ethics specifically during the time span spanning from 2017 to 2019. However, as the timeframe shifts to the period encompassing 2019 to 2022, a shift in focus becomes evident. During this later span, "artificial intelligence" (AI) takes center stage as a burgeoning area of interest, appearing with a frequency of 14, while "AI ethics" emerges as a prominent subfield within applied ethics, registering a

frequency of 10. These trends underline the growing significance of AI-related ethical considerations within academic research and discourse, showcasing the evolution of the field to encompass emerging technological and societal advancements.

5.12. Most Cited Research Papers in Applied Ethics

Rank	Title	Journal	Author and Year of Publication	Total Citation	Average Citation per Year
1	The Ethics of AI Ethics: An Evaluation of Guidelines	Minds and Machines	Hagendorff, T 2020	310	77.5
2	The Flaws and Human Harm of Animal Experimentation	Cambridge Quarterly of Health Ethics	Akhtar, A 2015	192	21.33
3	Environmental ethics, Environmental Performance and competitive Advantage	Technological Forecasting and Social Change	Singh, SK; Chen,J; El-KaSsar,AN 2019	170	34
4	Exploring Intrinsic, Instrumental and Relational Values for Sustainable Management of Social-Ecological System	Ecology and Society	Aris-Arevalo, P; Martin-Lopez, B; Gomez-Baggethun,E 2017	153	21.86
5	From what to How: an Initial Review of Publicly Available AI Ethics Tools, Methods and Research to Translate Principles into Practices	Science and Engineering Ethics	Morley,J; Florid,L; Elhalal,A 2020	143	35.75
6	Principles for Ethical Research Involving Humans:Ethical Professional Practice in Impact Assessment Part 1	Impact Assesment and Project Appraisal	Vanclay,F; Baines,JT; Taylor,CN 2013	113	10.27
7	Nudging and Informed Consent	American Journal of Bioethics	Cohen,S 2013	105	9.55
8	Anthropocentrism:More than Just a Misunderstood Problem	Journal of Agricultural Environmental Ethics	Kopnina,H; Washington,H; Piccolo, JJ 2018	99	16.5
9	A Broader Understanding of Moral Distress	American Journal of Bioethics	Chambell,SM;Ulrich, M; Grady,C 2016	99	12.38
10	The Ugly Truth about	Science and	Howard,A;	97	16.17

	Ourselves and Our Robot Creations: The Problem of Bias and Social Inequality	Engineering Ethics	Boweinstein, J 2018		

