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Unveiling scientific integrity in scholarly publications: a bibliometric approach

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Abstract

Scientific integrity stands as a fundamental principle and benchmark for the conduct of research and the dissemination of scholarly content. The objective of this research aims to explore the impact of research, new and emerging areas of research, and to identify potential research collaborators and journals of scientific integrity for scholarly publishing over the last 20 years. Utilizing data sourced from the Scopus database, this research gathers publications linked to scientific integrity in scholarly publishing spanning from 2004 to 2023. These records were subjected to bibliometric analysis through Bibliometrix and VOSviewer. The findings indicate that research articles are the predominant mode of publication, constituting a substantial 67.27% of the total. Moreover, this content has been contributed by a diverse group of 2,596 authors. The Journal of Science and Engineering Ethics distinguishes itself with an outstanding record of publishing 62 articles and an impressive H-index of 19. The USA possesses the most extensive collaborative network, followed by Australia and the United Kingdom. Another significant discovery from this research underscores that over 20 years, dominant research trends have revolved around topics concerning scientific integrity, such as academic integrity, research integrity, and research misconduct.

Keywords Scientific integrity, Research integrity, Scholarly publications, Bibliometric analysis

Introduction

Scholarly publishing is the process of producing and disseminating academic works that contribute to the advancement of knowledge and understanding in various fields of study (Dhillon et al. 2015; Kim 2018). It is important for advancing science and society, as it enables researchers to share their findings, receive feedback, build on existing knowledge, and generate new ideas (Wahid et al. 2022). Scholarly publishing also helps ensure the integrity and credibility of science, as it requires researchers to follow ethical standards and practices, such as reporting accurately and objectively, giving credit to others, disclosing conflicts of interest, correcting errors, and engaging in responsible communication (Dhillon et al. 2015; Kim 2018). Thus, ensuring the scientific integrity of scholarly publications significantly contributes to the academic community.

Scientific integrity is a crucial principle and standard for conducting research and publishing scholarly work. It involves honesty, responsibility, transparency, and independence of researchers and reviewers (Nek and Eisenstadt 2016). Adhering to the principles and standards of scientific integrity ensures the credibility and reliability of the research process and its outcomes. In the context of scholarly publishing, scientific integrity is essential for maintaining the trust of the scientific community and the public in published research. It is the foundation for advancing knowledge and promoting innovation in all fields of science (Kretser et al. 2019). Another important aspect is the responsible conduct of research. This includes ensuring that research is conducted ethically, with respect for human subjects and animal welfare, and in compliance with relevant laws and regulations. It also involves ensuring that data are collected, analyzed, and reported accurately and transparently, and that conflicts of interest are disclosed and managed appropriately (Elsevier 2023). Moreover, the peer-review process is considered as one of the key aspects of scientific integrity in scholarly publishing. It helps to ensure that published research is of high quality and contributes to the advancement of knowledge in the field (Iphofen 2020).

Previous studies point out that the pressure to publish is recognized as a factor that can impact the ethical conduct of researchers (Feenstra et al. 2021; Maggio et al. 2019). Besides, the personal sense of achievement and the level of scientific research knowledge among scientific researchers are intrinsic motivators that directly influence the extent and severity of their engagement in dishonest scientific practices. On the other hand, external factors, such as the available resources and institutional policies are indirect influencers that impact the credibility of scientific research conducted by researchers (Zhao et al. 2022). Feenstra et al. (2021) identified several types of research misconduct among Spanish researchers in ethics and philosophy. Their findings included the following: duplicate publication (66.5%), self-plagiarism (59.0%), use of personal connections (57.5%), manipulation of citations (44.0%), and data falsification or fabrication (10.0%). These findings should raise concerns about the potential outcomes of embracing assessment systems that gauge research accomplishments based on bibliometric measures and that encourage a publish-or-perish mindset. Such strategies are the prime catalyst for fostering the spread of research misconduct. The consequences of scientific misconduct can be severe and damaging for both the researchers and the scientific community. These misconducts may result in losing funding, restrictions to supervised research, job loss, failure to receive promotions, drying up of research grants, and undermine the researchers and the public's trust in science (Poutoglidou et al. 2022).

This study is a part of a research project of 'Factors influencing scientific integrity of the university research scholarly publishing' in the latest five-year duration. The objective of this research is to identify the top sources and most cited documents, analyze collaboration networks, and explore themes and trends related to scientific integrity in scholarly publishing over the last 20 years. This analysis is based on data extracted from the Scopus database.

In addition, by using bibliometric analysis, researchers can gain a better understanding of the development and knowledge structure of scientific integrity. The findings of this research offer valuable insights for researchers seeking a comprehensive understanding of scientific integrity on a global scale. Additionally, they can aid universities and administrators in devising suitable strategies to enhance the quality of academic publications,

foster collaborative research relationships, and mitigate research misconduct within their institutions.

Literature review

While scientific integrity underscores the commitment to ethical and honest practices in scientific research, it's essential to ensure the quality and reliability of scientific knowledge, and for building public trust in science, and address the counterpart of this commitment, which is scientific misconduct (National Science and Technology Council 2023). Scientific misconduct encompasses various violations of standard scholarly conduct and ethical behavior in professional scientific research (Gureev et al. 2019; Kretser et al. 2019; Nek and Eisenstadt 2016). Thus, understanding the common aspects influencing the transparency of scientific integrity is crucial in both upholding ethical standards and preventing misconduct.

