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Rina Safitri
Graduate Program
Universitas Negeri Yogyakarta, Indonesia
E-mail: rinasafitri455@gmail.com
ORCID ID 0000-0003-0003-8474

Rugaya Tuanaya
Graduate Program
Universitas Negeri Yogyakarta, Indonesia
E-mail: rugayatuanaya.2021@student.uny.ac.id
ORCID ID 0000-0002-1010-7026

Syahri Ramadan
Graduate Program
Universitas Negeri Yogyakarta, Indonesia
E-mail: syahriramadhan@uny.ac.id
ORCID ID 0000-0001-9801-0861

Heri Retnawati
Mathematics and Science Faculty
Universitas Negeri Yogyakarta, Indonesia
E-mail: heri_retnawati@uny.ac.id
ORCID ID 0000-0002-1792-5873

Trends and Network Analysis of Data Literacy in Various Fields: Bibliometric Analysis

Abstract: Data literacy has emerged as a key aspect in meeting the challenges of the evolving digital age. However, existing bibliometric analyses related to this topic are scarce. To fill the gap, this study uses a bibliometric approach to conduct a comprehensive review spanning nearly seven decades in order to assess the research landscape, progress, and emerging trends in data literacy. This article presents a new review of scientific production through an in-depth bibliometric analysis of the Scopus database using two software packages namely VOSviewer and RStudio. The article presents a synthesis of 2896 peer-reviewed articles from 1956 to 2023. Using keyword and co-occurrence analyses to identify key trends and relationships in research on this topic. Researchers highlighted the most researched concepts and the most important relationships between different publications. The analysis process was conducted by presenting the publication time, disciplinary area, scientific publications on data literacy, prolific authors, most cited publications, productive scientific countries, and keyword co-occurrence analysis on this topic.

Keywords: Bibliometrics, data literacy, scientific research.

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Introduction

One of the basic literacies supporting the 21st century is data literacy (Pratama et al., 2020; Kassymova et al., 2019). Data literacy has emerged as a key aspect in facing the challenges of the evolving digital era. Data literacy includes the ability to collect data (Zhang et al., 2019; Stepanova et al., 2018), understand data (Carlson et al., 2013), explain data (Swan et al., 2013), identify, interpret, and implement data (Mandinach & Gummer, 2013), communicate and evaluate data (Huang et al., 2022), use data (Prado & Marzal, 2013), analyze data (Dichev & Dicheva, 2017), and manage data (Li et al., 2019).

According to Venture Beat (2014) in Gray et al. (2018) data literacy will be the most important new skill of the 21st Century and refers to the development of capacities and technologies to help companies, countries, and citizens make the most of their data. Some argue that "competence in finding, manipulating, managing and interpreting data" should be "an integral aspect of every business function and activity" (Harris, 2012). Others warn of a data literacy deficit and predict a shortage of millions of "data-savvy managers and analysts" (Manyika et al., 2011). It can be concluded that effective data literacy is not only an important skill in the world of business and science, but has also penetrated into many other fields, including education, health, technology, and the general public. Data literacy is also a new addition to the growing group of literacies such as numerical literacy, statistical literacy, and IT literacy (Frank et al., 2016).

Interest in data literacy is also shared by many in the public sector and civil society. A report from the UN advocates "global data literacy" to catalyze a "data revolution" for sustainable development (Independent Expert Advisory Group on a Data Revolution for Sustainable Development, 2014). Data literacy is seen as something that enables "change agents" to advance progress toward "the future we want." Data literacy is the intersection of statistical literacy, information literacy, and technical skills for working with data. Research literature on data literacy has experienced rapid growth over the past few decades. From 1956 to 2023, a significant period in technological development and increased access to data, research on data literacy has been in the spotlight in various fields of knowledge.

Research trends in data literacy cover various aspects, including innovative learning methods, evaluation of data literacy levels, the role of data literacy in decision-making, and the relationship of data literacy with technological developments such as Artificial Intelligence (AI) and extensive data analysis. In addition to research trends, the analysis of collaboration networks is also a focus of this bibliometric study. Researchers in various disciplines and institutions have collaborated to explore a deeper understanding of data literacy. Collaboration network analysis will help identify who is involved in data literacy research, how cooperation between researchers evolves, and how research contributions cross disciplinary boundaries.

Bibliometrics is a statistical method of analyzing publications (Phoong et al., 2022; Wang et al., 2021; Zhang et al., 2019). Bibliometrics is the basis for determining the most popular and most significant publications in a particular field (Sa'ed H. Zyoud et al., 2023). Bibliometrics is a research method that has complete information by combining science, mathematics, and statistics in analyzing knowledge quantitatively (Zhang et al., 2019). So, bibliometrics is a statistical method that contains information related to publications used to analyze publications in a particular field.

