Review　　　　　　　　　　　　　　　　　　　　　　　　　　　Open Access

Information Ethics in Light of Bibliometric Analyses: Discovering a Shift to Ethics of Artificial Intelligence

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Abstract

The objectives of this study are to analyse the content of publications focused on the area of information ethics and discover patterns, knowledge and thematic trends. The main research question is: What is the intellectual and topical structure of the field of information ethics? We apply bibliometric analytical methods, including co-citation analysis (41 most cited authors out of 9947), co-word analysis (127 keywords), visualizations (maps) and analysis of time periods in strategic diagrams. These methods are interpreted with the use of previous content analyses and results of a Delphi study. The dataset covers publications between 1988 and 2023 collected from Web of Science using the search term "information ethics" in titles, keywords and abstracts (469 records). The study presents the research background and objectives, related research review, research methods and findings. Results are visualized in maps of topics and trends. We investigate the intellectual and thematic structure of information ethics, including numbers of publications, main disciplines, the intellectual structure (authors, topics, trends) and identify four time periods (1988–2005, 2006–2012, 2013–2019, 2020–2023) visualized by strategic diagrams. The study reveals the multidimensionality and multidisciplinary dynamic evolution of information ethics. The main trends are the topics of ethics of artificial intelligence and algorithms, data ethics, ethics of information literacy, informational privacy and dis/misinformation. We find that information ethics studies are embedded in wider contexts of the information crisis and design of public digital services. We propose education and information literacy courses related to ethical sensitivity, data ethics and the use of AI tools. The study contributes to bridging the gap between information ethics studies and human information interactions. Our results confirm the increasing interest in ethics of artificial intelligence.

Keywords

Information ethics; Bibliometric analyses; Trends in publishing; Ethics of artificial intelligence.

1   Introduction

Information ethics can be explained as a multidisciplinary field developing in information science and related disciplines, such as ethics of information technologies, philosophy (ethics, axiology), communication and media studies (media ethics), philosophy of information, ethics of information, ethics of information work and library ethics. At present, the topics of information ethics have raised attention especially in the context of ethics of artificial intelligence (AI), data ethics and digital ethics. Information ethics deals mainly with values of information, access to digital information, intellectual property, accuracy of information (including dis/misinformation), informational privacy (personal data protection), (online) communities (intercultural ethics) and digital information environment, including rules, rights and norms of information use, sharing and production. Information ethics was founded by Robert Hauptman, who published his monograph in 1988 (Hauptman, 1988).

The dynamically developing field of information ethics studies is based on the two dominant conceptions by Rafael Capurro (2005, 2019) and Luciano Floridi (2008, 2013). Both conceptual approaches emphasize philosophical principles of information work, often in contexts of online communication, media and digital environment. Capurro's approach (2019) is oriented towards the theory of messages ("angeletics") (Kelly & Bielby, 2016) in the context of cultural and historical aspects of information landscapes and intercultural differences. Floridi (2013) introduced environmentally driven ethics of information with an emphasis on the informational value of objects, collaboration of humans and machines ("inforgs") and moral agents in the infosphere. He defined the R-P-T model (information as a resource, as a target and as a product) in microethical and macroethical contexts. Both authors have pointed to the applications of ethics of artificial intelligence (AI) (Floridi, 2023a; Capurro, 2019). In the framework of information science, we can see a strong stream of information ethics studies as part of information literacy studies; such as the ACRL framework (2016), the ANCIL model (Secker & Coonan, 2012), multidimensionality of ethics with students (Pinto et al., 2021), moral literacy (Tuana, 2007), information ethics as part of information literacy in workplaces (Forster, 2013) and the model of metaliteracy (Mackey & Jacobson, 2019). Several works in the related area of human information behaviour studies have proven the strength of contextual factors for identification of dis/misinformation, accuracy and truth of information (Agarwal, 2022; Karlova & Fisher, 2013; Ruokolainen et al., 2023; Ruokolainen & Widén, 2020).

Despite a number of multidisciplinary overlaps of topics and concepts, we can regard information ethics as a separate field of study focused on the ethical background of information interactions, based on the social and philosophical contexts of information work. Information ethics is related to ethics of the information processes, ethics of information literacy, human information behaviour and interactions in the information environment. Intersections with related disciplines are typical of the development of information ethics and this is similar to the pattern of "fragmentation" of topics of information science, as proved by Vakkari et al. (2023). In the next sections, we will present research objectives and questions, a literature review, a research methodology with the use of co-citation and co-word analyses, and findings including intellectual structure, thematic evolution of publishing, visualizations of topics and trends, discussion and conclusions.

2   Research Background and Objectives

The research objectives are to analyse and discover the topical and intellectual structures of information ethics with the use of datasets of works published in WoS databases. The authors of information ethics studies have considered both global and local (intercultural) approaches and different perspectives. That is why we found deeper analytical views based on data from published works useful for better understanding of the field. We focus on the identification of main disciplines, topics, the timeline and dynamics of publishing in the information ethics studies. We also consider wider contexts of information ethics studies related to human information behaviour and information literacy. Information ethics

represents a strongly context-sensitive field (Agarwal, 2022). These contexts are manifested in related areas such as information systems, artificial intelligence, digital environment, information literacy, informational privacy, data literacy and data ethics. As there is no unitary approach in information ethics studies, we have to consider most common conceptual areas, which reflect ethics in studies of human information behaviour, information literacy, libraries, information technologies and AI, digital environment and information work.

The main concepts of information ethics are related to the concepts of ethics, information and information technologies (Bawden & Robinson, 2022). Ethics can be regarded as a philosophical discipline focused on a system of morals, rules and values, objectified (or codified) by a social group. Ethics can help determine the right behaviour and regulations, and information ethics is related to information behaviour, information literacy and regulations of the information environment. Ethics and information ethics are based on philosophical theories of consequentialism (rules) and utilitarianism, deontology (duties), rights, virtues (character ethics) and communities. Intersections of ethics and information have led to the concept of information ethics. Information can be defined as a modification of the human state of knowledge communicated in a message. Information ethics is regarded as a multidisciplinary field of research which builds on philosophy, information science, computer science (information systems, information technologies), psychology, education, media, information literacy, but also artificial intelligence and cognitive sciences. This diversity has been reflected in the development of terminology, which is not unified; therefore, several authors have introduced special concepts, namely ethics of information and related terminology (e.g., "infosphere" and "inforgs" by Floridi, 2013). Ethics of information is sometimes explained as a field different from information ethics. In the framework of information science, we can identify descriptive (analytical) information ethics, normative and professional (practical) information ethics. Professional development of information ethics is regulated by professional codices of librarians and related professions, including the international codices on information ethics by IFLA or UNESCO. Information ethics has developed as a separate field of research and practice focused on moral values and ethical rules applied to work with information. The general approaches in information ethics studies can be divided into the systems approach (ethics of information systems, technologies) and the social-cognitive and philosophical approach (users). Another broad categorization of information ethics is into the macroethical approach (information society) and the microethical approach (human information behaviour), and special attention to ethical issues has been raised in the academic environment (information literacy, academic integrity, plagiarism) and in practical institutional approaches (libraries, media, etc.). Recently, the concept of informational privacy has been explained as a human right to not make public special personal data, at both physical and psychological levels, including the preservation of personal integrity and dignity in the digital environment. Concepts closely related to information ethics are ethics of technologies (computer ethics), ethics of artificial intelligence, data ethics and digital ethics. Digital ethics has been defined as an emerging synthesized area of research and practice focused on digital information, its use and production and ethical issues of human information behaviour in the digital environment.

In recent years, we have noted new emerging ethical concepts at the intersection of the concepts of artificial intelligence and ethics (ethics of artificial intelligence) and data and ethics (data ethics). Data can be regarded as representations of objects, which can be used as evidence. Data ethics deals with ethical rules of data interpretations related to ethics of algorithms, ethics of searching systems or ethics of recommender systems (Floridi, 2019; Floridi & Taddeo, 2016). A dominating topic in the development of information ethics is ethics of artificial intelligence (AI), which can be regarded as a discipline focused on research of the principles of cognitive processing of information in the human mind and its simulation in artificial information systems. Ethics of artificial intelligence has developed as a new discipline which deals with the ethical issues of developing new systems of generative artificial intelligence (such as Chat GPT) and the questions of doing (no) harm to people by AI systems in applications such as evaluation of personal

data, banking systems, health information systems, autonomous systems (cars), etc. (Davenport, 2018; Stahl, 2021; Floridi, 2023a). The topics of information ethics, ethics of information, ethics of artificial intelligence, informational privacy, information governance and regulations and duties have developed in close interrelations (Floridi, 2018), including ethics of algorithms (van Otterloo, 2018; Semeler et al., 2024) and academic integrity (Macfarlane et al., 2014). These and other concepts have emerged as a result of the transition of information work to the digital environment. More detailed exploration of basic concepts of information ethics can be found in works such as Burgess and Knox (2019), Graff et al. (2020) and Floridi (2020, 2023). Modern development of information ethics dates from 1988. Its main founder was Robert Hauptman, who published a monograph (Hauptman, 1988) and established an international Journal of Information Ethics.

In line with this conceptual background, we designed a study focused on the field of information ethics based on bibliometric analyses of selected datasets of published works, registered in WoS databases. We articulated the following research questions:

1. What is the development of publishing in the field of information ethics in terms of numbers of works published in WoS journals over the period 1988–2023?
2. In which journals have publications on information ethics appeared most frequently? (Which are the most frequently used communication channels, what is the distribution by journals, conferences, authors, topics?)
3. Which disciplines are involved in the analysed publications related to information ethics?
4. What is the intellectual structure of the area of information ethics (the most cited authors, topics, trends)?
5. What are the main trends of the development of topics in information ethics studies?

3   Literature Review

Following the research questions, we use bibliometric methods that apply quantitative evaluation of a dataset of publications and bibliometric mapping of topics in order to discover the intellectual structure and new knowledge. Our study differs from previous ones in the original use of bibliometric mapping, which has not been applied on a larger scale in information ethics studies so far. The novelty of the methodology means application of bibliometric analyses in the specific context of information ethics. We have found similar studies related to ethics of information technologies (Heersmink et al., 2011; Ocholla et al., 2010; Stahl et al., 2010). Some of these studies have led to recommendations for the development of information strategies, especially in the European project ETICA (Fuchs, 2016; Stahl, 2016), and for the development of ethics of artificial intelligence (Floridi, 2020; Stahl, 2021; Floridi, 2023a). Other related topics of information science have been analysed using bibliometric methods, e.g., terminology (González-Valiente et al., 2021), production of institutions (schools) or journals (Mokhtari et al., 2021). A series of similar studies of the multidisciplinary characteristics of information science has been based on quantitative methods of evaluation of works published in information science (Järvelin & Vakkari, 2021; Vakkari et al., 2023). Further studies are mentioned in the research background. One of the most significant influencing factors for the development of information ethics was discussion, critical analyses and explanations of concepts by Floridi (2008), Capurro (2008), Stahl (2008) and Ess (2008) as part of a special issue of Ethics and Information Technology.

Fundamental bibliometric methodological principles have been presented in information science by Ingwersen and Christensen (1997) or Borgman and Furner (2002). Complex bibliometric methods have been used for analyses of big data, for discovering relationships among bibliometric units, such as documents, authors, institutions and keywords (Donthu et al., 2021; Leydesdorff, 2014). Researchers usually apply visualization and clustering methods for bibliometric mapping of scientific disciplines. In the field of information literacy, published studies have applied different types of bibliometric mapping.