Falsification, fabrication and plagiarism (FFP)

FFP are the three most common types of research misconduct in the process of conducting or reporting scientific research (OSTP 2017). Fabrication refers to the act of inventing data or outcomes and documenting or presenting them; (2) Falsification concerns altering research materials, equipment, procedures, or data, either by manipulation or omission, in a way that misrepresents the research in the recorded records; and (3) Plagiarism relates to the unauthorized use of another individual's concepts, methods, findings, or language without proper attribution (Mustajoki and Mustajoki 2017; Paruzel-Czachura et al. 2021).

Fabrication and falsification of data in research are completely unacceptable because they violate the core research values of honesty, accuracy, and transparency. They also go against the goals of research, which are to discover new knowledge and improve people's lives. All research guidelines clearly and strongly forbid fabrication and falsification. This is because these activities are dishonest and undesirable, and they can undermine the integrity of research findings (Mustajoki and Mustajoki 2017). According to Rodrigues et al. (2023), plagiarism frequently occurs as a form of research misconduct in countries situated in South and East Asia, because researchers have insufficient training in the field of scientific writing, and there are notable deficiencies in their comprehension of diverse plagiarism forms. Therefore, instances of misconduct should be addressed with the utmost transparency. It is advisable to involve individuals from outside the research community to collaboratively investigate the issues alongside the research community (Mustajoki and Mustajoki 2017). Besides, researchers should be trained on how to avoid plagiarism in scientific writing. This training should be interdisciplinary, meaning that it should cover a variety of different topics related to plagiarism (Fisher and Partin 2014).

Research ethics

Research ethics is a set of moral principles and guidelines that researchers should follow when conducting research. These principles and guidelines are designed to protect the rights and well-being of research participants, to promote public trust in research, and to ensure the integrity of research findings (Phoomirat et al. 2022; Tammeleht and Löfström 2022).

Codes of ethics are regarded as a significant instrument for influencing how individuals perceive and make ethical judgments. Research shows that codes of ethics can help to increase people's moral awareness and ethical behavior (Brinkmann and Ims 2003; Yallop and Mowatt 2016). Previous studies indicated that individual and organizational factors play a key role in ethical decision-making; for instance, personal values, ethical perceptions and judgments, moral intensity, interpersonal trust; organizational values, ethical standards, inter-organizational trust, and reputation (Bendixen and Abratt 2007; Brenkert 2008). Thus, it becomes crucial to ascertain the level of familiarity researchers possess regarding codes of ethics, their views on the effectiveness of codes in guiding ethical decision-making, and, most importantly, how they understand and apply ethical codes when faced with ethical dilemmas (Yallop and Mowatt 2016).

Mustajoki and Mustajoki (2017) emphasized that research ethics entails more than just adhering to rules and consequences; it should be viewed as a constructive influence guiding the entire research community toward achieving greater societal benefits. The significance of research ethics is on the rise due to several factors, including the expanding community of researchers and the effects of globalization, which intensify competition. Additionally, technological advancements have increased the likelihood of plagiarism, and there is a growing demand for accountability, among other factors (Gallant 2011). Emphasizing positive conduct and nurturing the competence of research ethics and integrity is crucial in preparing the next generation of researchers (Tammeleht and Löfström 2022).

Authorship

The number of scientific papers of a researcher is often seen as the most important measure of their research skills and potential. It advances knowledge and improves our understanding of the world; gives authors a sense of accomplishment; demonstrates their intellectual skills and expertise; enhances their professional reputation; and can lead to academic advancement, research funding, and professional recognition (Rethinaraj and Chakravarty 2018). Thus, researchers focus on boosting collaboration with other researchers at national and international levels to carry out research projects and have publications. However, publishing pressure could lead them to center on the quantity rather than publication quality (Rethinaraj and Chakravarty 2018).

Unethical authorship is one of the most common forms of misconduct among scientists. It occurs when people who do not meet international authorship criteria are included as authors, or when people who made significant contributions to a study are excluded from the author list (Gureev et al. 2019). Numerous unethical authorship behaviors (i.e., guest authorship, gift authorship, ghost authorship, honorary authorship etc.) have a detrimental impact on institutions, potentially motivating researchers to engage in outright research misconduct. The absence of consensus regarding authorship standards within different fields has enabled them to engage in a range of unethical behaviors (Gureev et al. 2019; Rethinaraj and Chakravarty 2018).

The three prevalent categories of research misconduct, namely fabrication, falsification, and plagiarism, are equipped with mechanisms to detect and rectify researchers' misconduct. Nevertheless, journal editors lack the means to ascertain whether an individual listed as an author on a paper fulfills the criteria for authorship (Rethinaraj and Chakravarty 2018). Thus, four criteria for authorship as defined by the International

Committee of Medical Journal Editors (2004), to be considered an author, a researcher must (1) Make significant contributions to the conception or design of the work, data acquisition, analysis, or interpretation; (2) Actively participate in the drafting or substantial intellectual content revision of the work; (3) Give final approval for the publication version; and (4) Assume responsibility for all aspects of the work, including addressing inquiries related to the accuracy and integrity of the research and resolving them as needed.

Conflict of interest

A conflict of interest (COI) in research occurs when a researcher has a personal stake in the results of the research, which could potentially bias their findings or interpretations (Curzer and Santillanes 2012; Kafaee et al. 2022). Conflicts of interest are considered to be "situations of temptation and bias" because they can put researchers in a position where they may be tempted to violate their duties in order to advance their own personal interests. COI poses a significant risk to the entire research process, from the choice of research problem to the publication of the results (Curzer and Santillanes 2012; Kafaee et al. 2022; Resnik 2023).