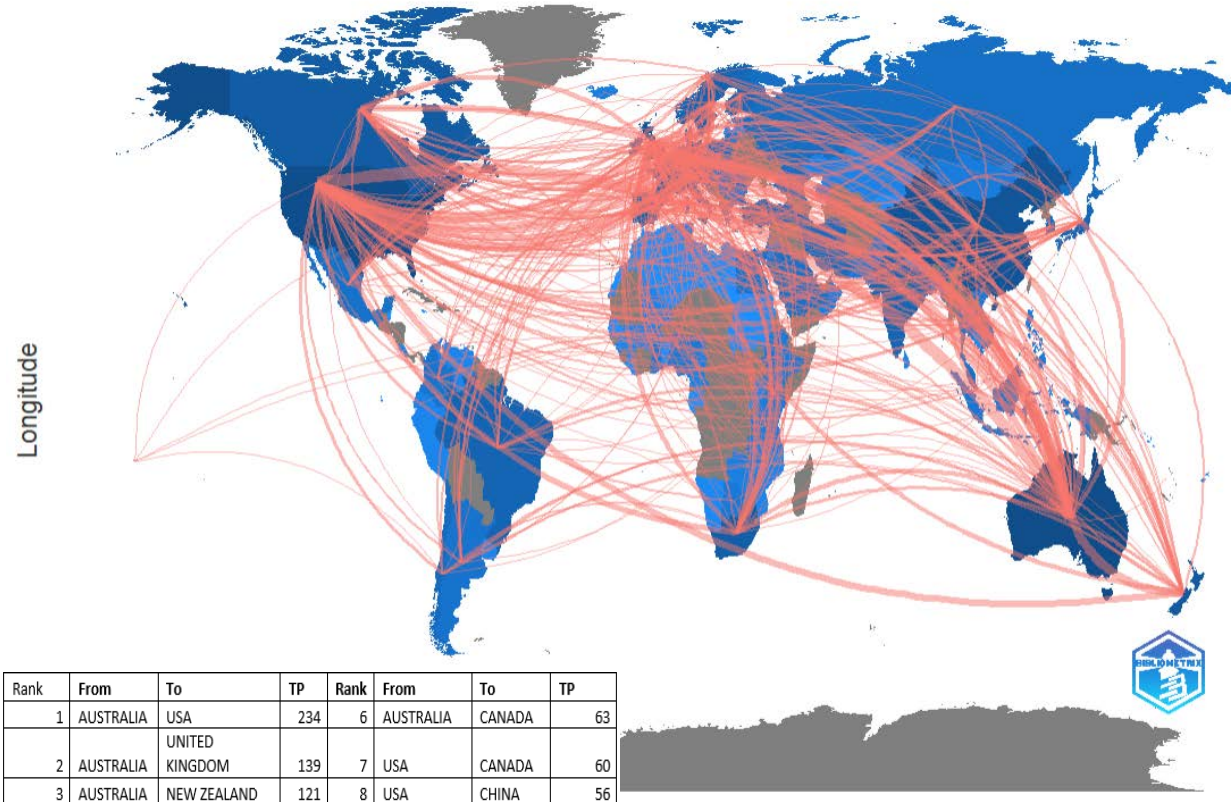
Table (6): Most Cited Research Papers in Applied Ethics

Table 6 offers an insightful glimpse into the landscape of applied ethics research by showcasing the ten most highly cited publications, meticulously ranked based on their total citation counts. When equal total citation numbers arise, their positions are determined by their average yearly citations. The leading spot is claimed by the paper titled "The Ethics of AI Ethics: An Evaluation of Guidelines," penned by Hagendorff, T, and published in 2020 within the journal "Minds and Machines." This publication secures the top rank with an impressive total of 310 citations. Noteworthy contributions follow suit: "The Flaws and Human Harm of Animal Experimentation" by Akhtar, A, emerges with 192 citations, averaging a commendable 21.33 yearly citations, having been published in 2015. "Environmental ethics, Environmental Performance and Competitive Advantage" by Singh, SK; Chen, J; El-KaSsar, AN, surfaces with a total of 170 citations, published in 2019. Similarly, "Exploring Intrinsic, Instrumental and Relational Values for Sustainable Management of Social-Ecological System" by Aris-Arevalo, P; Martin-Lopez, B; Gomez-Baggethun, E, garners recognition with 153 citations from its publication in 2017.

Moving onward, "From what to How: an Initial Review of Publicly Available AI Ethics Tools, Methods and Research to Translate Principles into Practices" by Morley, J; Floridi, L; Elhalal, A, achieves prominence with 133 citations, published in 2020. "Principles for Ethical Research Involving Humans: Ethical Professional Practice in Impact Assessment Part 1" authored by Vanclay, F; Baines, JT; Taylor, CN, commands attention with 113 citations since its inception in 2013. "Nudging and Informed Consent" by Cohen, S, makes its mark with a total of 105 citations since its publication in 2013.