For example, Pilerot (2016) presented a study focused on relations between practice and research. More general reviews based on bibliometric analyses were published by Pinto et al. (2013; 2015), Virkus (2013) and Stopar and Bartol (2019), focused on digital literacy. Hicks et al. (2023) presented an important contribution to bibliometric interpretations in information literacy. The authors applied qualitative interpretations of bibliometric analyses (qualitative mapping of information landscapes) and found four domains of information literacy research: higher education, management and business, public health, nursing and psychology. Thus, bibliometric methods can help discover patterns, monitor dynamics of topics, identify research trends and predict development. However, we identified a gap in the use of bibliometric methods for analyses of publishing in information ethics. Reviews of information ethics studies can be found in works such as Burgess and Knox (2019), Bawden and Robinson (2022), Kelly and Bielby (2016) or McMenemy (2021) and, in the context of AI ethics, mainly Floridi (2023a), Stahl (2021), Davenport (2018), Hagendorff (2020), van Otterlo (2018) or Etzioni and Etzioni (2017).

In this study, we apply an innovative mixed methodological approach. We use bibliometric methods of author co-citation analysis, co-word analysis and visualizations of topics in strategic diagrams for the topic of information ethics. Bibliometric mapping is interpreted in the light of previous content analyses of selected theoretical works and compared with results of qualitative analyses of data and discourse analysis as part of a Delphi study (Steinerová, 2022, 2023a). The Delphi study focused on the opinion of experts and their consensus on the ethical issues of information work in the digital environment. It was carried out in 2021–2022 as an online survey with selected experts from Slovakia and the Czech Republic. The study included four experts in a pilot study, 19 experts in the main study and six experts in an online discussion. The experts came from information science, computer science, social informatics, management, psychology, political science, library management and IT companies. The results emphasized social and cultural contexts of information ethics, tensions between people and technologies and the main values of information, such as utility, truth and objectivity. The experts' online discussion recommended more ethical sensitivity in society in future, including an information crisis, education of managers and information systems designers. For future, the focus on ethics of artificial intelligence and its use in education and information production were considered. A detailed content analysis of information ethics publications and results of the Delphi study were published elsewhere (Steinerová, 2023b). In the next sections, we will explain the applied bibliometric analytical methods and bibliometric mapping in more details.

4   Research Methods

We designed this study in the context of an exploratory analytical methodology supplemented with previous content analyses and qualitative analyses. The aim was to discover patterns and topics in publications on information ethics in line with knowledge discovery in information science. In the first step, we selected information resources for bibliometric analyses: specific databases of published works in information ethics. The criteria for selection of sources of articles were based on the multidisciplinarity of the databases, the concepts and topics used, indexing of most frequently cited journals and conference papers, accessibility of data for co-citation analysis and the use of the English language in titles, abstracts and keywords. In line with the research objectives and questions, we purposefully limited the search to the term "information ethics", although the topic is scattered in related areas of ethics of information technologies, libraries, information literacy and other related terms.

The first round of database searching took place in September 2022. We included the databases of WoS (Clarivate) and Scopus (Elsevier); later, we excluded the Scopus databases, as they did not include the subject of library and information science. The second round of searching took place in May 2023 in the Web of Science Core Collection. The resulting dataset was made up of publications published in 1988–2023 in sources registered in WoS which included the term "information ethics" in their titles, keywords

or abstracts. We retrieved 480 publications; 11 publications were excluded by additional qualitative analyses (removal of duplicate and irrelevant publications). The final dataset comprised 469 publications from 1988–2023. This database search is visualized in Table 1.

Table 1. *Query, timespan and extension of the dataset.*

Query	Retrieved	Excluded	Remaining	Timespan
TS = ("information ethics")	480	11	469	1988–2023

The retrieved publications were primarily articles (317), papers in proceedings (105) and book chapters (17). Several papers were assigned to two types of documents. We also included marginal types of documents (53), such as editorial materials or book reviews, in the number of publications. The reason is the individual authors' contribution to the general discussion on the topic of information ethics. However, these publication metadata records did not contain author keywords or abstracts, so they were not part of the thematic analysis.

The final dataset was subject to further analyses in accordance with the defined research questions. Based on descriptive statistics, we identified an increase in interest in the field of information ethics, the numbers and frequency of publications in the defined time period, main disciplines, journals, authors and the development of topics.

4.1 Co-citation analysis, co-word analysis, visualization

The main goals of bibliometric analysis are exploration, description, explanation, evaluation, discovery and prediction. The author co-citation analysis was used for discovery of the intellectual structure of the information ethics field. Co-citation analysis identifies similarities of bibliometric items (documents, authors, journals) based on their common appearance in references in publications. Author co-citation analysis follows the frequency with which an author's publication has been co-cited with another author's publication in the citing publication (Borgman & Furner, 2002; McCain, 1990). This analysis can help recognize the most influential authors based on citations and their impact on published works, while the measure of closeness of co-cited authors is the number of their co-citations in the analysed dataset of publications. Cluster analysis identifies groups of authors who can be linked with topics and perspectives from which they have studied the topic or define research "schools" focused on specific theoretical and methodological background (Eom, 2008; McCain, 1990). The result of the co-citation analysis is a network composed of cited authors (nodes) and links (connections) representing co-citations of linked authors. Visualization tools improve the identification of authors, clusters and mutual links. The co-citation analysis visualization was developed with the use of VOSviewer (https://www.vosviewer.com, visualization of similarities), which identifies clusters of topics and marks them with different colours. The space layout on the map represents the closeness of authors; the closer the placement of authors on the map, the more frequently they were co-cited and, thus, they deal with more related topics in their publications. The frequency of co-citations is represented by the thickness of the links and the size of a node (item) represents the number of the author's citations.

Co-word analysis was used for content analysis based on author keywords, keywords plus and terms from abstracts. Author keywords are terms that represent the principal content of a publication defined by authors. The authors usually apply wider, general terms. Keywords plus are generated by a Web of Science algorithm based on titles of cited publications (Clarivate, 2022). Abstracts present detailed information about the content, methods and results of publications. In further steps, the extracted data had to be cleaned and adjusted. We used all three types of text items within text analyses (author keywords, keywords plus, terms from abstracts). We used author keywords and keywords plus for a description of the topics and terms from the abstracts for validation. Results of the co-word analysis are

bibliometric maps of terms based on the frequency of their co-occurrence in publications. The maps are visualized, including the nodes (items) and connecting links (similar to the co-citation maps). The maps visualize clusters of terms that represent the topical areas. The VOS viewer and Bibliometrix software were used for these visualizations (Aria & Cuccurullo, 2017; Van Eck & Waltman, 2009).

In the last step of exploration, we developed a series of strategic diagrams (Callon et al., 1991). The idea of strategic diagrams is to place topics/clusters into 2D space, based on Callon's centrality values (x-axis) and Callon's density values (y-axis). The indicator of Callon's centrality represents the significance and relevance of the topic in the research area. It is based on the intensity of links of a topic with other topics. The indicator of Callon's density represents the state of the development of the topic through the density of connections of nodes/terms within the cluster. The topics/clusters in the strategic diagrams are placed into four quadrants using the values of density and centrality as variables. The first quadrant (upper right part) represents the topics with high density and centrality; the topics here are highly developed and strongly linked with other topics ("motor themes"). The second quadrant (upper left part) represents topics of high density and low centrality and includes topics that are highly developed, but relatively isolated and not highly linked with other topics ("niche themes"). The third quadrant (lower left part) presents new emerging themes or themes with low attention, based on lower values of density and centrality ("emerging or declining themes"). The fourth quadrant (lower right part) represents the low density and high centrality of topics; these topics are regarded as basic, transversal, as for the main stream of research interests ("basic themes").

4.2 Methodology limitations

The bibliometric mapping techniques are bound by several limitations, namely the limits of the input datasets and limits related to representations on the map (Heersmink et al., 2011). From the perspective of the input data, limitations to co-word analysis appear as the subjectivity of keywords defined by authors and the terminology used. Subjectivity in the description of the content of the author keywords leads to terminological inconsistency risks. This subjectivity is the result of differences in interpretations and variations of authors' understanding, background and perspectives on the topic. These variations are also manifested in the titles and abstracts of publications, which can include more insignificant words. Therefore, we had to clean the data before using them in the co-word analysis. The keywords were adjusted with respect to the use of plural/singular, abbreviations/full titles or synonyms. Regarding the terms in the abstracts, we excluded insignificant words and identified bigrams, from which we excluded general expressions ("frequent forms", "future research"), general verbs ("paper argues", "article concludes") or other insignificant expressions ("behavioural perception", "addressing ethical").

The limitations of the maps are related to possible loss of meaning and differences of interpretation in the overlap of general and specific concepts. The final visualizations and interpretations depend on decisions made with regard to queries, cluster weighting, keyword frequency thresholds and screening of concepts. For example, some specific concepts are not visualized on the map but can be significant for the topic, and the meaning is open and dynamic. Bibliometric mapping needs knowledge and experience to define visualization parameters, as well as knowledge of the subject to interpret and qualitatively evaluate results. In line with these limitations, we used complementary content analyses and qualitative analyses of main documents published in the field of information ethics, as well as results from qualitative analyses of data in a Delphi study for qualitative interpretations of the findings (Steinerová, 2023). This emergent mixed methodology was part of a larger project.