It is recommended that researchers disclose all conflicts of interest in all publications and presentations resulting to their institutions to ensure proper management of both the researchers and their work. Besides, they also have a variety of duties in upholding the ideals of science; acting ethically towards collaborators, financial backers, and readers; fulfilling their teaching duties; and protecting the interests of their research subjects (Curzer and Santillanes 2012). Hence, scientific institutions, such as universities, research institutes, professional societies, and professional and lay journals, should consider embracing the disclosure of conflicts of interest as an essential component of research integrity (Kafaee et al. 2022).

Data and method

In order to extract data, we encompassed titles in the publications available on the Scopus database during the specified time frame from 2004 to 2023. The Scopus database was chosen due to its reputation for housing a diverse array of multidisciplinary research articles and citations. Integrated within Elsevier's analytics and big data infrastructure, Scopus offers a comprehensive online repository of internationally recognized peer-reviewed academic publications. This database ensures the data's credibility and reliability, providing a strong basis for our bibliometric analysis. To collect studies pertaining to scientific integrity, we utilized a search query consisting of the following terms:

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TITLE ( "scientific integrity" OR "research integrity" OR "scientific misconduct" OR "research misconduct" OR "academic integrity" OR "integrity in research" OR "trustworthy research" OR "transparent research" AND NOT "research ethics committee" ) AND PUBYEAR > 2003 AND PUBYEAR < 2024 AND ( LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "re" ) OR LIMIT-TO ( DOCTYPE , "ch" ) OR LIMIT-TO ( DOCTYPE , "cp" ) OR LIMIT-TO ( DOCTYPE , "bk" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )
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The search criteria were restricted by applying specific exclusion criteria, including document types limited to research articles, review papers, conference papers, book chapters, and books, all of which were in English. In order to ensure the relevance and focus of the findings, the search term regarding 'research ethics committee' was excluded in search results. The main goal of this paper is to explore ethical issues directly

related to research practices, excluding administrative and procedural aspects typically associated with research ethics committees. This decision was made to avoid articles focusing on the organizational and procedural elements of ethics oversight, which, although important, were not central to the ethical considerations we aimed to investigate. We acknowledge the potential for excluding some relevant documents; however, this approach was necessary to maintain a targeted scope for this study.

To maintain the credibility and reliability of the collected data, papers lacking author names were excluded. Subsequently, titles and abstracts were scrutinized to remove unsuitable papers. As a result, 1,112 documents were identified for further analysis (Fig. 1). These publications were selected based on the following inclusion criteria:

- Factors and attributes (such as perceptions, attitudes, behaviors, knowledge, skills, challenges, etc.) related to scientific integrity within educational institutions across various countries.
- The established rules, protocols, regulations, principles, benchmarks, frameworks, and guidelines governing scientific integrity within educational institutions across different countries.
- Resolutions, educational programs, methods of instruction, and the process of imparting knowledge about scientific integrity within educational institutions across different countries.

During the data cleaning phase, 344 irrelevant papers were removed. Subsequently, the collected data were analyzed and visually represented, considering diverse factors such as publication year, the prominent journal in the field, involved institutions, country or territory of origin, document type, language, H-index, collaboration specifics, citation count, and term co-occurrence frequencies. This analysis was conducted using Bibliometrix in R software and VOSviewer.

Bibliometric analysis is a method of studying the patterns and trends of scientific publications using quantitative and statistical techniques to understand the characteristics, dynamics, and impact of scientific fields, topics, authors, journals, institutions, countries, etc. (Donthu et al. 2021; Rojas-Sánchez et al. 2023). Thus, the data analysis is conducted by using Bibliometrix in R package version 4.2.2 to perform comprehensive

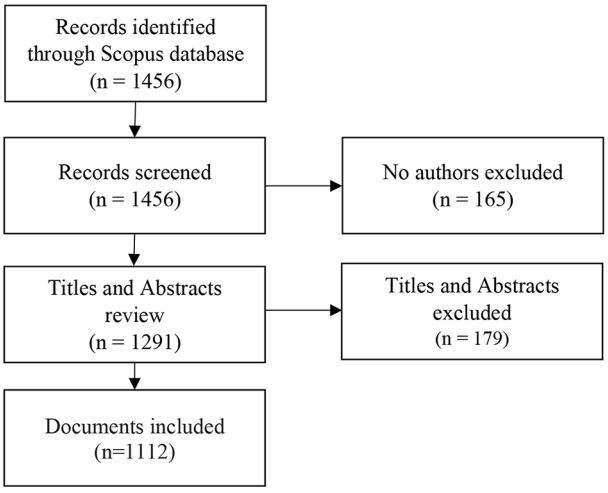

Fig. 1 A flow chart of the document selection with four steps in selecting appropriate documents and removing irrelevant documents. n: total documents

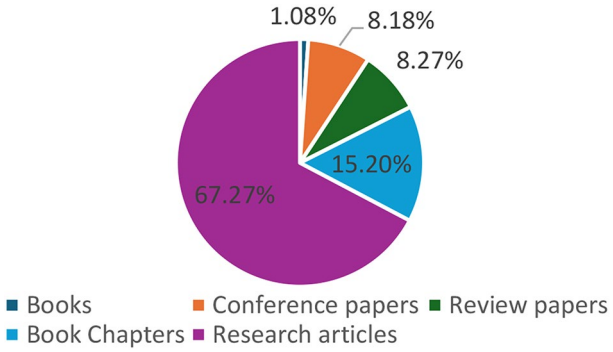

Fig. 2 Document types are represented by corresponding colors with the percentage

