Scientometric Analysis of Fake News Detection and Machine Learning Based on VOSviewer

Lumbardha Hasimi and Aneta Poniszewska-Marańda[a]
Institute of Information Technology, Lodz University of Technology, Łódź, Poland

Keywords: Fake News Detection, Machine Learning, Scientometrics, VOSviewer.

Abstract: This study presents a comprehensive analysis of recent research patterns and progress in the field of fake news detection and machine learning. By examining 2209 publications from 2015 to 2022, the study aims to identify the most fre-quently developed topics and explore the involvement of publications, authors, and institutions. Using the network visualizing tool VOSviewer, a quantitative analysis is performed to investigate research productivity, patterns, and keyword distribution. This study contributes to the understanding of the current state of research in fake news detection and machine learning, and offers valuable in-sights for researchers, policymakers, and technology developers seeking to ad-dress the challenges posed by fake news and disinformation. The findings indi-cate that fake news detection research is still in its early stages and primarily focuses on social media and social contexts. There is a growing interest in the subject, as evidenced by increasing attention from the research community, whereas the network of interconnected research clusters, highlights the multidis-ciplinary nature of fake news detection.

1 INTRODUCTION

The spreading potential of fake news has become one of the biggest challenges in recent years. The massive dissemination of information has emerged as a frightening issue worldwide. The prevalence of fake news has been present for a long period, however with the advancements of mass media, it has come to be one of the biggest concerns of the online world. According to new Central Statistics Office (CSO) data, almost two-thirds of Internet users have been exposed to online content they considered to be not true or doubtful in 2021 (CSO, 2020). Fake news creates an adverse impact in every area, be it defaming, changing public opinion on political opinion, or simply financial, entertainment, and/or personal gain (Choras, 2020).

Initiatives of considerable significance have started from a worldwide perspective. The International Grand Committee (IGC) on Disinformation and Fake News is among the created boards focused on technology and media companies, and accountability in fake news issues (Tavares et al., 2017). The problem of fake news has grown into a major challenge for many societies. This phenomenon reaches politics, organizations, and individuals having an impact in different spheres. The most recent example of the proliferation and risk of fake news dissemination is the spread of anti-vaccination misinformation or the rumours regarding the incorrectly compared number of registered voters in 2018 to the number of votes cast in US Elections 2020 (Reuters, 2021). Its prevalence has shown certain patterns, especially during certain periods. For instance, elections, outbreaks etc. Therefore, it is critically important to stop the spread of fake news at an early stage.

However, with the ongoing technological advancements, the format of fake news is advancing as well. In recent times, the detection of multimodal format is becoming an issue on the rise. Visual and video propagation are new domains concerning the research community (Rohman et al., 2021; Jain and Kasbe, 2018). False information also attracts the attention of academia from various disciplines. Current knowledge bases struggle to validate false news effectively when it is linked to time-critical events as there is a lack of supporting claims or facts (Vinhas and Bastos, 2022). Furthermore, the nature of the data and the structure of the raw fake information, does not follow a particular pattern. Researchers have attempted in recent years to uncover problems with false news and offer solutions, especially regarding social media and dissemination. Nevertheless, according to (Paor

[a] https://orcid.org/0000-0001-7596-0813

Hasimi, L. and Poniszewska-MaraÂĎda, A.
Scientometric Analysis of Fake News Detection and Machine Learning Based on VOSviewer.
DOI: 10.5220/0012128300003538
In *Proceedings of the 18th International Conference on Software Technologies (ICSOFT 2023)*, pages 548-555
ISBN: 978-989-758-665-1; ISSN: 2184-2833

and Heravi, 2020) not only the online solutions are a tool to fight fake news, the literacy and education are also essential in combating the spreading of false information. The academic community has risen up to the challenge, investigating the causes, the scope and scale, the detection method, and how they spread to avoid their dramatic impacts (Wang, 2020; Gerbina, 2021).