5 Findings

5.1 Characteristic features of publications in information ethics

Regarding the characteristics and timelines of publishing in the field of information ethics, we can identify four main periods based on the content and topics analyses and proved by the increasing numbers of publications (Figure 1): 1988–2005 (57 publications), 2006–2012 (143 publications), 2013–2019 (185 publications), 2020–2023 (84 publications). These time periods represent an increasing attention to topics of information ethics, raised by publishing and its content and topics, including major content milestones. The increased attention to information ethics within the dataset of published works started in 1988, when Robert Hauptman founded the Journal of Information Ethics and published his monograph *Ethical Challenges in Librarianship* (1988). Successive interest in the topic has later appeared in the works of Rafael Capurro and found its institutional grounds in the establishment of the International Center for Information Ethics (1999) and the journal International Review of Information Ethics (2004). Since 2006, Luciano Floridi has published his major works related to the philosophy of information, information ethics and ethics of information. Several basic background works were published in 2011 (*The Philosophy of Information* by Floridi, 2011) and in 2013 (*The Ethics of Information*, Floridi, 2013), including the topics on regulation of the digital environment (infosphere) (Floridi, 2018). Since 2020, we have noticed an increase in publications focused on ethics with regard to health information / disinformation related to the COVID-19 pandemic. Based on the content analyses, we can state that this period has been marked by an increased attention of authors focused on ethics of artificial intelligence (AI) and data ethics (e.g., Davenport, 2018; Stahl, 2021; Floridi, 2020; Floridi, 2023a; Gorichanaz, 2023).
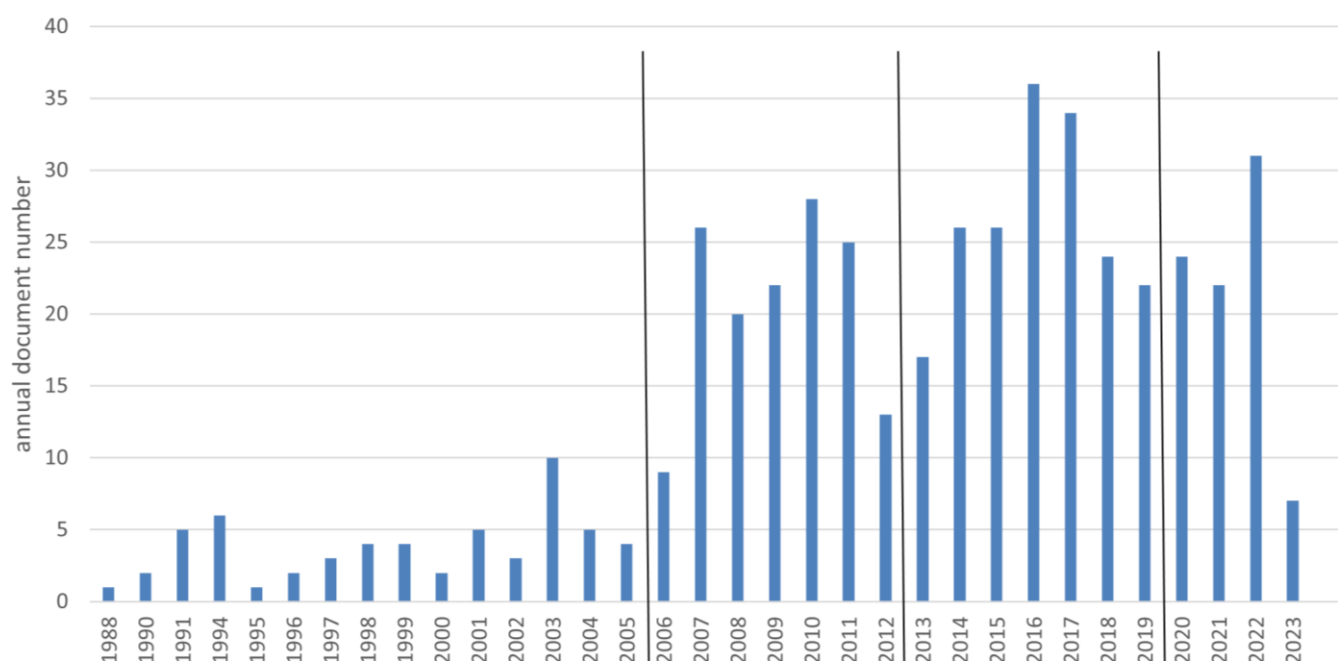

Figure 1. *Numbers of works in information ethics published in 1988–2023.*

Bibliometric analyses combined with content analyses also confirmed the multidisciplinary nature of information ethics (Figure 2, Table A4 in the Appendix A). Publications in WoS are categorized into scientific disciplines (WoS categories) by the publication sources, while one publication can be categorized into several disciplines. In the analysed dataset, the dominating discipline was information science and library science (177 publications), ethics (100 publications) and computer science and information systems (75 publications). Ethics was assigned to the blue cluster with philosophy (38 publications) and history and philosophy of science (18 publications). All the topics are related to the philosophical frameworks of ethics (Fallis, 2007; Floridi, 2013; Froehlich, 2004). These frameworks include virtue ethics (general ethical

values), consequentialism (rules), utilitarianism (outcomes) and ethics of caring. In the context of information science, information ethics has developed within the traditional topics of library ethics and later combined with contexts of media ethics and ethics of information technologies. Relatively close interdisciplinary links can be identified with the subdisciplines of information literacy and education and with computer sciences, recently related to the topics of ethics of artificial intelligence and data ethics (red cluster). Another close relationship was found between information ethics and information systems and information management (ethics of business and management; green cluster). Further related disciplines are communication sciences (media, marketing communication), psychology and health information (medical ethics), see Figure 2.
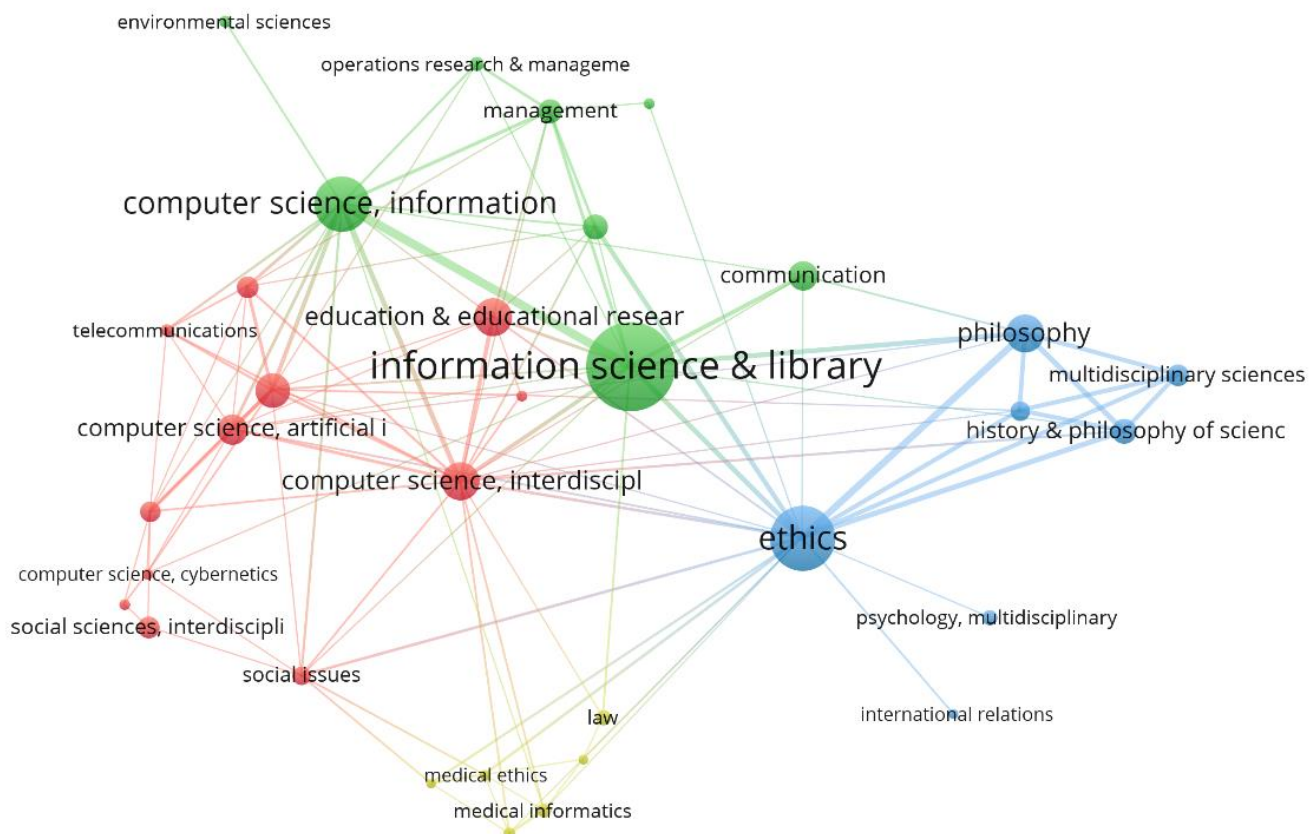

*Figure 2. Main disciplines represented in publications on information ethics
(co-occurrence of 33 WoS categories to which sources were assigned).*

Regarding countries, the highest numbers of published works (according to the authors' country affiliations) can be found in the United States (121), the United Kingdom (46), China (42), Germany (21) and Japan (16) (Table A5 in the Appendix A). The main journals based on numbers of publications include the International Review of Information Ethics (ICIE) (34), Ethics and Information Technology (Springer) (11), Journal of Business Ethics (10), Journal of Information Communication & Ethics in Society (10) and Science and Engineering Ethics (Springer) (10) (Table A6 in the Appendix A).

The journals with high levels of impact based on number of citations are Science and Engineering Ethics (449 citations), Journal of Business Ethics (228), European Journal of Operational Research (Elsevier) (216), Ethics and Information Technology (183) and Philosophical Transactions of the Royal Society A – Mathematical, Physical and Engineering Sciences (182) (Table A7 in the Appendix A). Emerging topics of information ethics focused on ethics of artificial intelligence (AI) are represented by journals such as AI and Society (Springer) and Behavior and Information Technology (Springer). Main conferences are represented by topics such as ethics of management (Annual Interdisciplinary Information Management Talks Conference), ethics of education (International Conference on Efficiency and Responsibility in

Education) and ethics of information technologies (International Conference on Advanced Computer Science – Application and Technologies). In the framework of information and library science, we can mention conferences such as CoLIS (Conceptions in Library and Information Science), ISIC (Information Seeking in Context) and ECIL (European Conference on Information Literacy).

5.2 Intellectual structure of information ethics publications

Our analyses discovered the dominant positions of the two most productive and most frequently cited authors, i.e., Luciano Floridi (12 publications, 528 citations) and Rafael Capurro (10 publications, 214 citations) (Table A8 in the Appendix A). The results of the author co-citation analyses (Figure 3, Table A9 in the Appendix A) are visualized by a map with four overlapping thematic areas linked with the main authors, including pioneer authors in ethics of information technologies and systems, such as N. Wiener, J. H. Moor, R. Mason and T. Bynum.
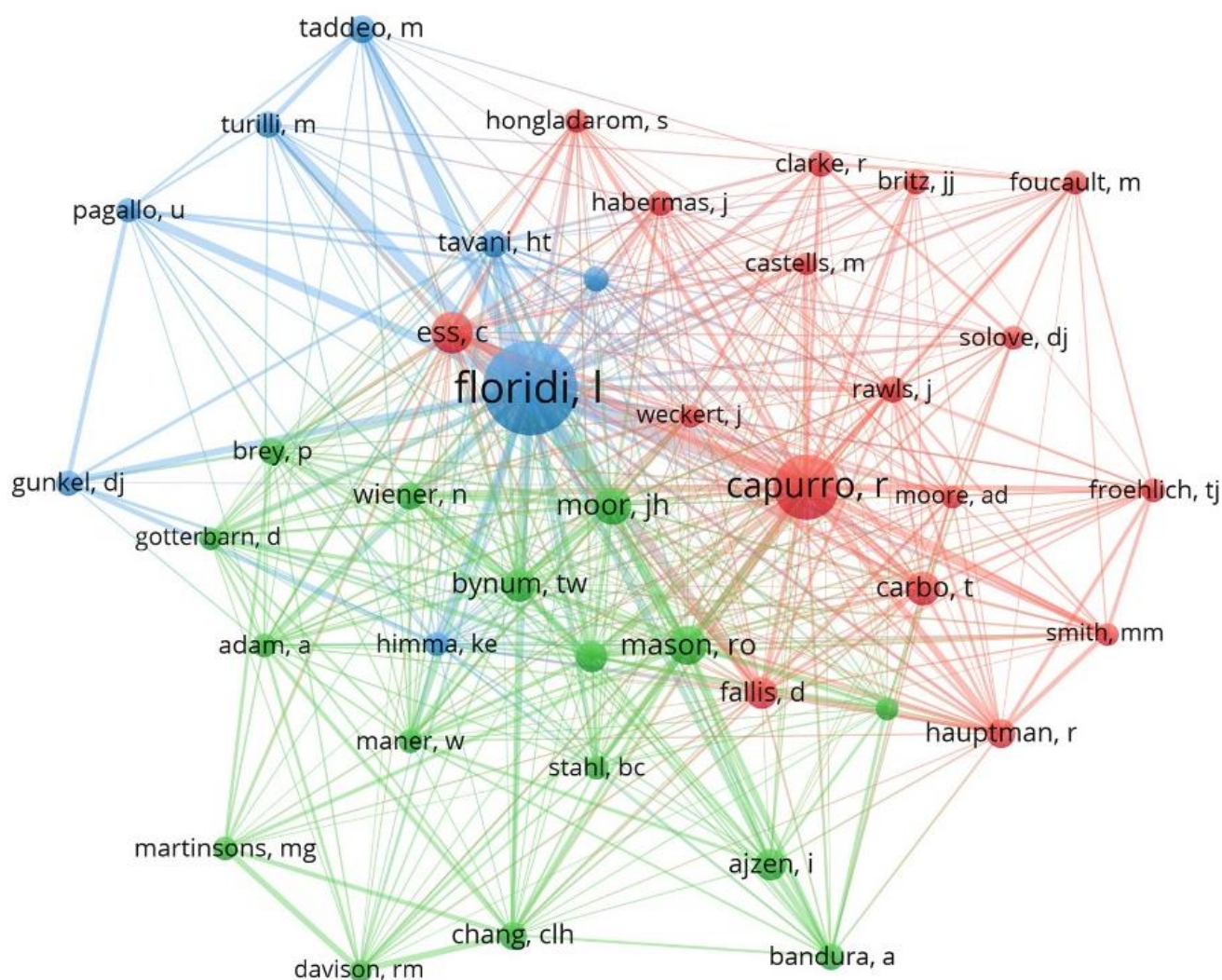

