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Research Article

Bibliometric Analysis of Sociological Research on Artificial Intelligence

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Abstract

This research aims to identify potential areas for future sociological research related to artificial intelligence (AI). The study used bibliometric analysis methods and the VosViewer program to process data. The data analyzed included 31 articles related to "sociology" and "artificial intelligence," and 1,277 articles pertinent to "social" and "artificial intelligence," all published on ScienceDirect between 2003 and 2023. Network visualization, overlay, and density analysis were used to process the data. This revealed that current sociological research on AI only covers five topics - artificial intelligence, sociology, technology, affects, and artificial intelligence. However, social research on AI has identified 100 topics across five datasets, with almost all research being conducted within the past decade. It is noteworthy that "sociology" is not among these 100 topics. However, these 100 topics have the potential to become sociological research subjects by applying sociological principles. The research findings suggest that sociologists can publish their scientific documents in 3,800 journals and books published by Elsevier, indicating a high probability of acceptance. Furthermore, the topics can be framed from a sociological perspective, thus providing greater insight on the subjects and potentially opening up the door to more publications by the sociologists.

Keywords: *AI; Artificial Intelligence; Bibliometric Analysis; Social; Sociology.*

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INTRODUCTION

The study of associating sociology with artificial intelligence (AI) began after 1950. Sociology studies contribute to the development of artificial intelligence in education (Midhun, 1955; Sebastian, 1955). A significant discussion of sociology in the 1960s and 1970s did not make sociology a significant discussion. AI, as a trusted computer technology, can help data processing in sociology (Shubik, 1960). Sociology was one of the theoretical units believed to contribute to AI study (Musés, 1962), and sociological scientists began to respond to technological developments through sociological studies (Apter, 1970). Organizations as a field of sociological study have begun to be perceived as one aspect of AI study (Howard & Morgenroth, 1968; Mallen, 1970). The specialized sociological study of artificial intelligence (AI) began in the early 1980s. An essential thing in the study of sociology on AI is reassessing sociology's central axiom that human behavior is something distinctively 'social' (Woolgar, 1985). AI as a computing approach contributes to theory construction in sociology (Anderson, 1989; Brent, 1988). The relationship between AI and scientists in expert systems, the development of knowledge systems, the influence of AI on social practices, and the impact of AI require a sociologist response (Bloomfield, 1988; Schwartz, 1989). Studies after the 1990s focused on gender, the sociology of mind, and AI as a social agent (Adam, 1993; K. M. Carley, 1996; K. Carley & Newell, 1994; Collins, 1992; Wolfe, 1991). Similar studies continued from 2000-2013 (Fuller, 2006; Malsch, 2001; Schillo et al., 2000).

Specific studies of AI forms began in 2014 (Ferrando, 2014). AI's impact on social change was studied in 2017 (Veretekhina et al., 2017). Studies after 2018 have still focused on the theoretical study and conceptual preparedness of sociologists for the development of AI (Mlynář et al., 2018; Vasile, 2018), but most have studied specific sociological issues such as inequalities (Lutz, 2019; Zajko, 2022), social transformation (Boyd & Holton, 2018), bureaucratic transformations (Newman et al., 2022), forms of AI such as machine learning (Molina & Garip, 2019; Mühlhoff, 2020) and robotics (Boyd & Holton, 2018), and ethical issues (Kerr et al., 2020). The development of AI invites sociologists to conduct further research. Further studies were asked to focus on issues of inequalities and structural change (Joyce et al., 2021), gender (Marinucci et al., 2023), social actors and technological processes interactions (Boyd & Holton, 2018), and adaptation to new data worlds (Diaz-Bone et al., 2020).

One method for developing further research opportunities is bibliometric analysis. Bibliometric analysis is the application of quantitative techniques to bibliometric data, such as citation and unit of publication. In contrast, using qualitative techniques in bibliometric analysis is limited to the interpretation of data (Donthu et al., 2021). Bibliometric analysis has advantages over literature review or meta-analysis methods because it can analyze large-

scale scientific data, has a broad coverage scope, and provides a spectrum of topics within a particular research area (Donthu et al., 2021; Ferreira, 2018). Through bibliometric analysis, data on the development of sociological research on AI can be validated (Donthu et al., 2021; Ho, 2018) and can help researchers determine future research topics (Stefani et al., 2020; Wang et al., 2017). The novelty of further research can be generated from topics that have never been studied (Mulyawati & Ramadhan, 2021), topics that are most dissected (Wang et al., 2017), or topics not yet studied simultaneously (Yanuarti & Suprapto, 2021).

This study utilizes bibliometric analysis to identify future research opportunities for artificial intelligence in sociology. The previous research conducted bibliometric analyses of artificial intelligence technologies for the social sciences (Bircan & Salah, 2022). Bibliometric analysis of sociology studies on AI still needs to be explored. This research provides valid data on the development of sociological research on AI, which serves as a foundation to determine future research topics. Both of these aspects still need to be studied.

RESEARCH METHODS

The study conducts a bibliometric analysis of the publication unit through five research phases. First is the collection of data. Data is collected from publications on the selected ScienceDirect website because it can be downloaded without paid membership and publication data processing. Previous research used ScienceDirect data (Buele & Guerra, 2021; Purnomo, 2022). ScienceDirect publishes articles from publisher Elsevier which has published 14 million publications, more than 35,000 books, and 3,800 journals (Elsevier, 2023 July).

Data is collected using the keywords "sociology" and "artificial intelligence" in conjunction with the title, abstract, or author. This step resulted in 42 articles from 1984-2022. This amount is small enough for 38 years. Data searches were modified using the keywords "social" and "artificial intelligence." This step resulted in 1,362 articles from 1999-2023. The period was changed to 2003-2023 to equate the data period. It has collected 1,277 articles for the keywords "artificial intelligence" and "social" and 31 articles for the keywords "sociology" and "artificial intelligence." Article data for the keywords "social" and "artificial intelligence" is 1000 most relevant articles according to ScienceDirect download capacity.

Second, keyword selection used the VosViewer program. Data selection used co-word analysis, which analyzes topics in title, article, abstract, and keywords (Van Eck & Waltman, 2010). Keywords "sociology" and "artificial intelligence" generated 161 keywords and only five meet the threshold for two times co-occurrences. Keywords "social" and "artificial intelligence" generated 3,460 keywords and 100 meet the threshold for five times co-occurrences. The number of co-occurrences remains different because the number of co-

occurrences for the keywords "sociology" and "artificial intelligence" is the maximum number of co-occurrences in the VosViewer programs.

Third, data processing used the VosViewer program with co-occurrence processing, total link strength, item topic, cluster, and map visualization. Co-occurrence analysis measures the frequency keywords appear together or co-occur (Donthu et al., 2021). Total link strength demonstrates the number of connections between two keywords (Van Eck & Waltman, 2010). Item topic is keyword meet the threshold with a minimum number of time co-occurrences selected in the data selection stage. Clusters are keywords with the highest co-occurrence (Donthu et al., 2021). VosViewer provides three map visualizations: overlay, network, and density visualization. These three maps present relationships between topics, trending topics per year, and research intensity in each topic (Van Eck & Waltman, 2010).