With the rapid increase in the spread of fake news, the research community most prominently observed AI use in the cause against fake news dissemination. Particularly, the use of machine learning as a promising solution, especially regarding the real-time factor. Machine learning can be used to track and analyse information that can be validated by a legitimate medium and this way automate the review process, without human intervention (Alharbi et al., 2021). Although it is difficult to prevent the creation and spread of fake news articles, machine learning algorithms can be employed to detect anomalies and patterns (Khalil et al., 2021; Agrawal et al., 2021) that can lead to the prevention of fake news spreading. The use of a machine learning approach against fake news and disinformation can not only increase the efficiency against the scalability of fake news but also speed up the prevention/detection process. Many researchers have tackled the issue of fake news detection in terms of machine learning methods (Tavares et al., 2017; Khalil et al., 2021; Agrawal et al., 2021; Biwalkar et al., 2021; Abdulrahman and Baykara, 2020; Babu et al., 2022). To analyse further such contributions, through the scientometric analysis method it is possible to investigate the quantity and quality of research on this topic. Articles related to fake news detection have attracted interest, and given the numbers, last five years the topic of fake news detection has shown a rapid increase. Thus, this study aims to delve into existing sources in order to provide a comprehensive and objective analysis of fake news detection, under different criteria and analysis.

The objective of this study is to ultimately help in the selection and identification of core literature in the field, the latest trends, and developments in fake news detection, while comprehensively investigating the most recent advancements in academia and the research community.

The paper is structured as follows: Section 2 presents the overview of methodology used for the conducted research and experiments. Section 3 describe the details of analysis of publishing patterns, while section 4 deals with the research productivity and research impact in the area of fake news and dissemination.

Table 1: PICO strategy – Keywords and synonyms.

Keyword	Synonyms	Related to
detection	classification identification verification	Intervention
fake news	disinformation fake information false news misinformation	Population
machine learning	supervised methods, unsupervised methods, reinforcement learning	Intervention

2 METHODOLOGY

The study utilizes data from the Scopus dataset as one of the largest scientific databases of multi-disciplinary publications (Schotten et al., 2017). The collection of relevant publications and citations establishes the foundation for a scientometric analysis of a specific research area (Mazov et al., 2020; Khokhlov, 2020). This study covers a big number of peer-reviewed articles published in the last six years. Through this, we seek to attain evidence regarding fake news detection and machine learning. To achieve the objective of this study we processed indexed publications of the highest quality. For the scientometric study, formalized keywords are of crucial importance in the process of data collection. After the formalization of keywords, we designed and ran the following search query: TITLE-ABS-KEY ((”fake news” OR ”disinformation” OR ”fake information” OR ”false news” OR ”misinformation”) AND (”detection” OR ”classification” OR ”identification” OR ”verification”)) AND (”machine learning”) AND PUBYEAR ¿ 2014 AND PUBYEAR ¿ 2014. The final query was obtained considering the keywords and synonyms using PICO model – search strategy presented in table 1.

Considering that the collection of relevant publications and citations is the foundation for a scientometric analysis, we gathered data for a specific span of years, from 2015 to 2022. All the available results from the executed query had been exported and recorded as a dataset file. The data visualization constructions, network assessments, and clustering performed are conducted with the support of the VOSviewer program (van Eck and Waltman, 2010; (SMU), 2020). VOSviewer is developed as a powerful software for constructing and visualizing bibliometric networks and keyword occurrences, allowing manipulations with a large number of data extracted from some of the most-known databases (van Eck and Waltman, 2010). The program allows data visualization that makes it possible to have a fully detailed examination of specific data. To achieve a fuller and

Table 2: Results of number of publications per year.

Year	Documents	RGR
2022	606	0.11
2021	685	0.66
2020	352	0.49
2019	215	0.89
2018	88	0.84
2107	38	1.24
2016	11	0.32
2015	8	-

more complete map it was aimed in getting as greater number of connections as possible. To ensure consistent analysis, we focused on parameters such as the type of publication, citation patterns per author and institution, research productivity, and keyword analysis.

2.1 Data Processing

The data collected from Scopus resulted in 2017 publications. Besides the query parameters, no other filters were applied, as the quantity of the publications is sufficient for the scientometric analysis. The scientific input in the database through the observed years is presented in table 2. As seen from the results, the highest increase in publications. Moreover, Scopus with the new version offers even more advanced functionality to export structured data. In order to investigate the research productivity, several attributes of the collected data were utilized to analyse various aspects of publications.

To ensure the data is all accurate with no information missing, the final number of publications retained 2003, containing 7413 keywords in all keyword's unit analysis. The most productive year in terms of impact and the number of papers published, resulting also in the highest relative growth rate (Baskaran, 2022) from year to year, is 2021 with almost double the number of records compared to 2020 (Equation 1).