Further enriching the discourse, "Anthropocentrism: More than Just a Misunderstood Problem" by Kopnina, H; Washington, H; Piccolo, JJ, gathers 99 citations after being published in 2019. Simultaneously, "A Broader Understanding of Moral Distress" authored by Chambell, SM; Ulrich, M; Grady, C, etches its presence with 99 citations, originating in 2016. Concluding the top ten list, the paper titled "The Ugly Truth about Ourselves and Our Robot Creations: The Problem of Bias and Social Inequality" authored by Howard, A and Boweinstein, J, asserts itself with 97 citations and a yearly average citation rate of 16.17, published in 2018. This compilation sheds light on the impactful research within applied ethics, highlighting both timeless concerns and emerging themes in the field.

5.11. Country collaboration



Rank	From	To	TP	Rank	From	To	TP
1	AUSTRALIA	USA	234	6	AUSTRALIA	CANADA	63
2	AUSTRALIA	UNITED KINGDOM	139	7	USA	CANADA	60
3	AUSTRALIA	NEW ZEALAND	121	8	USA	CHINA	56
4	USA	UNITED KINGDOM	89	9	AUSTRALIA	FRANCE	55
5	USA	NEW ZEALAND	79	10	AUSTRALIA	GERMANY	50

Figure (7): Country collaboration map in applied ethics research

The provided table illustrates the extent of international partnerships in the field of applied ethics spanning the years from 2013 to 2022. The data highlights the cooperation among various nations, shedding light on their collaborative efforts. Notably, the highest volume of joint endeavors took place between the United States and Australia, resulting in a substantial count of 234 published works. Following closely is the partnership between the United Kingdom and Australia, which contributed to 139 publications. Another significant collaboration emerged between Australia and New Zealand, yielding 121 publications. Additionally, a notable collaboration between the UK and USA resulted in 89 publications. The fifth-ranking collaboration was between the USA and New Zealand, producing 79 publications. Remarkably, the USA and Germany had the fewest joint ventures among the top ten countries, with a total of 50

publications. Collectively, these findings underscore a meaningful level of inter-country collaboration in generating research within the realm of Applied Ethics.

Conclusion:

This bibliometric analysisinquires into the realm of applied ethics research, focusing on publications spanning the years 2013 to 2022. The study harnessed the expansive repository of the Web of Science, uncovering a collectionof 7207 documents dedicated to applied ethics. The investigation employed an array of software tools, including MS Excel, the Java-based VoSViewer, Biblioshiny, and ScientoPY, to dissect thiscollection of documents. The study revealed a prolific assembly of 18461 authors, collectively contributing 7207 scholarly works that obtainedan impressive 76597 citations. Noteworthy collaborative efforts between the United States and Australia yielded a substantial 234 joint publications, signifying a global exchange of ideas. The linguistic landscape unveiled English as the favored medium, comprising 7015 publications and obtained 76349 citations. Amidst the scholarly landscape, the Journal of Agricultural and Environmental Ethics ascended as the paramount periodical, with a commanding Journal Impact Factor (JIF) of 2.37. This preeminent journal hosted 499 publications, with an impressive citation count of 5116. Notably, the Marine Ecology Progress series accuried a peak JIF of 12.59.

It is identified that articles are the most published document type, which is 6253 in number with 69133 citations. A paper titled, "The Ethics of AI Ethics: An Evaluation of Guidelines" authored by Hagendorff, T, took the lead. It is emerged from the journal, Minds and Machines in 2020, with an esteemed total citation count of 310. An enlightening visual analysis indicates"ethics" as the most prevalent keyword across documents, its prominence further accentuated by a increasing frequency of "artificial intelligence" in recent years. The synthesis of this data leads to a resolute declaration: environmental ethics stands as a dominant force within applied ethics, a position reinforced by the burgeoning emergence of new branches, notably AI ethics. Eminently recurring terms such as conservation, behavior, climate change, ethics, and management resonate throughout the research corpus. The repetitive use of these words can be noted in a multitude of research papers of applied ethics, bearing testament to their significance. Notably, a collaborative nexus between Australia and the USA generated a substantial total of 234 publications, emphasizing the transcontinental synergy in this scholarly pursuit.

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