The search results for the keywords "social" and "artificial intelligence" are numerous enough to categorize themes to facilitate analysis. These topics are grouped into several qualitative categories. Grouping refers to previous research and author judgment. The judgment of the author is allowed to determine a group of topics (Campbell et al., 2021). The judgment of the author is used to group topics that scientists or the general public know because the topic indicates a particular group. Topics that require clarification are clarified by previous research.

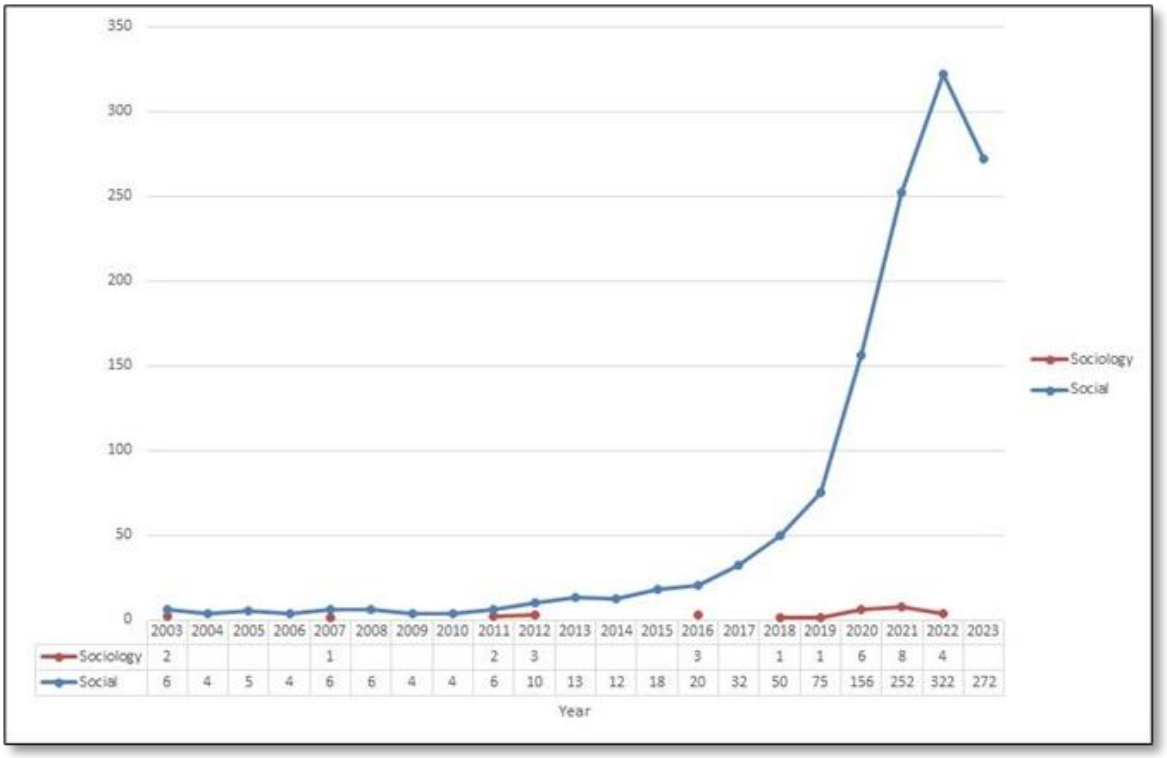
Fifth is the interpretation of data. The data interpretation is limited to the VosViewer program processing results. Qualitative interpretation of data does not transcend beyond quantitative data to maintain objectivity (Donthu et al., 2021). Thus, it is critical to ensure that the qualitative interpretation of data is limited to the quantitative data provided by the VosViewer program.

RESULT AND DISCUSSION

Research Developments Sociology on Artificial Intelligence

Data searches using the keywords "sociology" and "artificial intelligence" on specific titles, abstracts, or authors yielded a total of 31 articles for 20 years of publication. 31 articles out of 14 million publications on Elsevier (Elsevier, 2023 July) show minimal publications about sociology on AI. The data search using the keywords "social" and "artificial intelligence" yielded 1,277 articles. This number is still tiny compared to the keywords "sociology" and "food tourism," which generated 3,055 articles (Purnomo, 2022), and the keywords "sociology" and "tourism," which generated 6,320 articles (Purnomo, 2023a; Purnomo, 2023b). Using the same timeframe as previous research, the keywords "sociology" and "artificial intelligence" produced only 42 articles and the keywords "social" and "artificial intelligence" only produced 1,362 articles.

Figure 1 shows that in 2023 there was no sociological publication on AI. Social topics on AI are trending upward, on a trend that continues to rise until 2022. By 2023, there were 272 publications in the seven months until data collection was completed. The data reveals a huge opportunity for researchers to write articles on sociology topics on AI in 3,800 journals published by Elsevier (Elsevier, 2023 July). This indicates that there is a growing interest in social topics related to AI, which is likely to continue in the coming years. As more and more research is conducted in this area, the number of publications on sociology topics related to AI is expected to rise.



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Sociology	2				1				2	3				3		1	1	6	8	4	
Social	6	4	5	4	6	6	4	4	6	10	13	12	18	20	32	50	75	156	252	322	272

Figure 1. Development of Research of the Sociology on AI 2003-2023

Source: Processed from ScienceDirect by VosViewer, July 23, 2023

Visualization Sociology on Artificial Intelligence Research Topic

Analysis of co-occurrences for the keywords "sociology" and "artificial intelligence" resulted in five topics divided into three clusters. Cluster 1 consists of artificial intelligence and sociology. Cluster 2 comprises artificial intelligence and technology, while Cluster 3 contains affects. Topic artificial intelligence has the highest occurrences and total link strength (10 and 5); topic sociology is in second place with an occurrence value of 5 and total connection strength of 4. Of all the topics, only the "affect" topics do not directly relate to "sociology" and "artificial intelligence."

Based on Figure 1, it can be seen that sociology topics were researched alongside other topics other than technology while artificial intelligence topics were researched with the entire topic group. Referring to sociology research trends on AI from 1950-2023, research topics have varied from theoretical aspects, ethics, and types of technology to their impact on social phenomena (Kerr et al., 2020; Lutz, 2019; Molina & Garip, 2019; Vasile, 2018). There is still considerable opportunity for sociology scientists to write articles about sociology and AI in Elsevier journals.