Equation 1. The calculation of relative growth rate

$$RGR = (lnN_2 - lnn_1)/(t_2 - T_1)$$

Selection of inappropriate form of publication has an influence in the visibility of research, hence its impact as well. For this reason, we decided to analyse which type of publication venue, the majority of the researchers in this study convey their insights.

Table 3 indicates that conference papers make the most of the document types, with an average of 57.8%, whereas an average of 98.9 percent of these studies are written in the English language. In this surely has an influence on the fact the majority of research is from the Computer Science discipline, and as well the most dominant having conference papers

Table 3: Publications and language.

Type	Percentage
Document type	Conference Paper (57.9%), Article (32%), Book Chapter (3.2%), Conference Review (3.3%), Review (2.2%), Book (0.1%), Data Paper (0.1%), Letter (0.1%), Retracted, Editorial, Note, Short Survey, others (0.1%)
Language	English (98.9%), Chinese (0.4%), Portuguese (0.4%), Others (0.3%)

as the primary means of publication (Heilig and Vob, 2014). Nevertheless, another explanation lies in the fact that the topic is quite novice, and the timely presentation is important to consider, especially when dealing with a rapidly growing issue.

2.2 Research Patterns and Units

In order to measure the research impact, we implemented citation analyses, specifically the number of current citations per author, document, and institution. The scientometric approach of the article is designed to explore such interactions at the levels of topics, publication venues, disciplines, and institutions. Similarly, co-citation analyses were also executed, in order to observe a relational dimension of the research network. This resulted in the formation of connections between authors, articles, and institutions, which are the foundations of this study. The option of citation-based clustering in VOSviewer offers visualised groups of data that share significant similarities. This helps to draw connections and differentiations of the data into separate categories. To have even more comprehensive overview, the overlay option builds maps representing the timeline with different colours. In particular, this approach allows to identification of research fronts based on relationships between the data and follows the evolution of the research by means of spatial connotations such as discipline, fields and other parameters, visualized across time (van Eck and Waltman, 2010).

Keyword Analysis and Other Relevant Aspects

To further explore key topics and aspects of fake news detection and machine learning we implemented the co-occurrence analyses, in order to build keyword clusters and observe the most frequent keywords against intersections with other fields. To clearly observe the spectrum of keywords, we used full calculation methods to obtain a theme map of author keywords and all keywords. The data were extracted from the title and abstract and processed using the full counting method.

3 ANALYSIS OF PUBLISHING PATTERNS

To have a wider view in the basic structure of fake news in machine learning research we analysed the data from different perspectives. The analysis consists of a distribution of the involved research disciplines, the contributing institutions, the number of authors and the distribution of documents.

3.1 Academic Disciplines

We start with analyses of academic disciplines in order to obtain an understanding of the general structure and the development of the subject. The distribution of publications for the entire period of six years is presented in figure 1.

It is evident the contribution in the Computer Science subject is nearly constant throughout the years, whereas the number of contributions in other disciplines slightly changes, especially last three years. This indicates that the effects of fake news detection, and its intersection with other disciplines is still at a developing point.

The results reveal the strict inclusion of three main subjects in the topic of fake news detection, namely Computer Science, Engineering, and Mathematics. However, in 2021 there was a slight trend of Decision Sciences to take over Mathematics, especially if such results are compared to 2015 and 1016. In particular, the peak popularity of the subject is distinct during the Covid-19 pandemic, which had a huge impact on the research output (Raynaud, 2021). According to the search result on the title and abstract content, out of the whole number, 153 of the publications are Covid-19 related to fake news, dissemination, datasets, etc. This implies that research activities during this period were partially affected by the ongoing situation.

To further evaluate research productivity, it is crucial to identify the most active research institutes in the field. Such insight is useful in building research collaborations and reflecting on a global scale concerning the distribution of research (Srainternational, 2020).

Figure 2 shows the rankings of research institutes ordered by the number of publications. Evidently, the numbers demonstrate a dominance of publications from Indian institutions. Delhi Technological University, as one of the most reputable institutions in India, has the highest number of publications. Followed by Arizona State University and the Chinese Academy of Sciences. Most of these institutions have an excellent reputation in research and attract some of the best scientists in the field with broad knowledge and expertise.

In order to observe the research productivity, while considering the limitations of the methods used, we focus on the number of papers per author, alongside citation patterns and numbers.

3.2 Co-Authorship Distribution Analysis

To obtain a deeper insight into contribution patterns, we further investigate the distribution of publications per citation and authorship patterns. The majority of the research on fake news detection is carried out by researchers from India, given the individual productivity.