Figure 3. *Results of author co-citation analysis (41 authors out of 9947 meet minimum 15 citations).*

Another cluster of early authors comprises authors who published in the area of library ethics (M. Smith, T. Carbo, T. Froelich). The main (third) cluster comprises founders of information ethics, including R. Hauptman, R. Capurro and L. Floridi, who have published since the 1980s and 1990s. These authors have synthesized information ethics integrating library ethics, media ethics and computer ethics and developed specific concepts of digital ethics and online ethics (R. Capurro) and ethics of information (L. Floridi). The map also illustrates that many authors have applied general ethical philosophical theories to the topic of information ethics (M. Foucault, I. Kant, J. Habermas). Connections were found among authors in social

psychology (A. Bandura, I. Ajzen) and theories of justice (J. Rawls). Further authors who have developed ethical issues and have been linked with the main authors in the co-citations have focused on topics such as information society (M. Taddeo), media (M. Castells) or information systems (K. E. Himma and H. Tavani). Our prior content analyses confirmed the evolution of topics by the main authors and the development from isolated topics of ethics of libraries and information systems to the integrated topics of information ethics and digital ethics (Steinerová, 2023).

In general, the topics can be categorized into user-driven perspectives (social sciences, philosophy) and systems-driven perspectives (ethics of information technologies). The last cluster of the resulting co-citation analysis comprises links with authors who have elaborated information ethics in the related frameworks of informational privacy, design of information systems (H. Nissenbaum) and in relation to value-sensitive design (Friedman & Hendry, 2019). The results of this co-citation analysis confirmed strong links with authors who have focused on ethics of artificial intelligence (B. C. Stahl, L. Floridi) and ethics of social informatics (W. J. Orlikowski). These latest topics have developed in the analysed dataset especially since 2018.

5.3 Topics and trends in information ethics

The structure of themes of the published works was analysed using co-word analysis and analysis of author keywords and keywords plus. We selected 127 keywords that occurred three or more times in the dataset of published works. The resulting visualization is illustrated in Figure 4. The size of the nodes (keywords) corresponds to the keyword occurrence frequency; some of the keyword labels are overlapping and cannot be visible due to the density of the nodes.
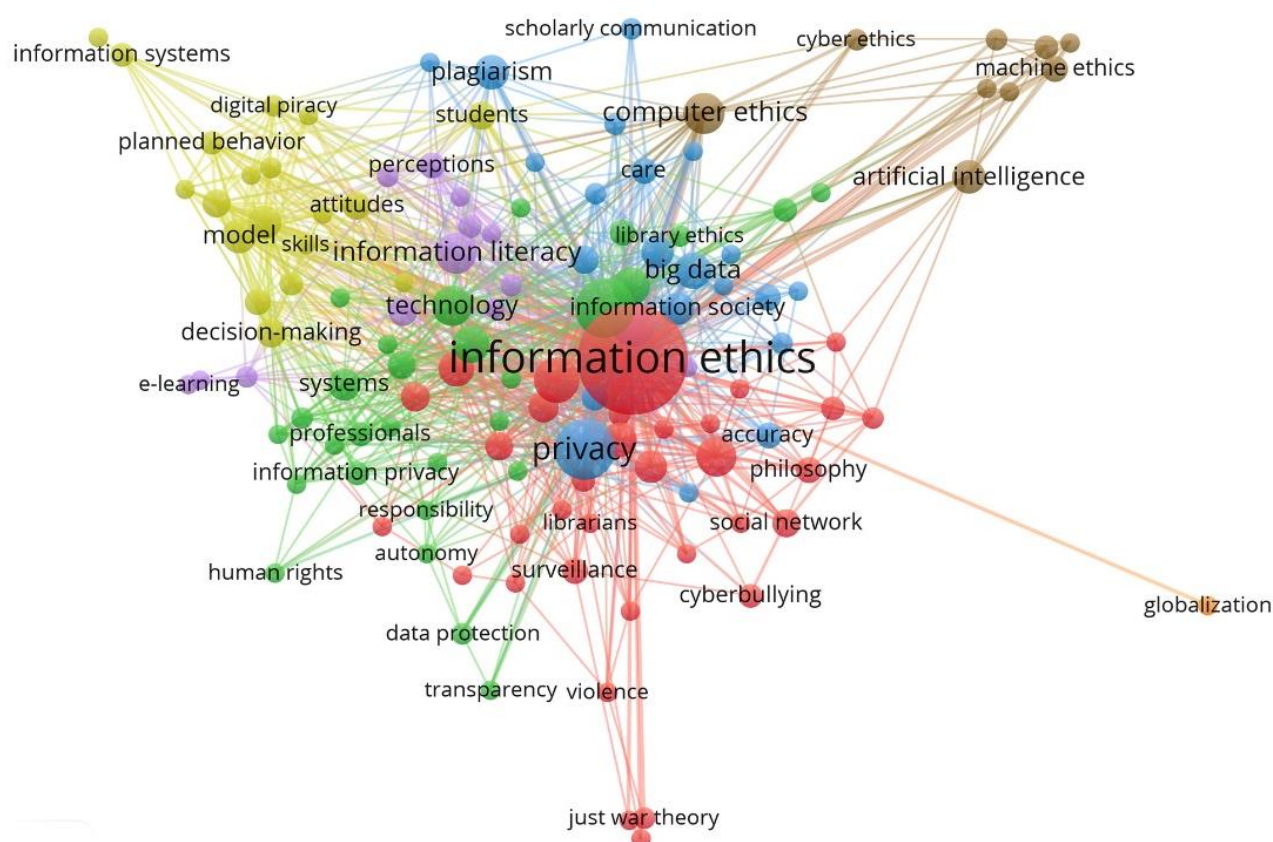

Figure 4. *Visualization of author keywords and keywords plus co-occurrence*
(127 keywords out of 1426 meet minimum 3 occurrences).

The main topics representing the content of publications in the field of information ethics are privacy, accuracy of information (including dis/misinformation), technologies and computer ethics (namely ethics of artificial intelligence), information literacy, scholarly communication and academic communication (e.g., plagiarism, science policy) and the emerging topic of data ethics (Figure 4, Table A10 in the Appendix A). In this resulting visualization, we can identify six clusters of themes of information ethics represented by different colours. The central theme is information ethics, which is linked strongly with sub-themes in the red cluster, including library and information science, information, knowledge, librarians, censorship and copyright. Ethical aspects of social networks, copyright or cyberbullying are also represented as significant topics in the red cluster. This cluster of topics is also linked closely with philosophy and ethics, including virtue ethics, epistemology, deontology and just war theory. The main topics are visualized in separate clusters, which include further subtopics. We can identify the theme of ethics of information systems, digital environment and information security, including ethics of "digital piracy", "digital rights", "planned behaviour" or "organisations". The intersection of computer ethics and information ethics (brown cluster) visualizes the emerging topic of ethics of artificial intelligence, exemplified by keywords such as "robot ethics" or "cyber ethics".

Another thematic cluster confirmed the significance of ethics in the context of information literacy (violet cluster). In recent years, the focus has been on digital literacy, online education and topics represented by keywords such as "digital divide", "infosphere" and "misinformation". In the context of education content, the field is closely connected with the field of information security in the yellow cluster. The focus on scholarly communication (blue cluster) is represented by keywords such as "research ethics" and "data ethics". The emphasis is on topics of plagiarism, academic dishonesty and integrity, academic policy and caring for the environment. Data ethics is related to keywords such as "big data", "data privacy" and "informed consent".
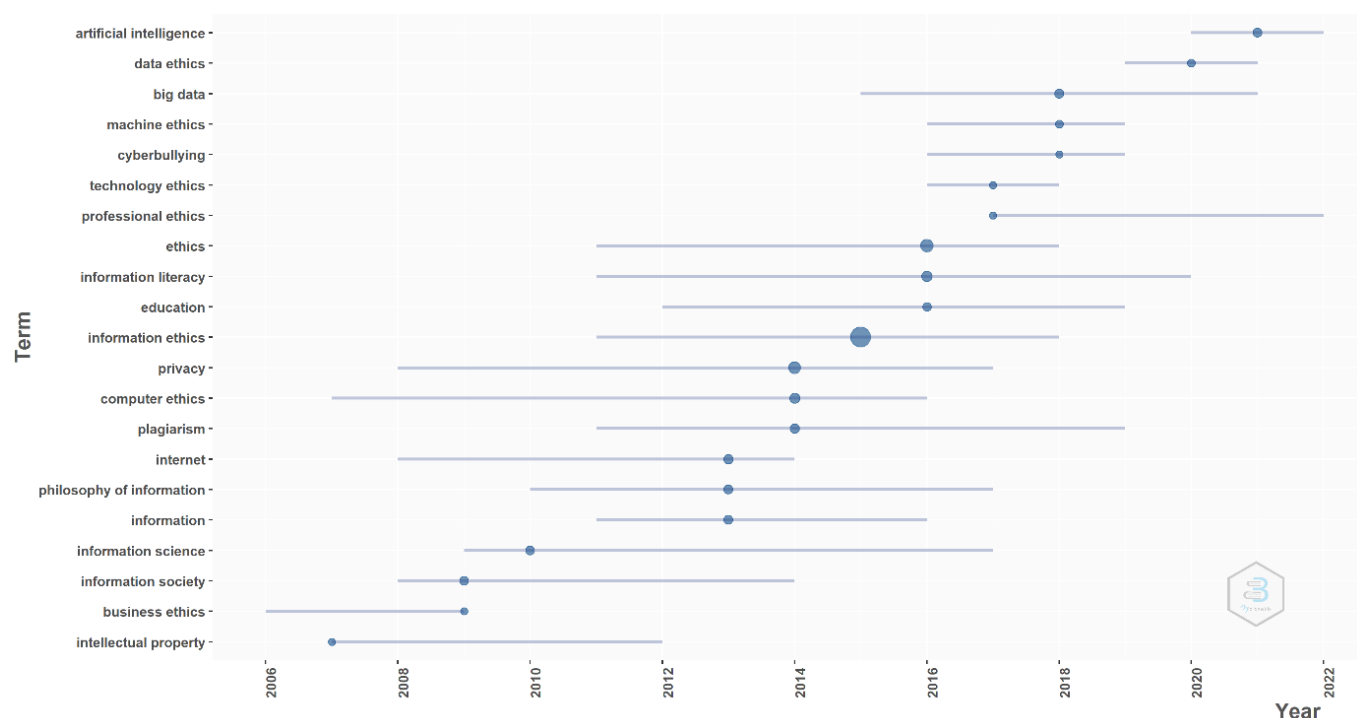
***Figure 5.** Trends in development of themes in information ethics.*

The thematic shift of published works towards ethics of artificial intelligence, data ethics, academic integrity (dishonesty) or misinformation was confirmed by further analyses and the overlay visualization based on the average occurrences of keywords in the years of the defined timeline. These trends in the development of topics of information ethics are visualized in Figure 5. The timeline represents the years and the occurrences of significant keywords in the individual years. Each keyword was visualized in a

timespan of years in which the keyword occurrence frequency was 50% out of all keyword occurrences (from the first to the third quartile). The placement of words is based on the median of the year of their occurrences, the size of the nodes represents the number of occurrences of the word.