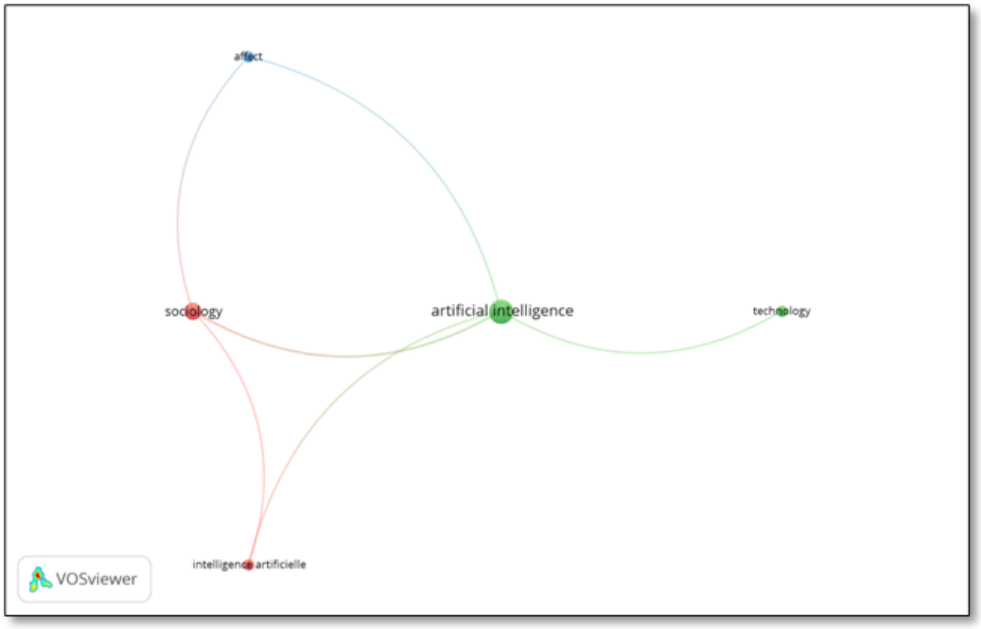


Figure 2. Network Visualization in Sociology on AI Research Topic in 2003-2023
Source: Processed from ScienceDirect by VosViewer, July 23, 2023

Figure 3 shows that the latest topic is technology. Recent research has specifically examined AI technology such as machine learning and robotics (Boyd & Holton, 2018; Molina & Garip, 2019; Mühlhoff, 2020). The topic "affect" may refer to the influence of AI approaches and acquisition advice sociology on AI to study the impact of AI on societal issues (Joyce et al., 2021). Although "affect" did not the most recent topic, it has been discussed for several years. Research on the sociology of AI in the future is expected to address social problems (Holton & Boyd, 2021; Joyce et al., 2021; Marinucci et al., 2023) and methodologies related to AI technology advances (Diaz-Bone et al., 2020). The forms of AI, social problems, and methods have never been published in Elsevier journals. Further research into the implications of AI technology advances and its potential to address social problems could bring a new perspective to the discussion of the topics. This research has the opportunity to be published in Elsevier journals.

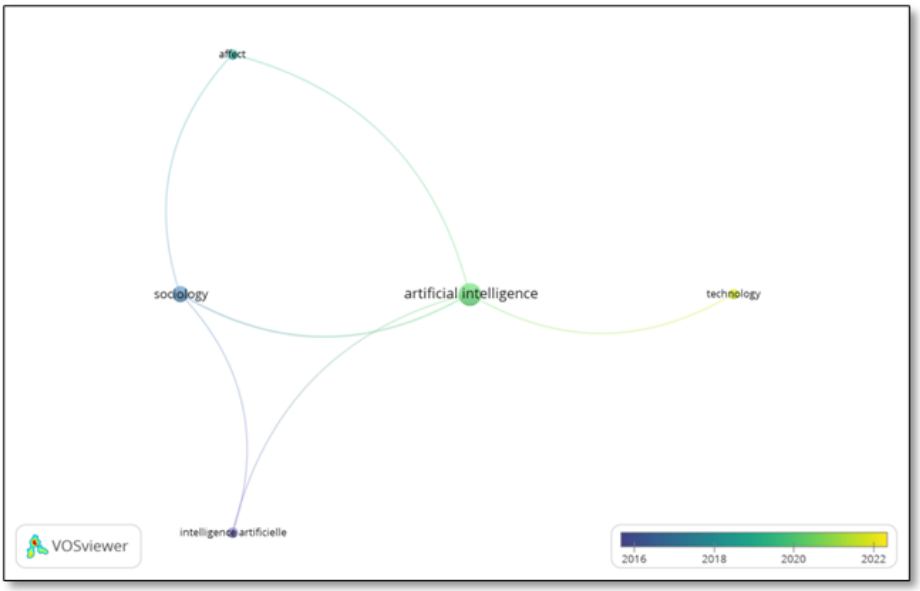


Figure 3. Density Visualization in Sociology on AI Research Topic in 2003-2023
Source: Processed from ScienceDirect by VosViewer, July 23, 2023

Figure 2 findings are reinforced by the density visualization in Fig. 3. The most muscular density is characterized by the brightest color (Van Eck & Waltman, 2010). Sociology research on AI focuses mainly on artificial intelligence and sociology. Analysis of co-occurrences, network, overlay, and density visualization shows that Elsevier journals have not published much on the sociology of AI.

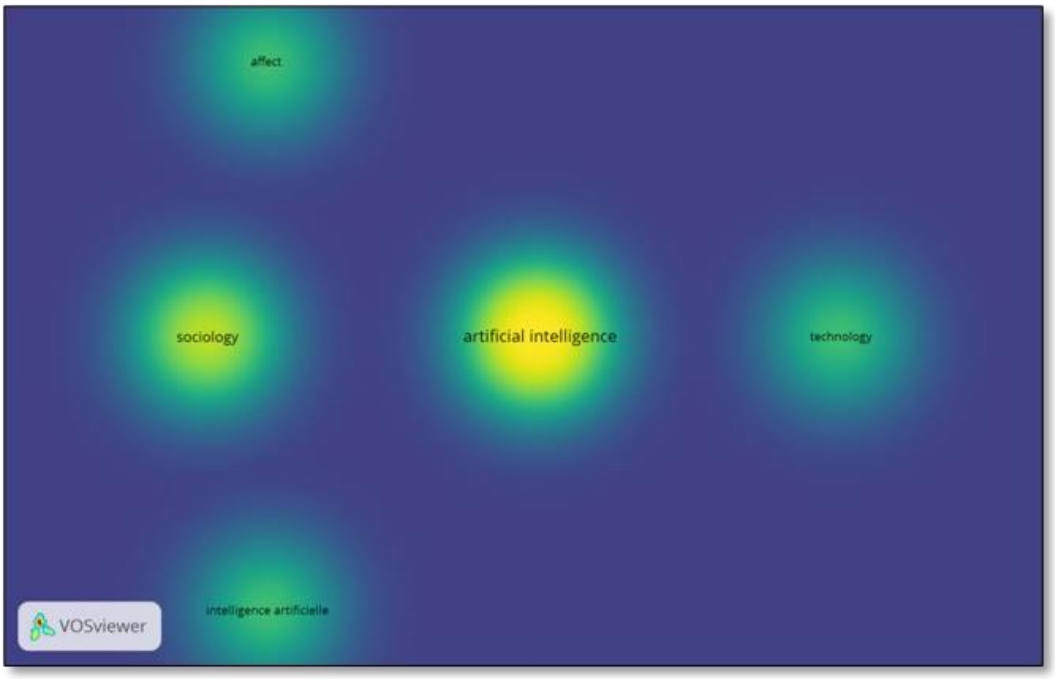


Figure 4. Density Visualization in Sociology on AI Research Topic in 2003-2023
Source: Processed from ScienceDirect by VosViewer, July 23, 2023

Visualization Social on Artificial Intelligence Research Topic

Analysis of co-words generated 100 keywords and nine clusters. Figure 4 shows the theme and cluster. Cluster 1, marked in red, has 15 topics. The topics were automation, circular economy, data science, digitalization, environmental sustainability, governance, ICT, industry 4.0, pandemic, public administration, resilience, responsible research and innovation, review, survey, and sustainability. Cluster 2, marked in green, has 15 topics. The topics were big data, blockchain, cloud computing, cognitive computation, the Covid-19 pandemic, digital technology, digital transformation, healthcare, innovation, internet of things, IoT, public health, robots, smart city, and social IoT.