To provide sufficient insight into the relevance of the contributions we also run the co-authorships analysis, alongside the citation analysis – presented in the next section. We analysed co-authorship with units of analysis of authors using the full counting method to get the authors' collaboration network.

Figure 3 shows 11 clusters of constructed patterns in the authors' collaboration network. The criteria of a minimum number of documents per author was set to 2, and to ensure the selection of high-impact data, the number of citations per author was set to 50. Thus, out of 4798 authors, only 74 are presented in the map creation. The largest clusters of collaboration patterns are between researchers of clusters 1 and 2, both containing 13 items. As seen from the figure, inter-cluster collaboration is more common among the leading authors. These authors have collaboration in wide aspects of fake news detection and machine learning. Some of the authors with various collaborations are Nakov, P., Shu, K., Liu, H., Da San Martino, G., Alam, F. Collaborative work is very important, especially in the case of an issue with the interdisciplinary outcome. Hence, through collaborative work not only productivity is affected, but also author and publication visibility is influenced by positive network membership, given the case of influential outlets.

3.3 Frequent Keywords and Keyword Clusters; Co-occurrence Network of High-Frequency Keywords

Keywords indicate the core fields of concern and represent an effective instrument in the classification of the content of scientific work. From a meta-perspective, keywords are the foundation for analysing the key topics and aspects representing a particular research area (Heilig and Vob, 2014). Co-occurrence analysis of keywords, not only help in

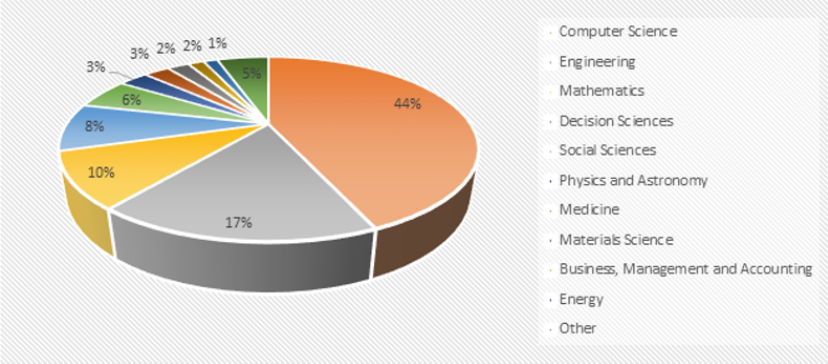

Figure 1: Distribution of documents per discipline.

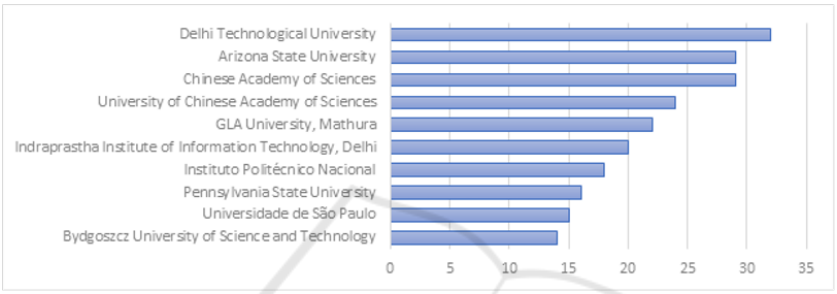

Figure 2: Distribution of documents per affiliation.

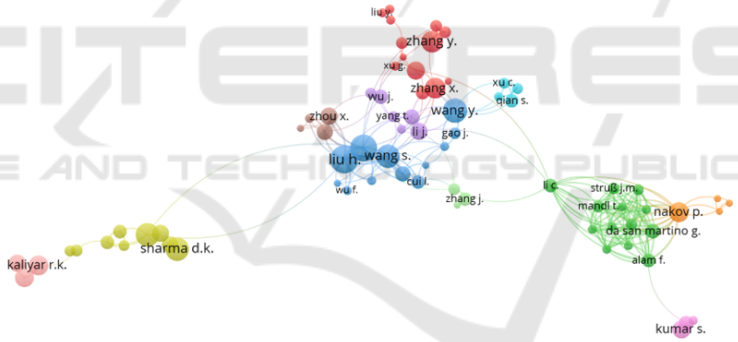

Figure 3: Co-authorship analysis map per author unit.

quick identification of popular topic within a timeframe but also help in pointing out aspects and topics related to each other. For this reason, we decided to observe closely the distribution of keywords, in both units: all are indexed (Fig. 4).