5.4 Evolution of themes of information ethics in strategic diagrams

In further analyses, we followed the thematic development of information ethics studies published in the identified four time periods, i.e., 1988–2005, 2006–2012, 2013–2019, 2020–2023. The themes were analysed with the use of a co-occurrence analysis of 150 most frequent bigrams from the published abstracts. Bigrams from abstracts are two-word noun phrases that represent a detailed description of the content and can be used for the validation of results based on keywords. Thematic clusters of bigrams were visualized by strategic diagrams with the use of Bibliometrix software (Figures 6 and 7). The bigram with the highest number of occurrences is used as the cluster label.
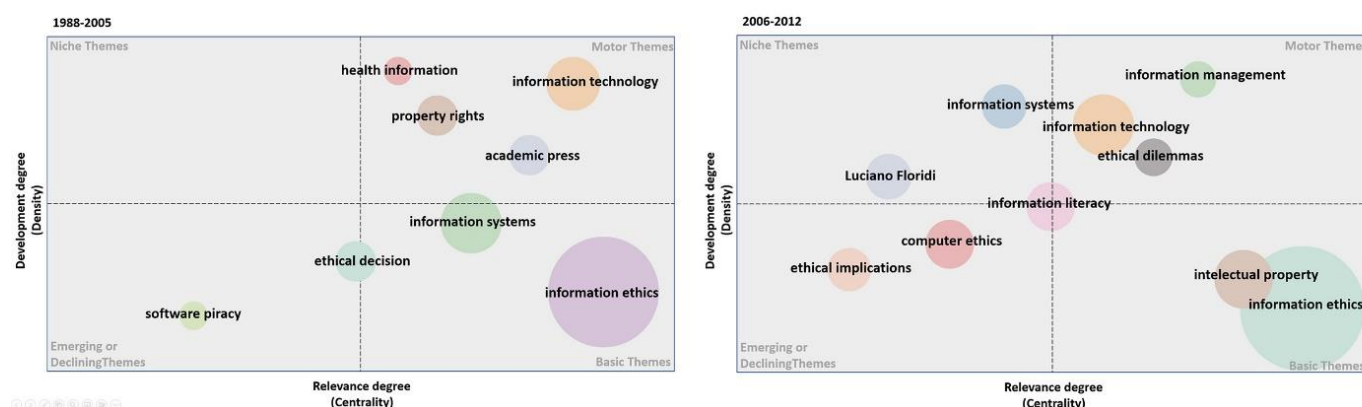

Figure 6. *Strategic diagrams 1988–2005, 2006–2012*.

The interpretation of the evolution of topics was supplemented by previous content analyses of related works. The milestones of information ethics publishing are: 1988 (R. Hauptman and the Journal of Information Ethics), 2006 (R. Capurro and the establishment of the International Center for Information Ethics), 2013 (Floridi and his Ethics of Information) and 2020 (ethics of artificial intelligence by Floridi and others). In 1988–2005 (Figure 6, Tables A11 and A12 in the Appendix A), the distribution of topics on the right side of the strategic diagram (with a high value of centrality) shows a relatively large interconnectedness and relevance of individual themes. The basic topics include information systems with a focus on informational privacy and a more general topic of information ethics dealing with information professionals and information poverty. Topics oriented to information technology, intellectual property and health information are included in the motor themes. Due to the lower number of publications in this group, the topics are not developed more broadly and are represented by only a few terms.

The years 2006–2012 were marked by a rapid increase in interest in information ethics, represented by works by Rafael Capurro and Luciano Floridi (Figure 6). The period was also marked by a discussion among the main authors focused on the background of the philosophical concepts of information ethics (Floridi, 2008; Capurro, 2008). The increase in the number of publications was manifested by the increasing number of themes. As opposed to the previous period, the themes are distributed evenly in all four quadrants and the interconnections and relevance are lower. Information ethics is a basic theme and its cluster includes the topics of information society, ethics of education, privacy and intercultural information (attributed to and linked with the term R. Capurro). The second basic theme is the intellectual property related to R. Mason's (1986) four ethical issues of the information age (privacy, accuracy, property, access). In the quadrant of the motor themes, we can find themes such as information management, information security, information privacy and data protection, information technology in business organizations and ethical dilemmas related to professional ethics and ethical theories. A separate

emerging theme is information literacy linked to information education and information processing. Slightly isolated themes in the upper left quadrant are focused on ethics of information systems and health information. A specific theme is represented by Floridi (2008), emphasizing his principal contribution to the development of ethics of information. In the lower left quadrant, new topics of computer ethics emerge, linked with applied ethics and cyber ethics.
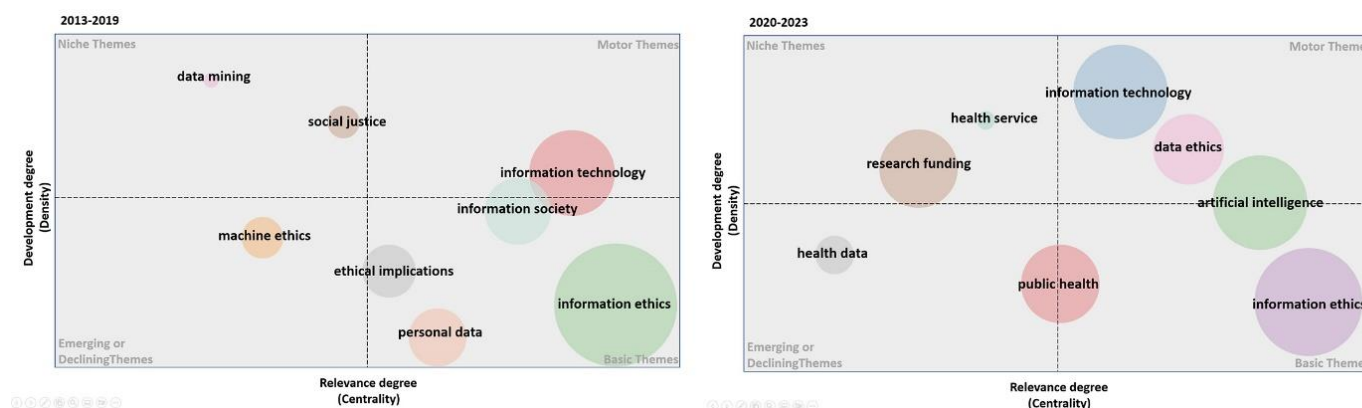
Figure 7. *Strategic diagrams 2013–2019, 2020–2023.*

The situation in 2013–2019 indicates that nearly 40% of all the publications in the whole dataset were published in that period (Figure 7, Tables A13 and A14 in the Appendix A). In comparison with the previous period, the themes are interconnected more intensely with a higher centrality score. The majority of themes are categorized into basic themes; however, the structure and content have changed. The thematic cluster of information ethics is connected to the closest topics of information literacy and education. Information ethics has also appeared in the thematic cluster of the academic environment, closely interconnected with education and research ethics. The thematic cluster of information technologies has shifted towards new topics such as social media and related privacy issues. We can find several thematic clusters focused on societal issues of information ethics in the themes of these clusters. The topics of information society are interconnected with ethical theories and ethical values, human values and ethical behaviour. Ethical issues such as information warfare, war theory and ethical regulations are related to ethical implications. A slightly isolated thematic cluster is social justice, focused on digital divide, knowledge construction and broadband access. Personal data is a new theme in the basic themes. The data-oriented thematic cluster comprises themes such as data science and data protection related to media ethics and artificial intelligence. In the lower left quadrant, another theme of machine ethics has appeared, connected to topics such as technology ethics, autonomous systems and moral agents, all related to ethics of artificial intelligence.

The thematic structure of the last period (2020–2023) (Figure 7) is composed of more concrete themes, resulting from two main factors: the COVID-19 pandemic and the development of artificial intelligence. A new thematic area of public health is connected with ethical challenges of the pandemic, such as conspiracy theories, awareness, health information and social media. Another highly relevant theme is the theme of artificial intelligence, which includes digital age, robot ethics and computer ethics. Among the motor themes, data ethics has emerged, partly linked with the topic of personal data. The theme of information technology is highly relevant in that period, as shown in the upper right quadrant. In contrast to previous periods, the theme of information technology is linked to the theme of information literacy, which has moved from basic to motor themes. A relatively separate, less interconnected theme is research funding, focused on publishing ethics and predatory journals. The evolution of topics proved the shift from atomic studies to more integrative approaches of information ethics, ethics of information and ethics of AI.

6   Discussion

This study proves that there has been a significant increase in interest in the topics of information ethics in publishing in different areas, mainly in computer science and AI, education and library and information science. We discovered the intellectual and thematic structure of the field of information ethics based on bibliometric analyses. We argue that there is significant diversity and multidisciplinary dynamics of the development of publishing that are related to the multidimensionality of information in contexts. The increase in publications was noted especially in the years 2006–2023. The dominant related contexts are information systems, artificial intelligence, informational privacy, personal data, online communication and digital environment, information literacy and education and data ethics (big data). Bibliometric analyses and mapping were interpreted using the results of previous content analyses and the results of a Delphi study. The most significant trend is the topic of ethics of artificial intelligence in contexts of information crisis, education and information literacy (Haider and Sundin, 2022). New perspectives on information experience related to ethical issues of information and information design have emerged (Gorichanaz, 2017, 2023).