Cluster 3, marked in dark blue, has 14 topics. The topics were affective computing, anthropomorphism, emotional intelligence, human-robot interaction, human–robot interaction, intelligence artificielle, robotics, service robots, social cognition, social present, social robot, social robotic, social robots, and technology. Cluster 4, marked in yellow, has 13 topics. The topics were AI, artificial intelligence, chatbots, communication, decision-making, education, human-computer interaction, literature review, mental health, neuroscience, perception, psychology, and social innovation. Cluster 5, marked in purple, has 13 topics. The topics were artificial intelligence (AI), autism, classification, collaborative learning, computer vision, deep learning, explainable artificial intelligences, fake news detection, Instagram, social media, social networks, systematic review, and transfer learning.

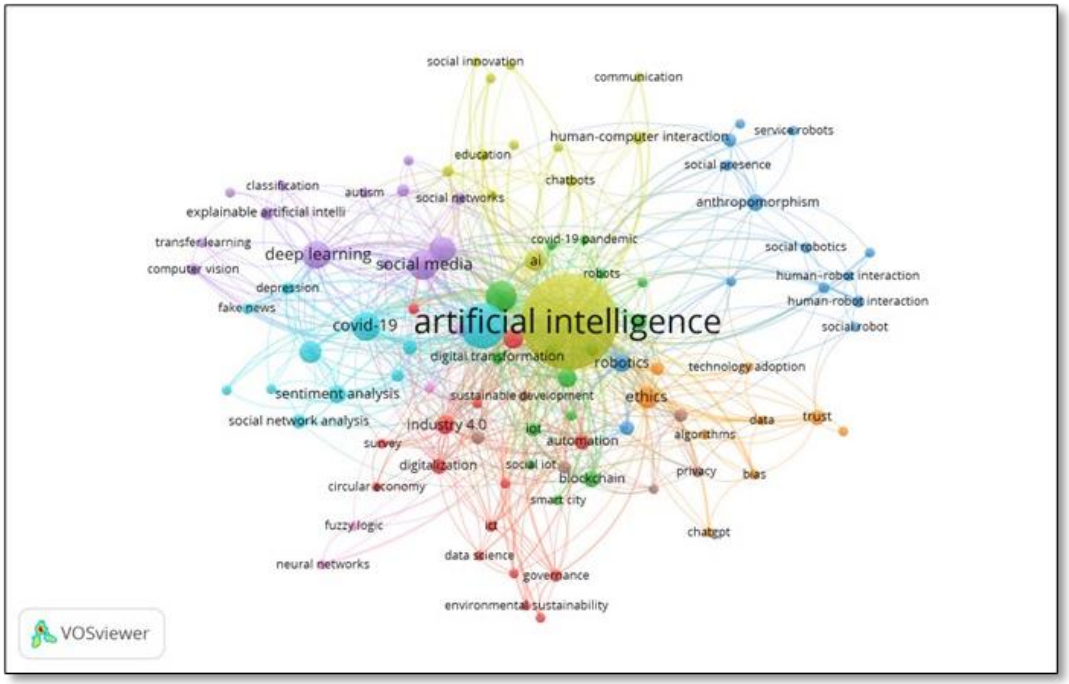


Figure 5. Network Visualization in Social on AI Research Topic in 2003-2023

Source: Processed from ScienceDirect by VosViewer, July 23, 2023

Cluster 6, marked in light blue, has 11 topics. The topics were Covid-19, decision support system, depression, fake news, machine learning, natural language processing, online social networks, sentiment analysis, social media analytics, social network analysis, and Twitter. Cluster 7, highlighted in orange, has nine topics. The topics were algorithm, bias, bibliometric analysis, chatGPT, data, ethics, explainable AI, technology adoption, and trust. Cluster 8, marked in brown, has six topics. The topics were AI ethics, climate change, privacy, security, smart cities, and sustainable development. Cluster 9, marked in light purple, has four topics. The topics include big data analytics, fuzzy logic, management, and neural networks.

Table 1 shows the grouping of topics based on latent word meaning (Campbell et al., 2021). The topics in each cluster that demonstrate relevant words are included in a group of topics. For example, some topics in the research method group, pandemics Covid-19, technological issues, and ethics, refer to the meaning of latent or similar words. Clarification is done on several topics. For example, responsible research and innovation are discussed in the ethics group (Stahl & Wright, 2018), fuzzy logic is considered within the research method group (Krzywanski, 2019), and human-robot interaction is incorporated into the social issues group (Zacharaki et al., 2020). Smart cities and smart cities can be associated with technological or social issues (Dash & Sharma, 2022; Mark & Anya, 2019). Both topics are included in the social issues group because previous research has positioned smart cities as the subject of AI research (Allam & Dhunny, 2019; Veselov et al., 2021). The possibility of debate can still arise about the placement of topics in the technological group. This is because previous research examined the topic as a form of technology or its impact on social life.

Sociology is not included in Table 1. It is easier to determine whether the study in the articles covering the topic is a sociological study with a literature review of each article to qualitatively determine the article's content (Donthu et al., 2021). Quantitative data suggests that "sociology" topics do not have the occurrences and link strength values sufficient to fit into the list of research topics "social" and "artificial intelligence."

Table 1. Grouping of Social on Artificial Intelligence Research Topic

Group	Topic and Cluster
Research method	Data science, review, and survey (1); big data (2); literature review (4); systematical review (5); sentiment analysis, social media analytics, and social network analysis (6); bibliometric analysis and data (7); fuzzy logic and big data analytics (9).
Technological issues	Automation, digitalization, ICT, and industry 4.0 (1); blockchain, cognitive computing, cloud computing, digital technology, digital transformation, internet of things, IOT, robots, and social IOT (2); affective computing, intelligence artificielle, robotics, service robots, social robot, social robotic, social robots, and technology (3); AI, artificial intelligence, and chatbots (4); artificial intelligence (AI), computer vision and explainable artificial intelligence (5); machine learning (6); algorithms, chatGPT, and explainable AI (7).
Covid-19 pandemic	Pandemic (1); Covid-19 pandemic (2); Covid-19 (6).