The observed papers comprising research related to fake news detection machine learning provide 7413 keywords in total. The most often cited expressions are: ”social networking (online)” (711), ”fake detection” (711), ”fake news” (697), ”social media” (613), ”fake news detection” (474), ”machine learning” (411). According to (Guo et al., 2017), using the relevant formula, the number of high-frequency keywords recommended for further analysis of co-occurrence should include 100 high-frequency keywords. On the other hand, for the 7 clusters obtained out of 314 words, as classified by VOSviewer, have the following dominant key-words per cluster: the first cluster shows the foremost keyword ”social network online” and ”fake news”, the second cluster ”fake news detection”, the third cluster ”fake detection”, the fourth cluster ”natural language processing”, the fifth cluster ”social media”, the sixth cluster ”embeddings”, the seventh cluster ”machine learning”. The results of the keyword analysis further revealed that the there is a tendency of approaching fake news detection mainly through the lenses of social media and social context.

Nevertheless, using VOSviewer, out of the total number of keywords, only 314 met the threshold of the minimum occurrences per keyword set to 10, while being classified in 7 clusters. In the map pre-

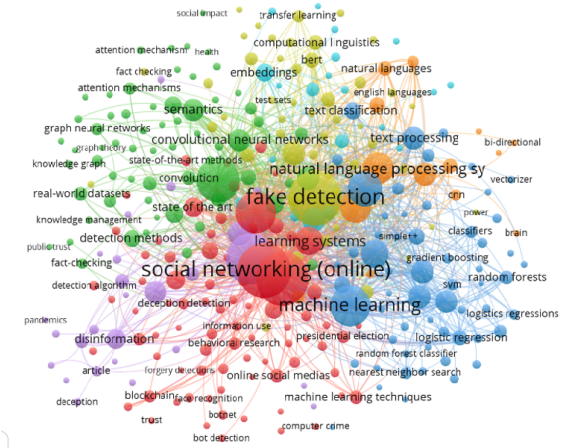

Figure 4: Co-occurrence analysis – all keywords.

sented, the size of nodes manifests the frequency of keyword's occurrence, while lines show relationships among keywords (Table 4).

4 RESEARCH PRODUCTIVITY AND RESEARCH IMPACT

Having the numbers that provide insights into publishing patterns alone is not sufficient to clarify the impact of research. One of the primary concerns of a scientometric study is to assess the impact of such contributions. A measure for analysing the impact of contributions is the aggregated number of citations a publication receives (Heilig and Vob, 2014). To measure the research impact, we applied citation and co-citation analysis at individual and institutional level (Fig. 5).

For citation analysis using the author unit, out of 4798, 64 meet the threshold. To create the map of citations per author, the minimum number of documents per author was set to 5, and the minimum number of citations per an author was set to 50. As a result, a network of 58 items (the largest set of connected items) was created, consisting of 8 clusters (Fig. 5). The biggest cluster, consists of 12 authors, depicted in red colour, and shows the network of some of the most productive authors such as Liu, H., Sharma D.K., Shu, K.

To receive the co-citation analysis of institutions, the minimum contribution was set to 1, and the minimum number of citations to 50. In return, 56 items were mapped (Fig. 6). Out of the overall number of items, 9 clusters were obtained, with the first cluster being the largest – consisting of 12 items, whereas the smallest the last one consisting of 3 items.

Reference co-citation analysis is one of the most important tools to analyse and reflect the evolutionary process in a particular scientific activity (Ding et al., 2021). We received overall 57, 355 cited references, for the co-citation network, out of which only 26 are represented below in the network, following the 20 citations per reference criteria. Figure 7 shows the mapping on the co-citation of references.

The red colour cluster indicates the first cluster, which through network lines identifies the references cited in the common paper. The frequency is depicted through the size of the dot – in this case, the reference point. From this network, 4 clusters were acquired, having the first cluster consisting of 9 items, and the smallest cluster 4, consisting of 5 items. The first cluster encompasses research regarding techniques, perspectives, and methods of fake news and its detection. The second cluster concentrates on fake news detection in social media and its detection within the social context. The third cluster investigates information credibility and fake news spreading patterns. The fourth cluster focuses on the machine learning approach, results, and efficiency of models. These results indicate that there is rapidly growing research on the topic of fake news detection and machine learning, especially in terms of inter-institutional and inter-disciplinary collaboration.