As for the intellectual infrastructure, we found that the dominant journal is the International Review of Information Ethics. Further domains related to the field of information ethics are media ethics, computer ethics, digital ethics and data ethics. The most significant and dominant topic is ethics of artificial intelligence. The co-citation analyses confirmed the most frequently cited cognitive authorities, namely Robert Hauptman, Rafael Capurro and Luciano Floridi. The analysis of the structure of the authors and content has been presented in detail elsewhere (Steinerová, 2023). Significant contexts of information ethics in the main authors' analysed published works are online communication and intercultural ethics (Capurro) and ethics of information, logics and semantics and ethics of data (Floridi). We can also identify some tension between the universal approach to information ethics and the contextual, intercultural approach (Floridi, 2008; Ess, 2008). In recent publications, these authors have explored ethics of artificial intelligence and human-robot interactions (Novelli et al., 2023; Capurro, 2019; Floridi, 2023a,b). The main concerns of ethical issues of artificial intelligence are the accountability of systems, information strategies, trust and responsibility and development of public digital services and recommender systems. The five principles of ethics of AI include beneficence, non-maleficence, autonomy, justice and explicability (Floridi, 2023a).

We also discovered the structure of topics of publications, the timeline and evolution of publishing in four time periods. The milestones of the periods are 1988 (R. Hauptman), 2006 (R. Capurro, L. Floridi, International Center for Information Ethics, 2013 (L. Floridi, ethics of information, informational privacy, ethics of information literacy) and 2020 (ethics of artificial intelligence, dis/misinformation, data ethics). The content analyses and the main authors' discussion in 2008 in the journal Ethics and Information Technology (Floridi, 2008; Capurro, 2008) pointed to their different philosophical backgrounds in interpreting the complexity of information ethics. While Capurro has developed mainly continental philosophical traditions of thinkers such as Kant and Heidegger, including intercultural ethics (Capurro, 2008), Floridi has developed the tradition of analytical language philosophy and logics (Floridi, 2008) with an emphasis on ethics of artificial intelligence (Floridi, 2023a).

As for the methodologies, the dominant methods applied in the analysed works were theoretical and philosophical analyses, but we also found a number of empirical studies, including case studies (Buchanan & Henderson, 2008), experiments, user experience testing and value-sensitive design (Friedman & Hendry, 2019). Several studies applied empirical user surveys or expert opinion consensus (Delphi study), including innovative methodologies that applied mixed empirical methods with conceptual modelling. More qualitative studies could help develop the topics in deeper contexts (Lloyd, 2021). The resulting analyses confirmed the categorization of information ethics studies into general studies focused on common social and epistemic values of information (virtue ethics) and culturally driven studies

(intercultural, local, professional and institutional ethics), including academic ethics, ethics of librarians and information professionals, ethics of managers, etc. We propose application of these findings to information strategies and development of public information digital services, especially with respect to ethics of artificial intelligence. The question is whether the use of AI tools can enhance creativity, education, information ethics or information literacy.

In our study, we used a mixed innovative methodology which connected qualitative methodology (content analyses, a Delphi study) at the beginning and then supplemented the results with bibliometric analyses. Results of the quantitative analyses of data were used for qualitative interpretations of the results of bibliometric analyses within a larger project. The results of the content analyses and a Delphi study (Steinerová, 2022, 2023) pointed to a common consensus of experts and differences in applied areas of information ethics and the use of AI tools. The diversity of topics appeared as a result of different philosophical, social, psychological, computer science, educational, political, or behavioural backgrounds. Common intersections of different methodologies (bibliometric analyses, content analyses, a Delphi study) resulted in the emphasis on social and cultural contexts of information technologies and human information interactions. Common topics include informational privacy, accuracy of information (mis/disinformation), algorithmic bias, information literacy, social perception and social diffusion of information. Our results also identified tensions between people and technologies, namely the topics of intellectual property rights (issues of plagiarism), accessibility of digital information and services (power interests, digital divide) and relations to information and digital literacy. At the level of values of information, the most appreciated values were truth, utility and objectivity in contexts of responsibility, accountability of systems (AI) and information literacy. Ethics of AI raised concerns of algorithmic bias in contexts of information crisis, informational privacy and information security (e.g., selection of employees, evaluations in banks, disinformation). In comparison with other studies (Section 3), our study contributed to the information ethics research by methodological innovation which discovered ways of presenting the complexity, dynamics and evolution of the topic, namely connections between the universal ethical categories and intercultural differences and the impact of the digital environment. The novelty of our results is in discovering hidden contexts, topics and trends. We developed an "image" of information ethics studies and proved the topical gist of the studies focused on values of information (truth, utility) and social and cultural rules, based on required trust, responsibility and closer collaboration of people and intelligent technologies.

The main trends in the evolution of topics include ethics of artificial intelligence, data ethics, informational privacy and personal data, health data and digital literacy. These topics are all complex concepts, that is why we propose collaboration of different disciplines (especially computer science, social informatics, social and behavioural sciences, education, management, psychology and information science), different professionals and institutions. New ethical disciplines have emerged, such as bioethics, nanoethics and applied areas of academic integrity, ethics of managers, research ethics, research integrity and ethics of developers of artificial intelligence. Theoretical implications of this study are related to the enhancement of studies and frameworks of ethics of information and ethics of artificial intelligence, especially collaboration of different disciplines, professionals and institutions, as noted in several recent collaborative initiatives (Floridi and Cowls, 2019; Milano et al., 2021). Practical implications lead to recommendations for including ethical issues in the development of public digital services, digital libraries, recommender systems and value-added services of library and information institutions. Recommendations for practice are also directed to the development of new courses on information ethics, academic integrity, moral literacy and related courses of information studies, including professional courses for library and information professionals (e.g., data literacy, algorithmic and AI literacy) (Semeler et al., 2024). The transformative strength of information ethics can be embodied in the methodology of value-sensitive design of services, education, libraries, business and information literacy. However, ethics

of artificial intelligence needs more attention in many applied areas of information interactions, including education, research, online searching, everyday life information, health, banking and social policies.

7   Conclusions

Different communities have paid increasing attention to the ethical issues of information use and production in the digital environment and many studies have resulted in the common topic of ethics of artificial intelligence, as indicated in our results (e.g., strategic diagram 7, Figure 5, Figure 4). This study is the first attempt to analyse and discover the field of information ethics with the use of bibliometric methods on published production. The main resulting message based on the complex mixed and emergent methodology is the need to enhance ethical sensitivity in the information crisis. The findings of our bibliometric analyses (Figure 2) also indicate that considerable interest in information ethics can be found in different disciplines. The common transferrable perspective is the transdisciplinary emphasis on education and information literacy in many contexts. For future development, we can foresee closer links among the fields of information ethics, information literacy, human information behaviour and artificial intelligence. Inclusion of ethical factors in models of information literacy, information behaviour and information interactions could enhance further research and practice. Challenges for future research have resulted from links among the topics of information ethics, information creativity and artificial intelligence in a variety of contexts (education, research, healthcare, human relations, law, autonomous systems, management, finances, banks, etc.). In the development of concepts and theories, the philosophical background represents a major inspiration for innovative methodologies and frameworks, e.g., information experience and information design (Gorichanaz, 2020). A strong stream of information ethics studies has focused on intercultural information ethics based on diversity of information, communities and related values of information, which has transformed information science and information work (McMenemy, 2021). A big issue is the consideration of ethical dilemmas in information cultures in the digital age (Kelly and Bielby, 2016).

We compared differences among results of bibliometric analyses, content analyses and a Delphi study and adjusted and verified our final conceptual models. We found that experts in the panel emphasized human issues of information use in the digital environment and information crisis. Experts also addressed the issue of ethics of artificial intelligence, its threats and risks and proposed closer cooperation among professionals, institutional stakeholders, providers of digital services and ethical education in all types of schools. These results indicate that more qualitative studies are required alongside with bibliometric mapping. Collaboration of different scientific disciplines is required, such as information science, computer sciences, cognitive sciences, psychology, educational sciences, social informatics, social sciences, philosophy, management, law, political sciences, etc. Our main proposal is to enhance the ethical sensitivity of society through closer collaboration.

For the practice, we propose development of the ethical awareness of society and recommend ethical education of managers and software (AI) developers, including managers of research, education and information systems, media, libraries and IT companies. Ethical issues are essential for the development of public policies, media, educational, information and research policies and for support of management and business. For practitioners, this study confirms the need to work on collaborative information ethics projects and education. Information ethics studies based on empirical data can help find innovative ways of research and development of the applied areas of education, research, online communication and media. Value-sensitive and ethically driven services of digital libraries can improve design of new spaces, places, products and systems. Information ethics research can help support ethical information behaviour in people's everyday life, ethically driven information literacy, ethical use of AI tools and ethical use, sharing and production of digital information. Challenges in ethics of AI include social rules, transparency and accountability of algorithms, algorithmic bias and personal data. In this context, our paper contributed

to the theoretical understanding of information ethics studies and to bridging the gap between information ethics studies and studies of human information interactions.

Additional Information and Declarations

Conflict of Interests: The authors declare no conflict of interest.

Author Contributions: J.S.: Conceptualization, Methodology, Writing – Original draft preparation. Writing – Reviewing and Editing. M.O.: Search, Data curation, Visualization, Bibliometric Methodology, Software, Validation.

Data Availability: The data that support the findings of this study are available from the corresponding author via the Academic Library of Comenius University in Bratislava, Slovakia.

Appendix 1: Tables A2–A14

Table A2. Data description – timespan, number of sources and documents, document types.

MAIN INFORMATION ABOUT DATA	
timespan	1988–2023
sources (Journals, Books, etc)	286
documents	469
DOCUMENT TYPES	
articles	317
proceedings papers	105
book chapters	17
others (editorial material, book review)	53
AUTHORS	
authors	692

Table 3. Numbers of publications published in the time periods.

Time period	Number of publications
1988 – 2005	57
2006 – 2012	143
2013 – 2019	185
2020 – 2023	84

Table A4. *Top 10 WoS categories to which were sources of publications assigned (WoS category, number of publications in the category, total link strength of the category node at the co-occurrence map – Figure 2).*

	WoS category	Number of publications	Total link strength
1	information science & library science	177	99
2	ethics	100	109
3	computer science, information systems	75	94
4	computer science, interdisciplinary applications	38	68
5	education & educational research	38	23
6	philosophy	38	74
7	computer science, theory & methods	32	45
8	computer science, artificial intelligence	25	25
9	communication	23	14
10	history & philosophy of science	18	52

Table A5. *Top 12 the most productive countries with at least 9 publications (country, number of publications, SCP: number of single country publications, MCP: number of multiple country publications).*

	Country	Number of Publications	SCP	MCP
1	USA	122	109	13
2	United Kingdom	46	41	5
3	China	42	37	5
4	Germany	21	17	4
5	Japan	16	15	1
6	Brazil	12	11	1
7	Canada	12	10	2
8	Italy	10	7	3
9	Czech Republic	9	9	0
10	Korea	9	9	0
11	Netherlands	9	6	3
12	South Africa	9	7	2

Table A6. *Top 13 journals with at least 5 publications (journal, number of publications).*

	Journal	Number of publications
1	International review of information ethics	34
2	Ethics and information technology	11
3	Journal of business ethics	10
4	Journal of information communication & ethics in society	10
5	Science and engineering ethics	10
6	Libri-international journal of libraries and information studies	7
7	Information society	6
8	Library trends	6

	Journal	Number of publications
9	Journal of the american society for information science and technology	5
10	Ibersid-revista de sistemas de informacion y documentacion	5
11	Information research-an international electronic journal	5
12	Journal of information ethics	5
13	Triplec-communication capitalism & critique	5

Table A7. *Top 11 the most cited journals with at least 69 citations (journal, number of citations, h-index).*