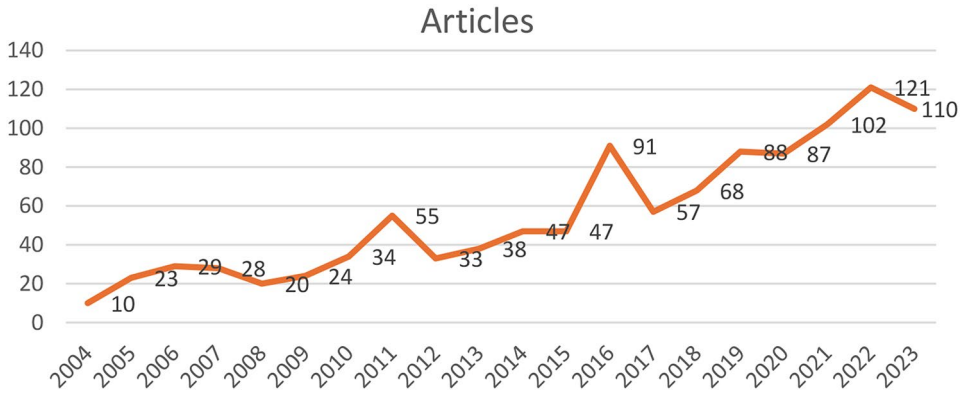

Fig. 3 Annual number of publications. Figure 3 shows the annual total number of publications, showcasing a steady rise from 2004 to 2023. With the gradual ascent of articles captured by the orange line

bibliometric analysis using data from Scopus. Bibliometrix can help to perform descriptive statistics, performance analysis, science mapping, and clustering analysis. It also helps to create various visualizations, such as bar charts, pie charts, line charts, scatter plots, heat maps, dendrograms, and network graphs (Aria and Cuccurullo 2017; Ullah et al. 2022). Besides, VOSviewer is also used to construct and visualize bibliometric networks based on co-citation, co-authorship, co-occurrence, or bibliographic coupling data to identify the main clusters and themes of a scientific field, the relationships and similarities among publications, authors, journals, keywords, or terms (Van Nunen et al. 2018).

Results

Overview of the data characteristics

The distribution of scholarly publications across various categories reveals interesting insights into the academic landscape (Fig. 2). Among the examined corpus, research articles constitute the predominant form of publication, accounting for a substantial 67.27% (748 papers). Book chapters, encompassing 15.20% (169 documents) of the dataset, play a pivotal role in synthesizing existing literature and offering critical perspectives.

Analyzing the provided data on the number of papers published across the years 2004 to 2023 reveals intriguing trends in scholarly output (Fig. 3). The initial years, 2004 and 2005, exhibit a relatively limited publication count, with 10 and 23 papers respectively. However, a notable uptick is observed in 2016, with 91 papers, signifying a substantial

increase in scholarly activity. The trend continues in 2022, reaching 121 papers, indicating sustained growth and a continued appetite for research publication. Overall, the data reflects fluctuation in scholarly output in scientific integrity; nevertheless, the last five years demonstrate a steady increase in publications.

Additionally, the provided dataset encompasses a substantial collection of sources, amounting to 549 in total. A wide-ranging group of 2,589 authors has contributed to these sources. The authors have employed 1,762 distinct keywords in their publications. On average, each document features 2.99 co-authors, underscoring the prevalence of collaborative efforts within the academic community. International co-authorship plays a significant role, accounting for 18.71% of collaborations. The research within this dataset demonstrates a significant impact, with an average of 11.66 citations per document.

Bibliometric analysis of scientific integrity in scholarly publications

The distribution of sources, and countries

Most journal influence The top impacted sources, as indicated by the provided data, showcase significant influence within their respective domains. The Journal of Science and Engineering Ethics stands out with an impressive H-index of 19 and a substantial total citation count of 1320. Accountability in Research Journal holds an H-index of 14, accompanied by a total citation count of 770. Similarly, Journal of Academic Ethics also boasts an H-index of 11 and a total citation count of 352, followed by International Journal for Educational Integrity, with an H-index of 10 and a total citation count of 324 (Table 1).

Top cited documents The top cited documents in the provided data showcase significant scholarly impact across scientific integrity. The work by Edwards MA in 2017, published in the Environmental Engineering Science, has amassed a remarkable total of 346 citations, with an impressive average of 49.43 citations per year. Similarly, the research by Steneck NH in 2006, featured in Science and Engineering Ethics, has garnered substantial attention with a total of 277 citations and an average of 15.39 citations annually. Notably, Stroebe W's work from 2012, published in Perspectives on Psychological Science, has earned 180 citations, translating to an average of 15.00 citations per year (Table 2). While an average can sometimes be influenced by outliers, the average citations per year provides a useful summary statistic that offers a quick and straightforward way to understand

Table 1 High-impact journals. Table 1 shows the top high-impact journals ranked by H-index based on the analysis results from the Biblioshiny. TC Is Total Citations of Journals; NP is Number of Publications of Journals