Group	Topic and Cluster
Social issues	Circular economy, environmental sustainability, governance, public administration, resilience, and sustainability (1); healthcare, smart city, innovation, and public health (2); social present, human-robot interaction, human-robot interactions, anthropomorphism, emotional intelligence, and social cognition (3); decision-making, human-computer interaction, social innovation, communication, education, mental health, neuroscience, perception, and psychology (4); social networks, autism, classification, collaborative learning, deep learning, fake news detection, Instagram, social media, and transfer learning (5); online social networks, decision support system, depression, fake news, natural language processing, and Twitter (6); bias, technology adoption, and trust (7); climate change, privacy, security, smart cities, and sustainable development (8); management and neural networks (9).
Ethical issues	Responsible research and innovation (1); ethics (7); AI ethics (8).

Source: Processed from ScienceDirect by VosViewer, July 23, 2023

Figure 5 shows that almost all research topics were in the post-2015 period except for fuzzy logic and neural networks. Figure 5 shows that almost the entire topic is current because it is highlighted in bright yellow (Van Eck & Waltman, 2010). Potential future opportunities can be obtained by studying these topics that have not been studied before or are in different clusters (Purnomo, 2022; Yanuarti & Suprapto, 2021). Therefore, these topics represent potential opportunities to make further advances in the field, and should be given special emphasis when considering future research.

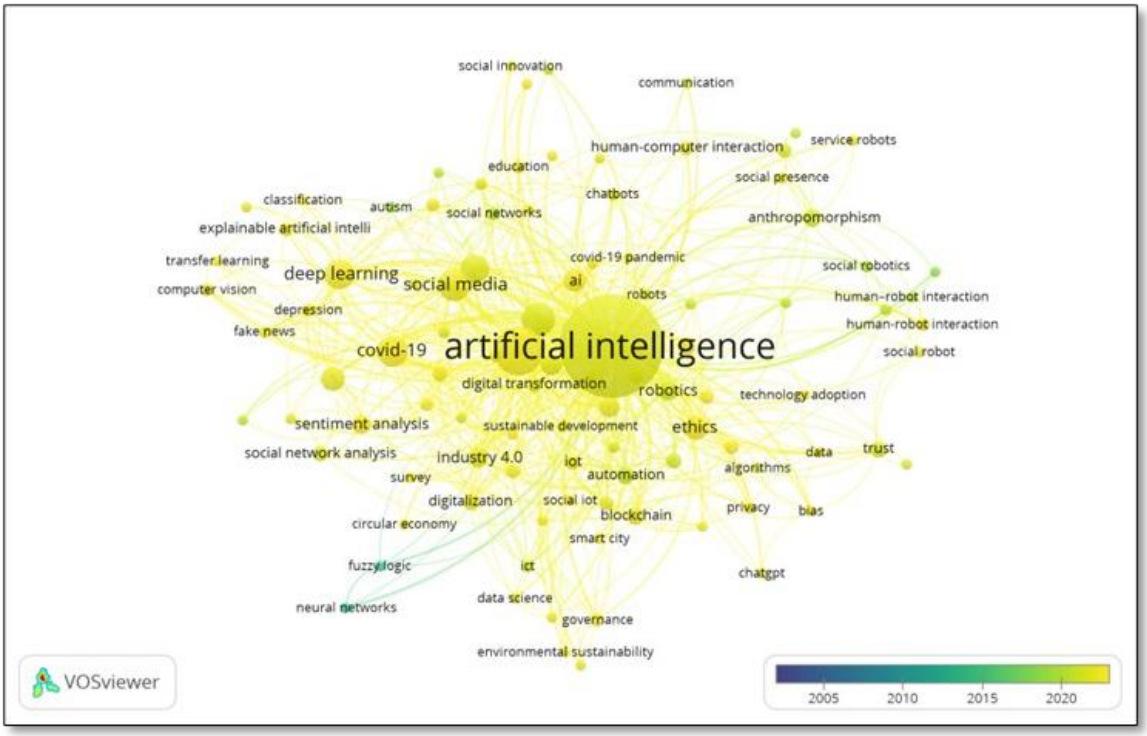


Figure 6. Overlay Visualization in Social on AI Research Topic in 2003-2023

Source: Processed from ScienceDirect by VosViewer, July 23, 2023

Figure 6 shows the most concentrated artificial intelligence research, followed by social media, Covid-19, and deep learning. The covid-19 outbreak, which began in early 2020, has attracted researchers' attention. Topics related to Covid-19 are in Clusters 1, 2, and 6 or have been researched with topics in those clusters. Social media and deep learning are in cluster 5. Social media and AI in sociology studies have been investigated through links between AI technology, social media, and human interaction (Fussey & Roth, 2020; Mühlhoff, 2020). Deep learning in educational sociology has gained attention since the 1950s (Midhun, 1955; Sebastian, 1955). Recent research has examined sociological perspectives on the relationship between deep learning and AI (Boyd & Holton, 2018; Liu, 2021). However, data on the limitations of sociology research topics on artificial intelligence in ScienceDirect suggests that any topic in the societal sphere still has an excellent opportunity to be researched in sociology studies on AI.