5 CONCLUSIONS

The latest trends and developments in fake news detection have shown increasing attention from the research community. The subject is gaining a lot of attention from an interdisciplinary scope, posing a challenge to many research fields. In this study, we conduct a scientometric analysis to comprehensively investigate the trends and developments in fake news detection and machine learning literature. To analyse publication patterns, research productivity, and identify various sources while investigating the biggest contributions per author and institution, we conducted a quantitative analysis using the network visualizing tool VOSviewer. The results of the study revealed that the research is currently dominated by computer science and conveyed especially through conference proceedings. The research activity is mainly influenced by highly recognised scientists and publications, carried out by some of the most reputable institutions worldwide. Concerning keyword analyses it was drawn to conclusion that the current focus of fake news detection lies mainly on social media and social contexts of fake news detection.

Furthermore, intersections of fake news detection and machine learning have shown to be cutting-edge

Table 4: Keywords analysis results – author vs. all keywords.

	All keywords	No.	Link	Author keywords	No.	Link
1.	fake news	685	1282	fake detection	711	10377
2.	fake news detection	474	765	social networking (online)	711	10641
3.	machine learning	308	766	fake news	697	8932
4.	deep learning	261	680	social media	613	8720
5.	social media	243	557	fake news detection	474	6098
6.	natural language processing	197	512	deep learning	411	5803
7.	misinformation	119	307	machine learning	410	5685
8.	covid-19	117	326	classification (of information)	296	4784
9.	twitter	80	218	natural language processing	241	3423
10.	disinformation	72	191	natural language processing systems	235	3622
11.	classification	62	147	learning systems	198	3270
12.	bert	57	149	learning algorithms	196	3183

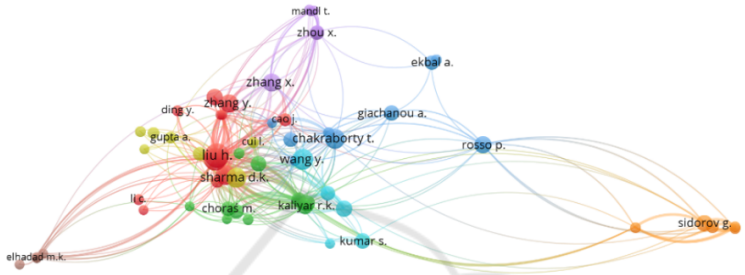

Figure 5: The most cited authors – citation per author.

Figure 6: Citation per institution unit analysis.

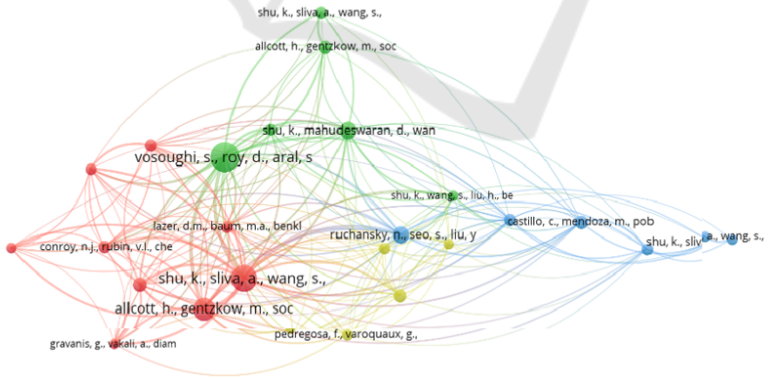

Figure 7: Co-citations per reference.

alongside social media, as recent research depicts. Based on the results, the article concludes with some general remarks on research productivity, research patterns, and keyword distribution. Future work can further explore certain aspects and concepts of fake news detection separately from social context and social media. While technological solutions are important, education and media literacy play a crucial role in combating the spread of fake news. Future research should focus on developing effective educational interventions, media literacy programs, and strategies to promote critical thinking and information evaluation skills. Studies related to fake news detection and machine learning are relatively new, and there is still a

huge gap related to the fake news detection issue and cross-disciplinary concepts related to it that can be investigated in the future.

ACKNOWLEDGEMENTS

The publication was created in the framework of Polish National Agency for Academic Exchange under the "STER Programme – Internationalisation of Doctoral Schools" as part of the project "Curriculum for advanced doctoral education & training – CADET Academy of Lodz University of Technology".