	Journal	TC	h-index
1	Science and engineering ethics	449	8
2	Journal of business ethics	228	8
3	European journal of operational research	216	1
4	Ethics and information technology	183	6
5	Philosophical transactions of the royal society a-mathematical physical and engineering sciences	182	2
6	MIS quarterly	145	1
7	Information society	137	5
8	Journal of management information systems	87	2
9	Journal of medical internet research	78	2
10	International review of information ethics	69	4
11	Minds and machines	69	4

Table A8. *Top 10 authors with the most publications
(author, number of publications, number of publications fractionalized).*

	Author	Number of publications	Number of publications fractionalized
1	Floridi, L	12	9,25
2	Capurro, R	10	8,5
3	Sigmund, T	8	7,5
4	Taddeo, M	7	5,25
5	Bendel, O	6	6
6	Bawden, D	5	3,5
7	Carbo, T	5	3,25
8	Vaccaro, A	5	2,67
9	Smith, MM	4	2,75
10	Britz, J	3	1,17

Table A9. *Top 10 the most cited author with at least 35 citations (author, number of citations, total link strength of the author node at the author co-citation map – Figure 3).*

	Author	Number of citations	Total link strength
1	Floridi, L	528	2285
2	Capurro, R	214	1057
3	Ess, C	67	509
4	Mason, RO	59	385
5	Moor, JH	56	422
6	Carbo, T	43	200
7	Bynum, TW	39	472
8	Johnson, DG	36	339
9	Ajzen, I	35	182
10	Fallis, D	35	293

Table A10. *Top 10 most frequent keywords with at least 15 occurrences (keyword, number of occurrences, total link strength of the keyword node at the co-occurrence map – Figure 4).*

	Keyword	Number of occurrences	Total link strength
1	information ethics	212	450
2	privacy	48	154
3	ethics	46	125
4	information	24	75
5	computer ethics	19	59
6	information literacy	19	36
7	internet	18	60
8	library and information science	17	45
9	technology	17	68
10	information technology	15	39

Table A11. *Terms in clusters at strategy diagram – period 1988–2005 (name of cluster, total number of occurrences of all terms in the cluster, list of terms in the cluster – Figure 4).*

1988–2005		
Cluster	Terms occurrences	Terms in the cluster
academic press	4	academic press, electronic information
ethical decision	4	ethical decision, moderating role
health information	2	health information
information ethics	30	information ethics, information professionals, information policy, information poor, information rich, so_called information
information systems	9	information systems, information privacy, tpb_based model

1988–2005		
Cluster	**Terms occurrences**	**Terms in the cluster**
information technology	7	information technology, information science, social ethical
property rights	4	property rights, intellectual property
software piracy	2	software piracy

Table A12. *Terms in clusters at strategy diagram – period 2006–2012 (name of cluster, total number of occurrences of all terms in the cluster, list of terms in the cluster – Figure 4).*

2006–2012		
Cluster	**Terms occurrences**	**Terms in the cluster**
computer ethics	23	applied ethics, business ethics, computer ethics, ethics information, cyber ethics, modern society
ethical dilemmas	14	ethical dilemmas, professional ethics, culture perspective, ethical theories, ethics codes
ethical implications	18	ethical implications, information professions, global information, electronic journals, ethical concerns, ethical obligations, ethics ice
information ethics	154	information ethics, information science, information society, ethics education, information professionals, intercultural information, artificial intelligence, teaching information, intercultural dialogue, LIS programs, integrating information, LIS educators, Rafael Capurro, social responsibility, society information, virtue ethics, academic field, closely related, comprehensive research, current research, ethical reflection, ethics held
information literacy	22	information literacy, information processing, information searching, theoretical framework, human rights, information education, information effectively, school students
information management	13	information security, information management, data protection, digital information, information privacy
information systems	19	information systems, health information, learning materials, epr laboratory, electronic patient, epr systems, ethical codes
information technology	36	information technology, ethical perspectives, affecting information, business organizations, contemporary firms, digital divide, ethical perspective
intellectual property	33	intellectual property, property rights, Chinese culture, digital rights, students information, accuracy property, communication technology, cultural differences, ethical attitudes, ethical dimensions, ethics literature
luciano floridi	20	Luciano Floridi, design choices, Floridi information, personal information, ethical reasoning, game design, computer games

Table A13. *Terms in clusters at strategy diagram – period 2013–2019 (name of cluster, total number of occurrences of all terms in the cluster, list of terms in the cluster – Figure 5).*

2013–2019		
Cluster	**Terms occurrences**	**Terms in the cluster**
data mining	3	data mining
ethical implications	38	ethical implications, war theory, information warfare, public library, library services, digital age, ethical framework, casus belli, cyber domain, ethical regulations
information ethics	202	information ethics, information literacy, information science, information security, college students, computer science, research ethics, students information, information ethical, information retrieval, luciano floridi, moral education, undergraduate students, digital content, ethics education, network society, ontic trust, ethical norms, geographic information, information ability, international law, science LIS, conceptual framework, empirical research, floridi conceptualization
information society	59	information society, university students, intellectual property, ethical dimension, human rights, ethical behavior, ethical principles, informational privacy, video clips, computer security, ethical aspects, ethical values, computer systems, ethical theories
information technology	98	information technology, social media, information systems, information privacy, computer literacy, ethical dilemmas, computer ethics, internet access, significant differences, cyber ethics, south africa, emerging technology, privacy issues, data collection, educational institutions, false information, information age, privacy accuracy, social implications, accuracy property, detrimental effects, gender age
machine ethics	23	machine ethics, sex robots, technology ethics, moral agents, animal ethics, applied ethics, autonomous systems
personal data	45	personal data, data science, digital technology, media ethics, artificial intelligence, artificial agents, data ethics, floridi information, data scientists, data protection, digital communication, ethical challenges, ethical impact
social justice	14	social justice, digital divide, knowledge construction, broadband access, individual capability

Table A14. *Terms in clusters at strategy diagram – period 2020–2023 (name of cluster, total number of occurrences of all terms in the cluster, list of terms in the cluster – Figure 5).*

2020–2023		
Cluster	**Terms occurrences**	**Terms in the cluster**
artificial intelligence	39	artificial intelligence, information science, digital age, intelligence ethics, computer ethics, digital technology, intelligence ai, robot ethics, ethics framework, ethics information, ethics robot, future directions, growing body
data ethics	14	data ethics, Luciano Floridi, computer science, deep learning, ethical evaluation
health data	4	health data, data protection
health service	2	health service
information ethics	89	information ethics, data science, digital information, information professionals, applied ethics, ethical challenges, ethical discourse, ethical reflection, ethics research, information management, intercultural information, professional ethics, professional information, social sciences, accuracy property, critical discourse, ethical guidelines, ethical implications, everyday lives, human society
information technology	35	information technology, information literacy, daily life, school teachers, information society, information utilization, professional development, secondary school, survey data,
public health	20	public health, conspiracy theories, covid_ pandemic, ethical framework, health information, social media, awareness information, current situation, ethical concerns
research funding	17	research funding, predatory journals, avoided methodology, concept characteristics, ethical impacts, fraudulent journals, funding agencies, growing phenomenon

References

ACRL. (2016). Framework for information literacy for higher education. Ala.org. Retrieved from https://alair.ala.org/server/api/core/bitstreams/7d1835a5-b616-4f1c-9fbe-ef7761d5171f/content

Agarwal, N. K. (2022). *Exploring context in information behavior: Seeker, situation, surroundings, and shared identities*. Springer Nature.

Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

Bawden, D., & Robinson, L. (2022). *Introduction to information science*. Facet Publishing.

Bielby, J., & Kelly, M. (2016). Information Cultures in the Digital Age: A Festschrift in Honor of Rafael Capurro. In M. Kelly & J. Bielby (Eds.), *Information Cultures in the Digital Age* (pp. 1–28). Springer. https://doi.org/10.1007/978-3-658-14681-8_1

Borgman, C. L., & Furner, J. (2002). Scholarly communication and bibliometrics. *Annual Review of Information Science and Technology*, 36(1), 2–72. https://doi.org/10/fs6fjb

Buchanan, E. A., & Henderson, K. A. (2008). *Case Studies in Library and Information Science Ethics*. McFarland & Company.

Burgess, J. T., & Knox, E. J. (2019). *Foundations of information ethics*. American Library Association.

Callon, M., Courtial, J. P., & Laville, F. (1991). Co-word analysis as a tool for describing the network of interactions between basic and technological research: The case of polymer chemistry. *Scientometrics*, 22(1), 155–205. https://doi.org/10.1007/BF02019280

Capurro, R. (2005). Information Ethics. *CSI Communications*, 28(12), 7–10.

Capurro, R. (2008). On Floridi's metaphysical foundation of information ecology. *Ethics and Information Technology*, 10(2–3), 167–173. https://doi.org/10.1007/s10676-008-9162-x

Capurro, R. (2019). *Ethical Issues of Humanoid-Human Interaction. Humanoid Robotics: A Reference*. Springer. https://doi.org/10.1007/978-94-007-6046-2_127

Clarivate. (2022). KeyWords Plus generation, creation, and changes. Retrieved from https://support.clarivate.com/s/article/KeyWords-Plus-generation-creation-and-changes?language=en_US

Davenport, T. H. (2018). *The AI Advantage: How to Put the Artificial Intelligence Revolution to Work*. MIT Press.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Eom, S. B. (2008). *Author Cocitation Analysis: Quantitative Methods for Mapping the Intellectual Structure of an Academic Discipline: Quantitative Methods for Mapping the Intellectual Structure of an Academic Discipline*. IGI Global.

Ess, C. (2008). Luciano Floridi's philosophy of information and information ethics: Critical reflections and the state of the art. *Ethics and Information Technology*, 10(2–3), 89–96. https://doi.org/10.1007/s10676-008-9172-8

Etzioni, A., & Etzioni, O. (2017). Incorporating Ethics into Artificial Intelligence. *The Journal of Ethics*, 21(4), 403–418. https://doi.org/10.1007/s10892-017-9252-2

Fallis, D. (2007). Information ethics for twenty-first century library professionals. *Library Hi Tech*, 25(1), 23–36. https://doi.org/10.1108/07378830710735830

Floridi, L. (2008). Information ethics: a reappraisal. *Ethics and Information Technology*, 10(2–3), 189–204. https://doi.org/10.1007/s10676-008-9176-4

Floridi, L. (2011). *The Philosophy of Information*. Oxford University Press.

Floridi, L. (2013). *The Ethics of information*. Oxford University Press.

Floridi, L. (2018). Soft ethics, the governance of the digital and the General Data Protection Regulation. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 376(2133), 20180081. https://doi.org/10.1098/rsta.2018.0081

Floridi, L. (2019). *The Logic of Information: A theory of Philosophy as Conceptual Design*. Oxford University Press.

Floridi, L., & Cowls, J. (2022). A Unified Framework of Five Principles for AI in Society. In *Machine Learning and the City* (pp. 535–545). John Wiley & Sons. https://doi.org/10.1002/9781119815075.ch45

Floridi, L. (2020). Artificial Intelligence as a Public Service: Learning from Amsterdam and Helsinki. *Philosophy & Technology*, 33(4), 541–546. https://doi.org/10.1007/s13347-020-00434-3

Floridi, L., & Taddeo, M. (2016). What is data ethics? *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 374(2083), 20160360. https://doi.org/10.1098/rsta.2016.0360

Floridi, L. (2023a). *The Ethics of Artificial Intelligence: Principles, Challenges and Opportunities*. Oxford University Press.