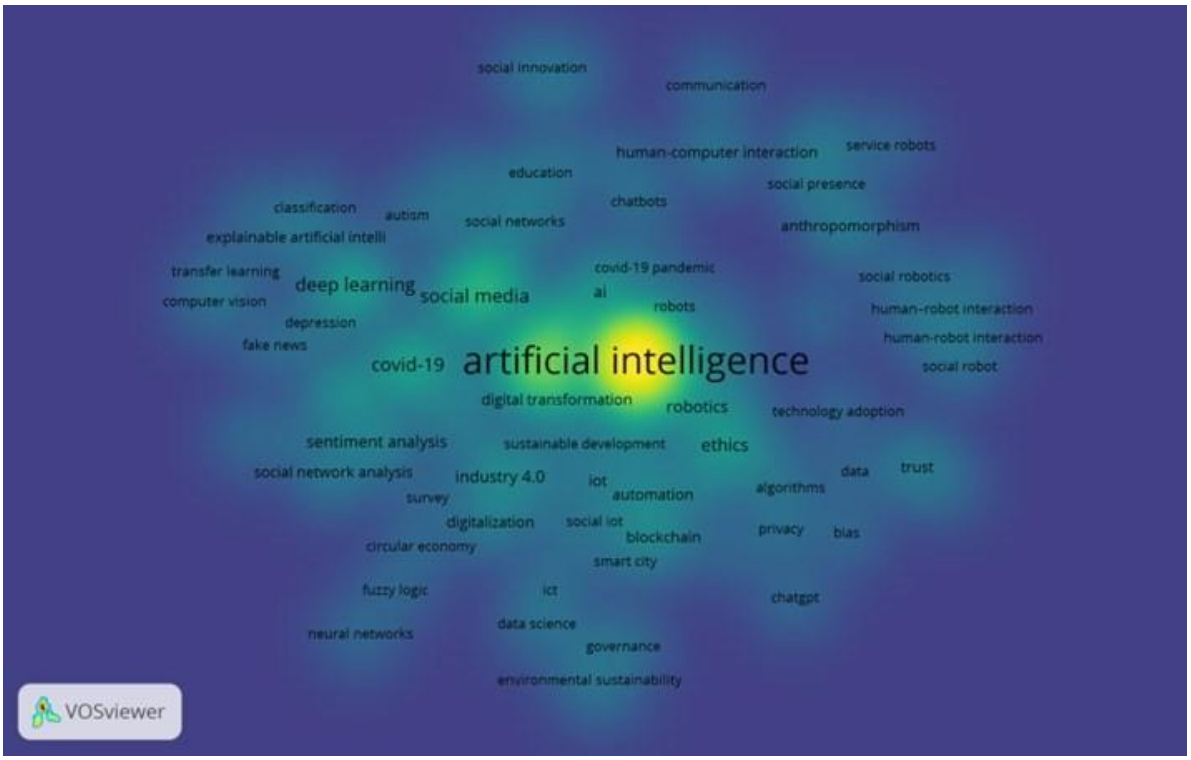


Figure 7. Density Visualization in Social on AI Research Topic in 2003-2023

Source: Processed from ScienceDirect by VosViewer, July 23, 2023

Linking the findings between social on AI research and sociology requires understanding how an analysis becomes sociological. Sociology itself has developed in a variety of specifications, such as sociology of education (Oliveira & Silva, 2020), medicine (Monaghan & Gabe, 2022), economics (Hass, 2020), and digital (Selwyn, 2019). Sociological analysis studies social impact, issues, and theory (Matthewman & Huppatz, 2020). Soci-

ology focuses on social change, order, movement, process, interaction, and relationships. The distinction between sociological and other perspectives is the use of sociological imagination in explaining the relationship between individuals and society (Aarons & Willis, 2022). The study of any topic can be categorized as sociological if it is described and studied at a distinct level in accordance with the sociological research act (Swedberg, 2021). This guidance enables all societal, ethical, and technological topics to be studied from a sociological perspective.

Topics in the research method group are open to study or use from various scientific perspectives. The use of the word "research method" is still debatable. Methodology is a general principle that guides sociological research systematically and logically in order to establish social knowledge by sociologists and convince them of how they should carry out their research (Bulmer, 2003: 4). The correct word for some topics in a group of research methods is research technique. This is because it refers to specific ways to obtain or process data (Bulmer, 2003: 5). The topics were review, survey, big data analytics (Hariri et al., 2019), sentiment analysis (Wankhade et al., 2022), social media analytics (Chang et al., 2019), and bibliometric analysis (Donthu et al., 2021). Some topics even refer to data types, such as data science, big data, and data. The research method includes the following topics because they have general principles that systematically and logically guide research. However, they also cover specific ways to obtain or process data. These topics include a literature review (Paul & Criado, 2020), systematical review (Linnenluecke et al., 2020), social network analysis (Knoke & Yang, 2019), and fuzzy logic (Krzywanski, 2019).

Topics in research techniques, methods, or data can be sociological research if it meets the elements of sociological research. These elements are the use of sociological imagination in explaining the relationship between individuals and society (Aarons & Willis, 2022), studied with distinct unity under the sociological research act (Swedberg, 2021), and sociological investigation to establish social knowledge (Bulmer, 2003: 5).

It is imperative that topics in the Covid-19 pandemic group be adjusted to take into account the ending of the pandemic (World Health Organization, May 2023). Research since 2022 has led to post-pandemic issues (Arunagiri & Udayaadithya, 2022; Purnomo et al., 2022). Going forward, it is important to consider the long-term implications of the Covid-19 pandemic and how it has changed the research landscape in the world.

CONCLUSION

Sociology research on artificial intelligence in ScienceDirect still needs improvement. A bibliometric analysis of ScienceDirect articles in 2003-2023 found that the keywords "sociology" and "artificial intelligence" only existed in 31 articles and had five topics, name-

ly intelligence artificielle, sociology, artificial intelligence, technology, and affect. This number is minimal compared to the number of articles published in ScienceDirect. There is a high probability that a sociologist can publish their scientific paper in 3,800 Elsevier journals and books.

Keyword expansion using the keywords "social" and "artificial intelligence" resulted in 1,227 articles and 100 keywords that meet the threshold. These topics include research methods, technological issues, Covid-19 pandemic, and social and ethical issues. Almost all topics were researched over the past ten years, with the highest research density in artificial intelligence, social media, Covid-19, and deep learning. The findings indicate that societal research on artificial intelligence at ScienceDirect is still relatively new compared to research developments since the 1950s. Density visualization analysis finds that opportunities are still open for other research outside of topics that have been extensively studied or to associate topics that have been primarily studied with other topics yet to be researched.

Social research topics on artificial intelligence have sociological research opportunities on all 100 topics. The absence of sociology topics in social research on artificial intelligence invites sociologists to study these topics by meeting sociological research elements. The Covid-19 pandemic group requires adaptation to the post-pandemic societal context. To contribute to this research agenda, sociologists should identify gaps in the existing literature and generate new topics that address the implications of artificial intelligence in the post-pandemic context.

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BIBLIOGRAPHY

Aarons, H., & Willis, E. (2022). *The Sociological Quest: An introduction to the study of social life*. Taylor & Francis.

Adam, A. (1993). Gendered knowledge—Epistemology and artificial intelligence. *AI & Society*, *7*, 311–322.

Allam, Z., & Dhunny, Z. A. (2019). On big data, artificial intelligence and smart cities. *Cities*, *89*, 80–91. (https://doi.org/10.1016/j.cities.2019.01.032), [Online]

Anderson, B. (1989). On artificial intelligence and theory construction in sociology. *Journal of Mathematical Sociology*, *14*(2–3), 209–216.

Apter, M. J. (1970). Cybernetics: a case study of a scientific subject-complex. *The Sociologi-*

cal Review, *18*(1_suppl), 93–116.

Arunagiri, A., & Udayaadithya, A. (2022). Governing Artificial Intelligence in Post-Pandemic Society. In *Global Pandemic and Human Security: Technology and Development Perspective* (pp. 413–433). (doi: 10.1007/978-981-16-5074-1_22), [Online]

Bircan, T., & Salah, A. A. A. (2022). A Bibliometric Analysis of the Use of Artificial Intelligence Technologies for Social Sciences. *Mathematics*, *10*(23), 4398. (doi: https://doi.org/10.3390/math10234398), [Online]

Bloomfield, B. P. (1988). Expert systems and human knowledge: a view from the sociology of science. *AI & SOCIETY*, *2*, 17–29.

Boyd, R., & Holton, R. J. (2018). Technology, innovation, employment and power: Does robotics and artificial intelligence really mean social transformation? *Journal of Sociology*, *54*(3), 331–345. (doi: https://doi.org/10.1177/1440783317726591), [Online]

Brent, E. (1988). Is there a role for artificial intelligence in sociological theorizing? *The American Sociologist*, *19*(2), 158–166.

Buele, I., & Guerra, T. (2021). Bibliometric analysis of scientific production on tax evasion in sciencedirect, years 2010 to 2019. *J. Legal Ethical & Regul. Isses*, *24*, 1.

Bulmer, M. (2003). *Sociological research methods*. London: Transaction Publishers.