REFERENCES

Abdulrahman, A. and Baykara, M. (2020). Fake news detection using machine learning and deep learning algorithms. In *2020 International Conference on Advanced Science and Engineering (ICOASE), Duhok, Iraq*, pages 18–23.

Agrawal, C., Pandey, A., and Goyal, S. (2021). A survey on role of machine learning and nlp in fake news detection on social media. In *4th International Conference on Computing, Power and Communication Technologies (GUCON)*, pages 1–7.

Alharbi, R., Vu, M., and Thai, M. (2021). Evaluating fake news detection models from explainable machine learning perspectives. In *Proceedings of IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS (ICC 2021)*.

Babu, D., Sushmitha, G., Lasya, D., Krishna, D., and Rajesh, V. (2022). Identifying fake news using machine learning. In *2022 International Conference on Electronics and Renewable Systems (ICEARS)*, pages 1–6.

Baskaran, S. (2022). Publications trends in big data: A scientometric analysis.

Biwalkar, A., Rao, A., and Shah, K. (2021). Real or fake: An intrinsic analysis using supervised machine learning algorithms. In *5th International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)*, pages 372–380.

Choras, M. (2020). Advanced machine learning techniques for fake news (online disinformation) detection.

CSO, C. S. O. (2020). *Information Integrity*. Online, https://www.cso.ie/en/releasesandpublications/ep/p-isshisi/householdinternetsecurityandinformationintegrity 2021/informationintegrity/.

Ding, Y., Wang, Y., and Wang, Y. (2021). It's time to confront fake news and rumors on social media: A bibliometric study based on vosviewer. In *4th Intern. Conference on Computer and Communication Engineering Technology*, pages 226–232.

Gerbina, T. (2021). Science disinformation: On the problem of fake news.

Guo, D., Chen, H., Long, R., Lu, H., and Long, Q. (2017). A co-word analysis of organizational constraints for maintaining sustainability.

Heilig, L. and Vob, S. (2014). A scientometric analysis of cloud computing literature.

Jain, A. and Kasbe, A. (2018). Fake news detection.

Khalil, A., Jarrah, M., Aldwairi, M., and Jararweh, Y. (2021). Detecting arabic fake news using machine learning. In *2nd International Conference on Intelligent Data Science Technologies and Applications (IDSTA)*, pages 171–177.

Khokhlov, A. (2020). How scientometrics became the most important science for researchers of all specialties.

Mazov, N., Gureev, V., and Glinskikh, V. (2020). The methodological basis of defining research trends and fronts.

Paor, S. D. and Heravi, B. (2020). Information literacy and fake news: How the field of librarianship can help combat the epidemic of fake news.

Raynaud, M. (2021). Impact of the covid-19 pandemic on publication dynamics and non-covid-19 research production.

Reuters (2021). *Fact check: '133 million registered voters' argument uses flawed logic*. Online, https://www.reuters.com/article/uk-factcheck-voters-133-million-idUSKBN296284.

Rohman, M., Khairani, D., Hulliyah, K., Arini, P., Riswandi, and Lakoni, I. (2021). Systematic literature review on methods used in classification and fake news detection in indonesian. In *9th International Conference on Cyber and IT Service Management (CITSM)*, pages 1–4.

Schotten, M., el Aisati, M., Meester, W., Steiginga, S., and Ross, C. (2017). A brief history of scopus: The world's largest abstract and citation database of scientific literature.

(SMU), S. M. U. (2020). *Using VOSviewer as a bibliometric mapping or analysis tool in Business, Management & accounting*. Online, https://library.smu.edu.sg/topics-insights/using-vosviewer-bibliometric-mapping-or-analysis-tool-business-management.

Srainternational (2020). *Enabling Collaborative Work in Higher Education: An Exploration of Enhancing Research Collaborations Within an Institution*. Online, https://www.srainternational.org/blogs/srai-jra1/2019/12/08/enabling-collaborative-work-in-higher-education.

Tavares, B., da Silva, E. S., and de Souza, A. D. (2017). Risk management analysis in scrum software projects.

van Eck, N. and Waltman, L. (2010). Software survey: Vosviewer, a computer program for bibliometric mapping.

Vinhas, O. and Bastos, M. (2022). Fact-checking misinformation: Eight notes on consensus reality.

Wang, C.-C. (2020). Fake news and related concepts: Definitions and recent research developments.