Floridi, L. (2023b). AI as Agency Without Intelligence: On ChatGPT, Large Language Models, and Other Generative Models. *Philosophy & Technology*, 36(1), 15. https://doi.org/10.1007/s13347-023-00621-y

Forster, M. (2013). Information literacy as a facilitator of ethical practice in the professions. *Journal of Information Literacy*, 7(1), Article 1. https://doi.org/10.11645/7.1.1783

Friedman, B., & Hendry, D. G. (2019). *Value Sensitive Design: Shaping Technology with Moral Imagination*. MIT Press.

Froehlich, R. (2004). Information Ethics. In *Encyclopedia of Library and Information Sciences* (pp. 256–258). Taylor and Francis.

Fuchs, C. (2016). Information Ethics in the Age of Digital Labour and the Surveillance-Industrial Complex. In M. Kelly & J. Bielby (Eds.), *Information Cultures in the Digital Age: A Festschrift in Honor of Rafael Capurro* (pp. 173–190). Springer. https://doi.org/10.1007/978-3-658-14681-8_10

Gorichanaz, T. (2017). Information and experience, a dialogue. *Journal of Documentation*, 73(3), 500–508. https://doi.org/10.1108/JD-09-2016-0114

Gorichanaz, T. (2020). *Information Experience in Theory and Design*. Emerald.

Gorichanaz, T. (2023). Accused: How students respond to allegations of using ChatGPT on assessments. *Learning: Research and Practice*, 9(2), 183–196. https://doi.org/10.1080/23735082.2023.2254787

González-Valiente, C. L., Costas, R., Noyons, E., Steinerová, J., & Šušol, J. (2020). Terminological (di) Similarities between Information Management and Knowledge Management: a Term Co-Occurrence Analysis. *Journal on Special Topics in Mobile Networks and Applications/Mobile Networks and Applications*, 26(1), 336–346. https://doi.org/10.1007/s11036-020-01643-y

Graff, K., Quiñonez-Riegos, G., Scott, J., & Senior, H. (2020). Ethical Issues in Academic Libraries: An Annotated Bibliography. *Journal of Information Ethics*, 29(1), 65–88.

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

Haider, J., & Sundin, O. (2022). *Paradoxes of Media and Information Literacy: The Crisis of Information*. Taylor & Francis. https://doi.org/10.4324/9781003163237

Haider, J. & Sunsin, O. (2019). *Invisible Search and Online Search Engines. The Ubiquity of Search in Everyday Life*. Routledge.

Hauptman, R. (1988). *Ethical challenges in librarianship*. Onyx Press.

Heersmink, R., van den Hoven, J., van Eck, N. J., & van den Berg, J. (2011). Bibliometric mapping of computer and information ethics. *Ethics and Information Technology*, 13(3), 241–249. https://doi.org/10.1007/s10676-011-9273-7

Hicks, A., McKinney, P., Inskip, C., Walton, G., & Lloyd, A. (2023). Leveraging information literacy: Mapping the conceptual influence and appropriation of information literacy in other disciplinary landscapes. *Journal of Librarianship and Information Science*, 55(3), 548–566. https://doi.org/10.1177/09610006221090677

Ingwersen, P., & Christensen, F. H. (1997). Data set isolation for bibliometric online analyses of research publications: Fundamental methodological issues. *Journal of the American Society for Information Science*, 48(3), 205–217. https://doi.org/10.1002/(SICI)1097-4571(199703)48:3<205::AID-ASI3>3.0.CO;2-0

Järvelin, K., & Vakkari, P. (2021). LIS research across 50 years: Content analysis of journal articles. *Journal of Documentation*, 78(7), 65–88. https://doi.org/10.1108/JD-03-2021-0062

Karlova, N. A., & Fisher, K. E. (2013). A social diffusion model of misinformation and disinformation for understanding human information behaviour. *Information Research*, 18(1). https://informationr.net/ir/18-1/paper573.html

Kelly, M. and Bielby, J. (eds.) (2016). *Information Cultures in the Digital Age. A festschrift in Honour of Rafael Capurro*. Springer.

Leydesdorff, L. (2014). Science visualization and discursive knowledge. In *Beyond Bibliometrics: Harnessing Multidimensional Indicators of Scholarly Impact*, (pp. 167–185). MIT Press. https://doi.org/10.7551/mitpress/9445.003.0013

Lloyd, A. (2021). *Qualitative Landscape of Information Literacy Research. Perspectives, Methods and Techniques*. Facet.

Macfarlane, B., Zhang, J., & Pun, A. (2014). Academic integrity: A review of the literature. *Studies in Higher Education*, 39(2), 339–358. https://doi.org/10.1080/03075079.2012.70949

MacKey, T. P., & Jacobson, T. E. (2019). *Metaliterate learning for the post-truth world*. ALA.

McCain, K. W. (1990). Mapping authors in intellectual space: A technical overview. *Journal of the American Society for Information Science*, 41(6), 433–443. https://doi.org/10.1002/(SICI)1097-4571(199009)41:6%3C433::AID-ASI11%3E3.0.CO;2-Q

McMenemy, D. (2021). No Longer "Neutral Among Ends" – Liberal Versus Communitarian Ethics in Library and Information Science. In K. Toeppe, H. Yan, & S. K. W. Chu (Eds.), *Diversity, Divergence, Dialogue* (pp. 207–214). Springer. https://doi.org/10.1007/978-3-030-71305-8_16

Milano, S., Taddeo, M., & Floridi, L. (2021). Ethical aspects of multi-stakeholder recommendation systems. *The Information Society*, 37(1), 35–45. https://doi.org/10.1080/01972243.2020.1832636

Mokhtari, H., Saberi, M. K., Vakilimofrad, H., & Barkhan, S. (2021). Iranian Authors' Contributions to the Library Philosophy and Practice. *Library Philosophy and Practice*, 2021, 1–15.

Novelli, C., Taddeo, M., & Floridi, L. (2023). Accountability in artificial intelligence: What it is and how it works. *AI & Society*, (in press). https://doi.org/10.1007/s00146-023-01635-y

Ocholla, D. N., Onyancha, O. B., & Britz, J. (2010). Can information ethics be conceptualized by using the core/periphery model? *Journal of Informetrics*, 4(4), 492–502. https://doi.org/10.1016/j.joi.2010.05.001

Pilerot, O. (2016). Connections between research and practice in the information literacy narrative: A mapping of the literature and some propositions. *Journal of Librarianship and Information Science*, 48(4), 313–321. https://doi.org/10.1177/0961000614559140

Pinto, M., Escalona-Fernández, M. I., & Pulgarín, A. (2013). Information literacy in social sciences and health sciences: A bibliometric study (1974–2011). *Scientometrics*, 95(3), 1071–1094. https://doi.org/10.1007/s11192-012-0899-y

Pinto, M. J., & Fernandes, S. (2015). New questions arise: Are bibliometric indicators adequate for evaluating the scientific production of the Social Sciences and Humanities? *Qualitative and Quantitative Methods in Libraries*, 2015, 161–169.

Pinto, M., Sales, D., & Fernández-Pascual, R. (2021). Understanding Ethics and Quality in Information Literacy: A Multidimensional Approach. *Portal: Libraries and the Academy*, 21(4), 835–858. https://doi.org/10.1353/pla.2021.0043

Ruokolainen, H., & Widén, G. (2020). Conceptualising misinformation in the context of asylum seekers. *Information Processing & Management*, 57(3), 102127. https://doi.org/10.1016/j.ipm.2019.102127

Ruokolainen, H., Widén, G., & Eskola, E.-L. (2023). How and why does official information become misinformation? A typology of official misinformation. *Library & Information Science Research*, 45(2), 101237. https://doi.org/10.1016/j.lisr.2023.101237

Secker, J., & Coonan, E. (2012). *Rethinking information literacy: A practical framework for supporting learning*. Facet.

Semeler, A., Pinto, A., Koltay, T., Dias, T., Oliveira, A., González, J., & Rozados, H. B. F. (2024). ALGORITHMIC LITERACY: Generative Artificial Intelligence technologies for data librarians. *EAI Endorsed Transactions on Scalable Information Systems*, 11(2), 4067. https://doi.org/10.4108/eetsis.4067

Stahl, B.C. (2008). Discourses on information ethics: the claim to universality. *Ethics and Information Technology*, 10(2), 97–108. https://doi.org/10.1007/s10676-008-9171-9

Stahl, B. C. (2016). Ethics of European Institutions as Normative Foundation of Responsible Research and Innovation in ICT. In M. Kelly & J. Bielby (Eds.), *Information Cultures in the Digital Age: A Festschrift in Honor of Rafael Capurro* (pp. 207–219). Springer. https://doi.org/10.1007/978-3-658-14681-8_12

Stahl, B. C. (2021). *Artificial Intelligence for a Better Future: An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies*. Springer. https://doi.org/10.1007/978-3-030-69978-9

Stahl, B. C., Heersmink, R., Goujon, P., Flick, C., Hoven, J. van den, Wakunuma, K., Ikonen, V., & Rader, M. (2010). Identifying the Ethics of Emerging Information and Communication Technologies: An Essay on Issues, Concepts and Method. *International Journal of Technoethics*, 1(4), 20–38. https://doi.org/10.4018/jte.2010100102

Steinerová, J. (2022). Delfská štúdia o informačnej etike: Výsledky analýz diskurzu. *ITlib*, 26(3–4), 5–18. https://doi.org/10.52036/1335793X.2022.3-4.5-18

Steinerová, J. (2023). Ethical Issues of Human Information Behaviour and Human Information Interactions. *Open Information Science*, 7(1), 20220155. https://doi.org/10.1515/opis-2022-0155

Steinerová, J. (2023a). Social and epistemic values of information in the framework of information ethics. In *Knižničná a informačná veda, 30. Zborník FiFUK*, (pp. 9–38). Comenius University in Bratislava.

Steinerová, J. (2023b). Perspektívy rozvoja informačnej etiky v informačnej vede. *ProInFlow*, 15(2), 35-67. https://doi.org/10.5817/ProIn2023-33837

Stopar, K., & Bartol, T. (2019). Digital competences, computer skills and information literacy in secondary education: Mapping and visualization of trends and concepts. *Scientometrics*, 118(2), 479–498. https://doi.org/10.1007/s11192-018-2990-5

Tuana, N. (2007). Conceptualizing moral literacy. *Journal of Educational Administration*, 45(4), 364–378. https://doi.org/10.1108/09578230710762409

Vakkari, P., Järvelin, K., & Chang, Y.-W. (2023). The association of disciplinary background with the evolution of topics and methods in Library and Information Science research 1995–2015. *Journal of the Association for Information Science and Technology*, 74(7), 811–827. https://doi.org/10.1002/asi.24757

Van Eck, N. J., & Waltman, L. (2009). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

Van Otterlo, M. (2018). Ethics and the Value(s) of Artificial Intelligence. *Nieuw Archief voor Wiskunde*, 19(3), 206–209.

Virkus, S. (2013). Information Literacy in Europe: Ten Years Later. In S. Kurbanoğlu, E. Grassian, D. Mizrachi, R. Catts, & S. Špiranec (Eds.), *Worldwide Commonalities and Challenges in Information Literacy Research and Practice* (pp. 250–257). Springer. https://doi.org/10.1007/978-3-319-03919-0_32