Campbell, K. A., Orr, E., Durepos, P., Nguyen, L., Li, L., Whitmore, C., Gehrke, P., Graham, L., & Jack, S. M. (2021). Reflexive thematic analysis for applied qualitative health research. *The Qualitative Report*, *26*(6), 2011–2028. (doi: 10.46743/2160-3715/2021.5010), [Online]

Carley, K. M. (1996). Artificial intelligence within sociology. *Sociological Methods & Research*, *25*(1), 3–30.

Carley, K., & Newell, A. (1994). The nature of the social agent. *Journal of Mathematical Sociology*, *19*(4), 221–262.

Chang, Y.-C., Ku, C.-H., & Chen, C.-H. (2019). Social media analytics: Extracting and visualizing Hilton hotel ratings and reviews from TripAdvisor. *International Journal of Information Management*, *48*, 263–279. (doi: https://doi.org/10.1016/j.ijinfomgt.2017.11.001), [Online]

Collins, R. (1992). Can Sociology Create an Artificial Intelligence. *Sociological Insight: An Introduction to Non-Obvious Sociology*, 155–184.

Dash, B., & Sharma, P. (2022). Role of Artificial Intelligence in Smart Cities for Information Gathering and Dissemination - A Review. *Academic Journal of Research and Scientific Publishing*. *4*. 58-75. (doi: 10.52132/Ajrsp.e.2022.39.4), [Online]

Diaz-Bone, R., Horvath, K., & Cappel, V. (2020). Social research in times of big data. The challenges of new data worlds and the need for a sociology of social research.

Historical Social Research/Historische Sozialforschung, *45*(3), 314–341. (doi: https://doi.org/10.12759/hsr.45.2020.3.314-341), [Online]

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. (doi: https://doi.org/10.1016/j.jbusres.2021.04.070), [Online]

Elsevier. (2023). *ScienceDirect*. Retrieved from https://www.elsevier.com/en-xs/research-platforms

Ferrando, F. (2014). Is the post-human a post-woman? Cyborgs, robots, artificial intelligence and the futures of gender: a case study. *European Journal of Futures Research*, *2*(1), 1–17. (doi: https://doi.org/10.1007/s40309-014-0043-8), [Online]

Ferreira, F. A. F. (2018). Mapping the field of arts-based management: Bibliographic coupling and co-citation analyses. *Journal of Business Research*, *85*, 348–357. (doi: 10.1016/j.jbusres.2017.03.026), [Online]

Fuller, S. (2006). Intelligent design theory: A site for contemporary sociology of knowledge. *Canadian Journal of Sociology/Cahiers Canadiens de Sociologie*, 277–289. (https://doi.org/10.2307/20058711), [Online]

Fussey, P., & Roth, S. (2020). Digitizing sociology: Continuity and change in the internet era. *Sociology*, *54*(4), 659–674. (doi: https://doi.org/10.1177/0038038520918), [Online]

Hariri, R. H., Fredericks, E. M., & Bowers, K. M. (2019). Uncertainty in big data analytics: survey, opportunities, and challenges. *Journal of Big Data*, *6*(1), 1–16. (https://doi.org/10.1186/s40537-019-0206-3), [Online]

Hass, J. K. (2020). *Economic sociology: An introduction*. London: Routledge.

Ho, Y.-S. (2018). Comment on:"A bibliometric analysis and visualization of medical big data research" Sustainability 2018, 10, 166. *Sustainability*, *10*(12), 4851. (doi: https://doi.org/10.3390/su10124851), [Online]

Holton, R., & Boyd, R. (2021). 'Where are the people? What are they doing? Why are they doing it?')Mindell) Situating artificial intelligence within a socio-technical framework. *Journal of Sociology*, *57*(2), 179–195. (doi: https://doi.org/10.1177/144078331987304), [Online]

Howard, J. A., & Morgenroth, W. M. (1968). Information processing model of executive decision. *Management Science*, *14*(7), 416–428. (https://doi.org/10.1287/mnsc.14.7.416), [Online]

Joyce, K., Smith-Doerr, L., Alegria, S., Bell, S., Cruz, T., Hoffman, S. G., Noble, S. U., & Shestakofsky, B. (2021). Toward a sociology of artificial intelligence: A call for research on inequalities and structural change. *Socius*, *7*, (doi: 10.1177/2378023121999581), [Online]

Kerr, A., Barry, M., & Kelleher, J. D. (2020). Expectations of artificial intelligence and the performativity of ethics: Implications for communication governance. *Big Data & Society*, *7*(1), (doi: https://doi.org/10.1177/20539517209159), [Online]

Knoke, D., & Yang, S. (2019). *Social network analysis*. SAGE publications.

Krzywanski, J. (2019). Heat transfer performance in a superheater of an industrial CFBC using fuzzy logic-based methods. *Entropy*, *21*(10), 919. (doi: https://doi.org/10.3390/e21100919), [Online]

Linnenluecke, M. K., Marrone, M., & Singh, A. K. (2020). Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, *45*(2), 175–194. (doi: 10.1177/0312896219877678), [Online]

Liu, Z. (2021). Sociological perspectives on artificial intelligence: A typological reading. *Sociology Compass*, *15*(3), e12851. (doi: https://doi.org/10.1111/soc4.12851), [Online]

Lutz, C. (2019). Digital inequalities in the age of artificial intelligence and big data. *Human Behavior and Emerging Technologies*, *1*(2), 141–148. (doi: 10.1002/hbe2.140), [Online]

Mallen, G. L. (1970). Control theory and decision making in Organisations a reconnaissance. *Measurement and Control*, *3*(3), T46–T48.

Malsch, T. (2001). Naming the unnamable: Socionics or the sociological turn of/to distributed artificial intelligence. *Autonomous Agents and Multi-Agent Systems*, *4*(3), 155–186. (https://doi.org/10.1023/A:1011446410198), [Online]

Marinucci, L., Mazzuca, C., & Gangemi, A. (2023). Exposing implicit biases and stereotypes in human and artificial intelligence: state of the art and challenges with a focus on gender. *AI & SOCIETY*, *38*(2), 747–761. (https://doi.org/10.1007/s00146-022-01474-3), [Online]

Mark, R., & Anya, G. (2019). Ethics of using smart city AI and big data: The case of four large European cities. *The ORBIT Journal*, *2*(2), 1–36. (https://doi.org/10.29297/orbit.v2i2.110), [Online]

Matthewman, S., & Huppatz, K. (2020). A sociology of Covid-19. *Journal of Sociology*, *56* (4), 675–683. (https://doi.org/10.1177/1440783320939416), [Online]

Midhun, P. (1955). Artificial Intelligence: A Pillar of the Modern Society. In Shanmuga Sundari, Seng Thong Chong, M. Prabu (Eds.). *Outcomes of best practices in classroom research* (pp. 9-15). L. Ordino Nuovo Publications: New Delhi.

Mlynář, J., Alavi, H. S., Verma, H., & Cantoni, L. (2018). Towards a sociological conception of artificial intelligence. *International Conference on Artificial General Intelligence*, 130–139. (https://doi.org/10.1007/978-3-319-97676-1_13), [Online]

Molina, M., & Garip, F. (2019). Machine learning for sociology. *Annual Review of Sociolo-*

gy, *45*, 27–45. (https://doi.org/10.1146/annurev-soc-073117-041106), [Online]

Monaghan, L., & Gabe, J. (2022). *Key concepts in medical sociology*. Sage.