Rank	Journal	H-index	TC*	NP**
1st	Science and Engineering Ethics	19	1320	62
2nd	Accountability in Research	14	770	71
3rd	Journal of Academic Ethics	11	352	44
4th	International Journal for Educational Integrity	10	324	29
5th	Journal of Empirical Research on Human Research Ethics	8	302	11
6th	Plos One	7	356	8
7th	Academic Medicine	6	224	7
8th	Developing World Bioethics	6	156	7
9th	BMC Medical Ethics	5	70	9
10th	Studies in Higher Education	5	315	5

Table 2 Top-ranking references in terms of citations. The top-cited documents are ranked according to the number of citations, as determined by the Biblioshiny analysis. TC stands for total citations, and TCY stands for total citations per year

Rank	Documents	DOI	TC*	TCY**
1st	Edwards MA, 2017, Environmental Engineering Science *"Academic Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition"*	https://doi.org/10.1089/ees.2016.0223	346	49.43
2nd	Steneck NH, 2006, Science and Engineering Ethics *"Fostering integrity in research: Definitions, current knowledge, and future directions"*	https://doi.org/10.1007/s11948-006-0006-y	277	15.39
3rd	Stroebe W, 2012, Perspectives on Psychological Science *"Scientific Misconduct and the Myth of Self-Correction in Science"*	https://doi.org/10.1177/1745691612460687	180	15.00
4th	Fanelli D, 2015, Plos One *"Misconduct policies, academic culture and career stage, not gender or pressures to publish, affect scientific integrity"*	https://doi.org/10.1371/journal.pone.0127556	157	17.44
5th	Moher D, 2020, Plos Biology *"The Hong Kong principles for assessing researchers: Fostering research integrity"*	https://doi.org/10.1371/journal.pbio.3000737	137	34.25
6th	Resnik DB, 2011, Accountability in Research *"The Singapore statement on research integrity"*	https://doi.org/10.1080/08989621.2011.557296	93	7.15
7th	Bretag T, 2016, Handbook of Academic Integrity *"Handbook of academic integrity"*	https://doi.org/10.1007/978-981-287-098-8	84	10.50
8th	Gopalakrishna G, 2022, Plos One *"Prevalence of questionable research practices, research misconduct and their potential explanatory factors: A survey among academic researchers in the Netherlands"*	https://doi.org/10.1371/journal.pone.0263023	71	35.50
9th	Amzalag M, 2022, Journal of Academic Ethics *"Two Sides of the Coin: Lack of Academic Integrity in Exams During the Corona Pandemic, Students' and Lecturers' Perceptions"*	https://doi.org/10.1007/s10805-021-09413-5	37	18.50
10th	Weibel S, 2023, Research Synthesis Methods *"Identifying and managing problematic trials: A research integrity assessment tool for randomized controlled trials in evidence synthesis"*	https://doi.org/10.1002/jrsm.1599	11	11.00

the overall impact of the work over the specified period. This is particularly helpful for comparing the impact of different works or authors.

Three-field plot The three-field plot allows researchers to visually analyze the distribution and relationships among these elements within a bibliometric dataset. This analysis can provide insights into patterns of collaboration among authors, the prevalence of

certain research topics or themes, and the sources that are most commonly cited within scientific integrity. The use of the three-field plot in bibliometric analysis can have far-reaching implications for evaluating the scholarly impact of authors and sources; guiding research strategies; identifying influential topics among authors and sources, and fostering collaboration within the academic community. The arrangement of three variables, which comprised Keywords in the Left field, Authors in the Middle field, and Source in the Right field of cited references, was established to depict the distribution of research subjects and the sources from which authors published over the preceding 20 years. The analysis of these fields, each comprising 10 items, was performed utilizing Bibliometrix in R software. As depicted in Fig. 4, researchers' primary areas of interest appeared to center around research integrity, responsible conduct of research, and research misconduct. Additionally, a noteworthy proportion of the authored papers were published in journals such as Science and Engineering Ethics and Accountability in Research, with top authors in these topics and sources including Dierickx K, Marušić A, and Bouter L.

Collaboration network by countries The collaboration network of publications regarding scientific integrity between countries, as depicted by the provided data in Figs. 5 and 6, reveals intriguing dynamics in research partnerships. The USA leads with 241 articles, reflecting a substantial research output. Among these, 210 articles involve domestic collaboration (SCP), and 31 articles involve international collaboration (MCP). The Australia follows closely with 73 articles, out of which 63 are produced in collaboration within the country (SCP), while 10 involve international co-authorship (MCP). The UK contributes 58 articles, with 43 showcasing national cooperation (SCP), and 15 featuring international collaboration (MCP). Netherlands, with 35 articles, highlights 16 articles produced through local partnerships (SCP) and 19 articles through international collaboration (MCP). Canada's 25 articles comprise 23 articles with domestic collaboration (SCP) and 2 articles with international collaboration (MCP). These statistics underscore the intricate cooperation network on both national and international levels, fostering a diverse exchange of ideas and expertise among countries of scientific integrity.