Mühlhoff, R. (2020). Human-aided artificial intelligence: Or, how to run large computations in human brains? Toward a media sociology of machine learning. *New Media & Society*, *22*(10), 1868–1884. (https://doi.org/10.1177/1461444819885334), [Online]

Mulyawati, I. B., & Ramadhan, D. F. (2021). Bibliometric and visualized analysis of scientific publications on geotechnics fields. *ASEAN Journal of Science and Engineering Education*, *1*(1), 37–46. (DOI:10.xxxxx/AJSEE.v1i1), [Online]

Musés, C. A. (1962). The Logic of Biosimulation. *In Aspects of the Theory of Artificial Intelligence: The Proceedings of the First International Symposium on Biosimulation Locarno, June 29–July 5, 1960*, 115–163.

Newman, J., Mintrom, M., & O'Neill, D. (2022). Digital technologies, artificial intelligence, and bureaucratic transformation. *Futures*, *136*, 102886. (https://doi.org/10.1016/j.futures.2021.102886), [Online]

Oliveira, A., & Silva, C. (2020). The sociology of education in Brazil today. *Revista de Sociología de La Educación-RASE*, *13*(1), 36–51. (DOI:10.7203/RASE.13.1.14658), [Online]

Paul, J., & Criado, A. R. (2020). The art of writing literature review: What do we know and what do we need to know? *International Business Review*, *29*(4), 101717. (https://doi.org/10.1016/j.ibusrev.2020.101717), [Online]

Purnomo, A. M. (2022). Sociology of Food Tourism Research Opportunities: A Bibliometric Analysis. *Society*, *10*(2), 203–222. (DOI:10.33019/society.v10i2.433), [Online]

Purnomo, A. M. (2023a). Bibliometric Analysis the Sociology of Tourism Research. In Rahmat Rosyadi (Ed.). *Ibn Khaldun International Conference on Applied and Social Sciences (IICASS-2022)* (pp. 277-292). Bogor: UIKA Press.

Purnomo, A. M. (2023b). The Trend of Sociology of Tourism Research: A Bibliometric Analysis. In Mega Febriani Sya, Nurul Annisa Yuniarti, Afmi Afriliani, and Muslim (Eds.). *Djuanda International Conference 2022* (pp. 135-144). Bogor: Unida Press.

Purnomo, A. M., Pratidina, G., & Setiawan, M. F. (2022). Komunikasi pemasaran perusahaan pasca pandemi: Studi respon pelanggan terhadap pesan di instagram. *Jurnal Komunikatio*, *8*(2), 103–113. (https://doi.org/10.30997/jk.v8i2.6731), [Online]

Schillo, M., Fischer, K., & Klein, C. T. (2000). The micro-macro link in DAI and sociology. *International Workshop on Multi-Agent Systems and Agent-Based Simulation*, 133–148. (DOI:10.1007/3-540-44561-7_10), [Online]

Schwartz, R. D. (1989). Artificial intelligence as a sociological phenomenon. *Canadian Journal of Sociology/Cahiers Canadiens de Sociologie*, 179–202. (https://

doi.org/10.2307/3341290), [Online]

Sebastian, R. (1955). Artificial Intelligence: A Through Dissection. *In Shanmuga Sundari, Seng Thong Chong, M. Prabu (Eds.)*, 266–272.

Selwyn, N. (2019). *What is digital sociology?* John Wiley & Sons.

Shubik, M. (1960). Simulation of the Industry and the Firm. *The American Economic Review*, *50*(5), 908–919.

Stahl, B. C., & Wright, D. (2018). Ethics and privacy in AI and big data: Implementing responsible research and innovation. *IEEE Security & Privacy*, *16*(3), 26–33. (DOI:10.1109/MSP.2018.2701164), [Online]

Stefani, U., Schiavone, F., Laperche, B., & Burger-Helmchen, T. (2020). New tools and practices for financing novelty: a research agenda. *European Journal of Innovation Management*, *23*(2), 314–328. (DOI:10.1108/EJIM-08-2019-0228), [Online]

Swedberg, R. (2021). How Do You Establish the Research Object in Sociology? In *Constructing Social Research Objects* (pp. 9–23). Brill.

Van Eck, N., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538. (https://doi.org/10.1007/s11192-009-0146-3), [Online]

Vasile, G. (2018). Why Are We Afraid of Artificial Intelligence (Ai)? *European Review of Applied Sociology*, *11*(17), 6–15. (DOI:10.1515/eras-2018-0006), [Online]

Veretekhina, S., Medvedeva, A., & Khitskov, E. (2017). Digital ecosystem of data. Directions for the development of the government of russia and the identification of confidence in the ongoing changes in society. *Economic and Social Development: Book of Proceedings*, 437–445.

Veselov, G., Tselykh, A., Sharma, A., & Huang, R. (2021). Applications of artificial intelligence in evolution of smart cities and societies. *Informatica*, *45*(5). (https://doi.org/10.31449/inf.v45i5.3600), [Online]

Wang, J., Veugelers, R., & Stephan, P. (2017). Bias against novelty in science: A cautionary tale for users of bibliometric indicators. *Research Policy*, *46*(8), 1416–1436. (https://doi.org/10.1016/j.respol.2017.06.006), [Online]

Wankhade, M., Rao, A. C. S., & Kulkarni, C. (2022). A survey on sentiment analysis methods, applications, and challenges. *Artificial Intelligence Review*, *55*(7), 5731–5780. (https://doi.org/10.1007/s10462-022-10144-1), [Online]

Wolfe, A. (1991). Mind, self, society, and computer: Artificial intelligence and the sociology of mind. *American Journal of Sociology*, *96*(5), 1073–1096.

Woolgar, S. (1985). Why not a sociology of machines? The case of sociology and artificial intelligence. *Sociology*, *19*(4), 557–572.

World Health Organization. (2023). *Statement on the fifteenth meeting of the IHR (2005) Emergency Committee on the Covid-19 pandemic*. Retrieved from https://www.who.int/news/item/05-05-2023-statement-on-the-fifteenth-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-coronavirus-disease-(covid-19)-pandemic?adgroupsurvey=%7Badgroupsurvey%7D&gclid=CjwKCAjwqZSlBhBwEi

Yanuarti, E. A., & Suprapto, N. (2021). Ten years of research on history of science (physics): A bibliometric analysis. *Studies in Philosophy of Science and Education*, *2* (1), 7–16. (https://doi.org/10.46627/sipose.v2i1.66), [Online]

Zacharaki, A., Kostavelis, I., Gasteratos, A., & Dokas, I. (2020). Safety bounds in human robot interaction: A survey. *Safety Science*, *127*, 104667. (https://doi.org/10.1016/j.ssci.2020.104667), [Online]

Zajko, M. (2022). Artificial intelligence, algorithms, and social inequality: Sociological contributions to contemporary debates. *Sociology Compass*, *16*(3), e12962. (https://doi.org/10.1111/soc4.12962), [Online]