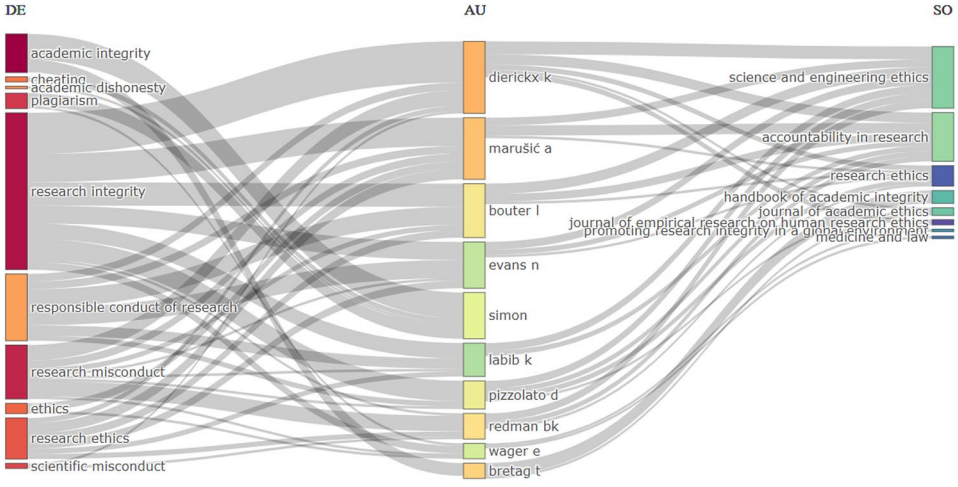

Fig. 4 A Three-Field Plot shows the network between keywords (left), authors (middle) and journals (right) of original articles on scientific integrity from 2004 to 2023. DE: Keywords, Au: Authors, SO: Sources/Journals

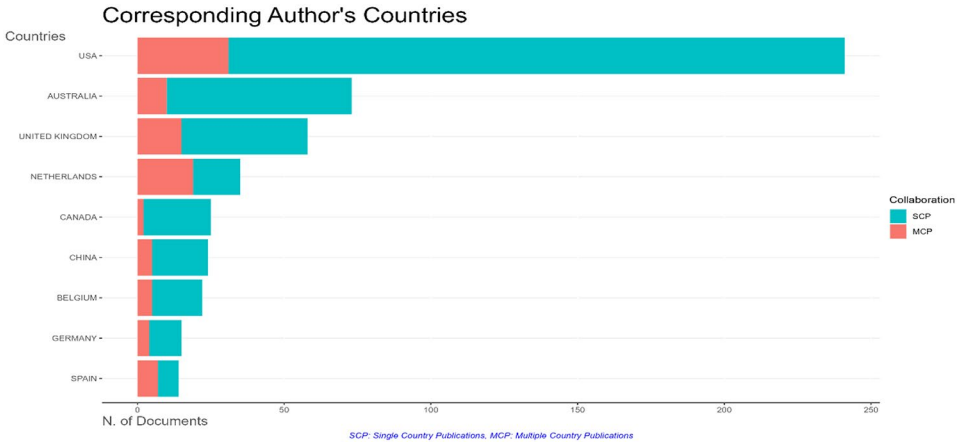

Fig. 5 Corresponding author's country (this chart was generated by Biblioshiny). SCP = Single Country Publications, MCP = Multi Country publications. Following this, each article is associated to a single country on the basis of the affiliation of the corresponding author (SCP = Single Country Publications). In this case, the frequency per country corresponds to the total number of articles. In addition, this analysis calculates the proportion of articles in which there is at least one author with an affiliation in a country other than that of the corresponding author (MSP = Multiple Country Publications)

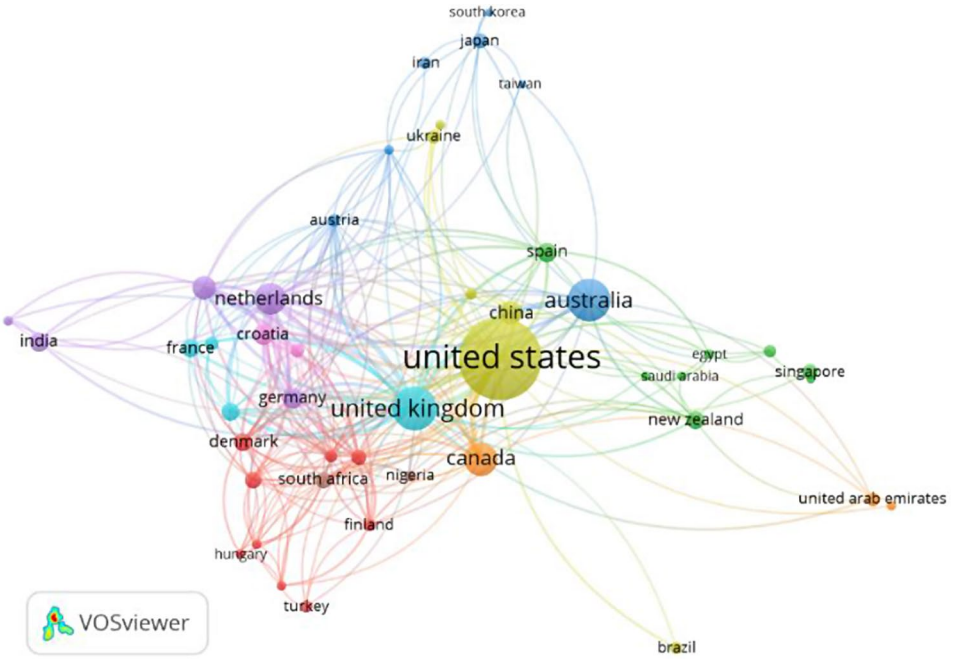

Fig. 6 Collaboration network by countries with seven different clusters. The size of the circle is weighed by documents of the author and country. The thickness of the connecting lines reflects the strength of collaborations

Research themes and trends of scientific integrity

Research topics analysis The process of thematic examination involves grouping authors' keywords and their interconnectedness into clusters, yielding distinct themes. These themes are distinguished by specific attributes, including density and centrality. Density is depicted along the vertical axis, while the horizontal axis represents the degree of centrality. Illustrated in Fig. 7, the thematic diagram was delineated into four categories: Niche Themes (upper left), Motor Themes (upper right), Emerging or Declining Themes (lower left), and Basic Themes (lower right). The findings indicate that motor themes revolve around one cluster, encompassing discussions on plagiarism (261 occurrences) (e.g., plagiarism, ethics, students), and research integrity topics (864 occurrences)

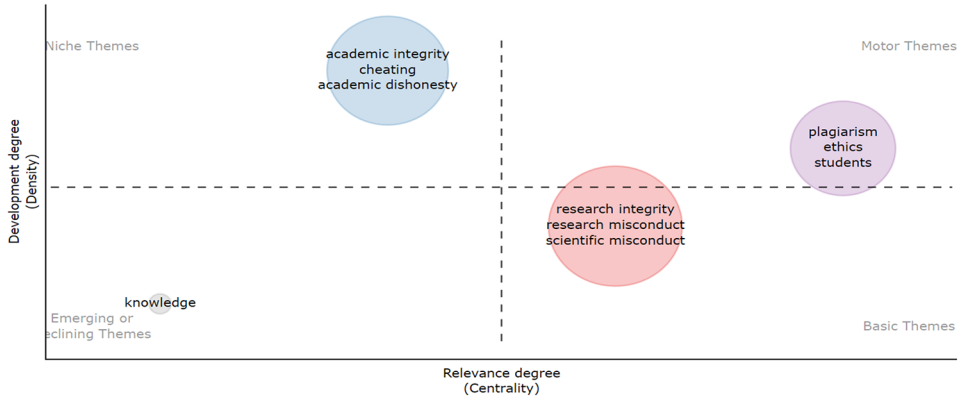

Fig. 7 Visualization of thematic mapping was constructed based on author keywords and was mapped into four themes: Niche (upper left), Motor (upper right), Emerging or Declining (lower left), and Basic Themes (lower right)

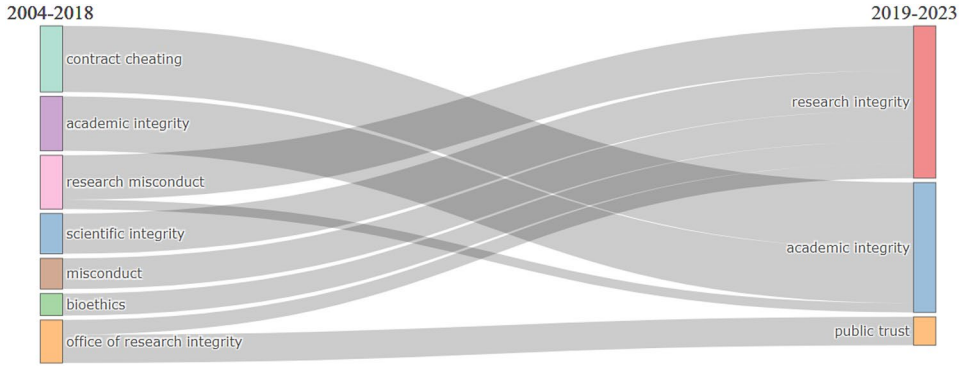

Fig. 8 Transformation of Themes from 2004 to 2023. The evolution of themes in the period of 20 years is depicted over two distinct periods of scientific integrity, illustrating the progression of theme changes represented by box clusters over time. The flow bands indicate the transition of themes from one period to the next

(e.g., research integrity, research misconduct, scientific misconduct) in basic themes. Additionally, other themes like academic integrity (508 occurrences) in niche themes, and knowledge (8 occurrences) in Emerging or Declining Themes, seem to be emerging. These findings suggest that certain fundamental elements are pivotal for the progress of the scientific integrity field.

Research trends analysis The observation highlights that research trends spanning from 2004 to 2018 primarily centered around subjects related to academic integrity, research misconduct, contract cheating, scientific integrity, misconduct, bioethics, and office of research integrity. During the years 2019 and 2023, the focus shifted towards research integrity, academic integrity and public trust. As illustrated in Fig. 8, academic integrity emerges as the dominant theme within scientific integrity research, registering a frequency of 246 occurrences. It is trailed by subjects like research integrity (168), research misconduct (140), and plagiarism (117).

Discussion

Based on the data provided, several influential sources have been at the forefront in promoting scientific integrity. The Journal of Science and Engineering Ethics stands out with a remarkable publication of 62 documents and an impressive H-index of 19,

indicating its significant influence within its domain. Other sources, such as Accountability in Research Journal, and Journal of Academic Ethics also contribute to the promotion of scientific integrity with their respective publication counts. These sources play a pivotal role in advancing knowledge and practice in scientific integrity. The results of this study differ from Maral's study (2024), which used data from the Web of Science database spanning 1966 to 2023, has identified the International Journal for Educational Integrity as the top influential journal, with 101 documents and an H-index of 16.

The top-cited documents collectively underscore the profound influence that certain research contributions can exert on various issues of scientific integrity. Notably, Edwards MA's work published in the Environmental Engineering Science Journal in 2017 stands out. This article has an impressive total of 346 citations, with a remarkable average of 49.43 citations per year. The high citation count and citation rate indicate the enduring value and importance of these works in helping researchers in selecting the most appropriate journals and guiding further research. However, Maral's (2024) study revealed that the 2001 publication by McCabe et al., which addresses cheating behaviors in educational institutions, holds the highest citation count with 579 citations.

In terms of the collaborative networks among countries, the preeminence of the USA, with 241 articles, underscores its substantial research output and engagement with the international academic community. The Australia contributes 73 articles, reflecting the Australia's position as a global research hub. These statistics collectively emphasize the complexity of scientific cooperation, operating at both national and international levels. The collaborative networks illustrated the power of partnerships, enabling the sharing of diverse perspectives, insights, and expertise and contributing to the development of scientific integrity in scholarly publishing. These findings supported the results of Maral (2024), which noted that USA, UK, Australia, and Canada are the leading countries for collaboration in data extracted from the period between 1966 and 2023.

The examination of research trends spanning the years 2004 to 2023 provides valuable insights into the evolving focus of scientific integrity discussions. Notably, the data underscores the dynamic nature of research themes, revealing shifts in emphasis over this time period. From 2004 to 2018, the central subjects revolved around pertinent topics, such as academic integrity, research misconduct, contract cheating, scientific integrity, misconduct. This highlights the critical response of the research community to the emerging challenges, while also emphasizing the enduring importance of scientific misconduct considerations in research practices. As found by Soehartono and Khor (2022) in their study on research integrity and ethics using data from the Web of Science between 1990 and 2020, patterns in publication and collaboration trends mainly focused on 'research ethics structures,' 'research environment,' and 'dealing with breaches of research integrity' in the years 2018, 2019, and 2020. Additionally, Maral (2024) indicated five main themes mentioned in publications of academic integrity: 'academic integrity and its violations', 'online education', 'cheating and academic dishonesty', 'research ethics', and 'detecting academic integrity violations'.

The years 2016, 2019 and 2023 witnessed a notable evolution in research trends. The focus transitioned to encompass research integrity, academic integrity, research misconduct and public trust. This finding is consistent with the study of Soehartono et al. (2022), which also indicates that there was a significant emphasis on research ethics and structures in research trends between 2011 and 2020. This signifies the commitment of

the research community to uphold ethical standards and practices in their endeavors. In addition, the prominence of research ethics reflects the ongoing recognition of its fundamental role in maintaining the credibility and integrity of scientific research (Aguilera et al. 2022; Bockhold et al. 2022; Madikizela-Madiya and Motlhabane 2022; Surmiak et al. 2022). Tammeleht and Löfström (2022) explored novel insights into the ways in which individuals can acquire knowledge about research integrity in higher education. This exploration encompassed an examination of the 'learning process, scaffolding patterns, collaboration, and the development of leadership' in the context of research integrity. Meanwhile, the study of Ali et al. (2021) indicated five primary research areas or categories concerning academic misconduct in higher education from 2010 to 2020, including academic collaboration, scientific impropriety, academic dishonesty in online learning, contract cheating, and plagiarism.

Furthermore, efforts encompass implementing educational initiatives and programs dedicated to instilling responsible conduct in research, fostering integrity, and thwarting research misconduct. This involves the preparation and dissemination of guiding documents outlining optimal research practices. Additionally, providing technical aid to institutions dealing with accusations of research misconduct and the development of comprehensive policies, procedures, and regulations aimed at detecting, investigating, and preventing instances of research misconduct are integral facets of this approach (Abdi et al. 2021; Armond and Kakuk 2023; Bašić et al. 2019; Gazibara et al. 2020; Kretser et al. 2019).

Additionally, it can be seen that the rapid development of generative artificial intelligence tools create significant opportunities and challenges for researchers and profoundly influence scientific integrity. Thus, future studies could develop guidelines and processes to harness the benefits of generative AI while mitigating risks relating to data fabrication and plagiarism. In addition, it is also necessary to focus on studying the ethical and responsible use of AI in generating research content and ensuring the authenticity of scholarly publishing to maintain public trust in scientific research (Bourg et al. 2024; Gallent et al. 2023).

Conclusion

The use of bibliometric analysis in this study helps explore general picture of research practices, publications, global collaboration, themes and trends concerning scientific integrity. It underscores the interdependence of diverse elements, from influential sources and authors to thematic shifts, research trends and international cooperation, all contributing to the advancement of research ethics and knowledge dissemination of scientific integrity. However, this study has some limitations that need to be acknowledged and addressed. Firstly, the analysis is based on specific sources on Scopus database (excluding Web of science, Google Scholar, etc.), which will not fully represent the entire landscape of scientific integrity. Secondly, using only English in the search would have also limited the results of research concerning scientific integrity. This language restriction may have excluded valuable studies published in other languages. Thirdly, the data analysis based on available data through bibliometric indicators and statistics could limit the pro-founding understanding of collaboration contexts, changes, regulations, or institutional initiatives that impact the scientific integrity of scholarly research. Thus, extracted could thereby reduce the comprehensiveness and diversity of the data

analyzed. Future research efforts can build upon these findings by considering these limitations and employing diverse methodologies to offer a more comprehensive understanding of the evolving landscape of scientific integrity.

Abbreviations

COI Conflict of Interest
FFP Falsification, Fabrication and Plagiarism

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Declarations

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Competing interests
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