According to Abouzid et al. (2021), bibliometric research is an important method in analyzing qualitatively and quantitatively publications on certain subjects. According to S. H. Zyoud et al. (2017), in bibliometric research, data analysis is carried out using qualitative and quantitative indices such as publication year, affiliation, document type, country name, subject category, journal name, publisher language, collaboration, and citation pattern.

Over the years, bibliometrics has evolved and become common in analyzing and mapping concepts and knowledge published in many fields (Rana & Pragati, 2022; Zupic & Čater, 2015). Along with information and communication technology, research on data literacy has undergone significant development. Researchers from various disciplines have contributed to understanding the concept of data literacy, effective teaching strategies, and the impact of data literacy in various contexts. Through this bibliometric analysis, it is possible to understand recent developments in data literacy, identify vulnerabilities, and map trends that can guide further development in data literacy. As such, this analysis can provide valuable insights into how we can improve the understanding and use of data literacy in various fields in the future.

This study aims to explore the development of scientific literature related to data literacy over the period 1956 - 2023 and provide a comprehensive overview of trends and collaboration networks in data literacy. With a better understanding of research contributions and collaborative relationships among researchers, we can design strategic measures to face challenges and opportunities related to data literacy in the future.

Research Method

This research is a type of research with bibliometric analysis. Bibliometric analysis is applied to quantitatively measure and analyze certain indicators in the published literature in a particular domain and to generate knowledge maps based on large databases (Hung, 2012; Thelwall, 2008; Zeng & Chini, 2017). Bibliometric analysis in this study was conducted using RStudio and VOSviewer software. Metadata was collected based on the Dimension database in the last 67 years (1956-2023) related to data literacy in various fields.

In this study, VOSviewer was used to analyze, visualize, and evaluate all the information about the publications that had been collected, such as bibliographic pairs of authors, countries, institutions, journals, and co-occurrence of author keywords (Orduña-Malea & Costas, 2021; Oyewola & Dada, 2022; Sovacool et al., 2020; van Eck & Waltman, 2014). The stages in this research can be seen in Figure 1.

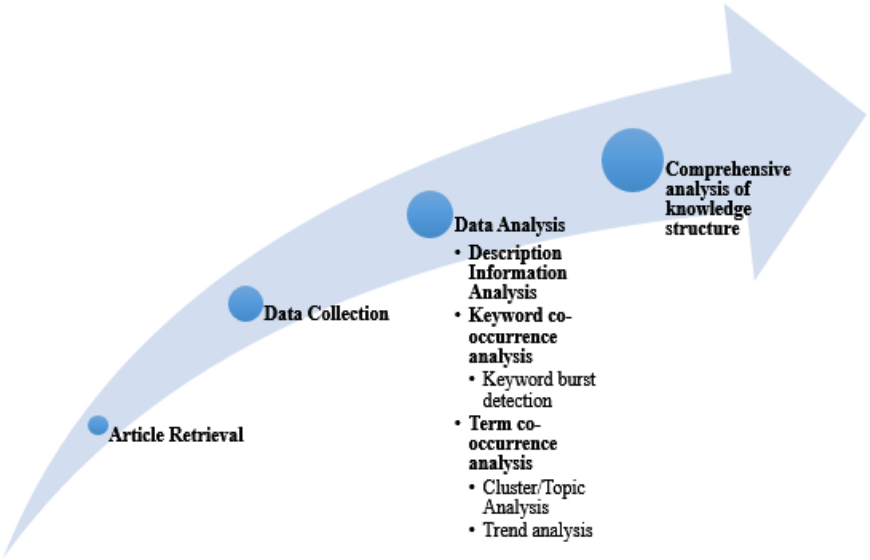

Figure 1. Research Design Framework

Once the data was collected, it was filtered, and 2,896 publications were selected. The entire dataset is available on Scopus.com. Three types of analysis were conducted to analyze and synthesize the data in the following order: (1) keyword co-occurrence analysis, (2) keyword explosion detection, and (3) term co-occurrence analysis. In addition, basic descriptive information analysis was used to categorize publications by year, source of scientific information by journal, discipline area of publication, prolific authors, and highly cited articles.

Specifically, the researcher completed the following series of steps: (1) retrieved relevant research articles from 1956 to 2023 with data literacy search terms; (2) Collected publication data of research titles, authors, keywords, and abstracts on Scopus; (3) Identified descriptive information, such as the distribution of publications by year, disciplinary focus, source, and author, and illustrated the most cited articles; (4) Applying keyword and term occurrence analysis with the help of visualization software such as RStudio and VOSviewer; (5) Detecting keyword bursts that have a high frequency of occurrence within a certain period; and (6) determining research topics and research trends using term cluster analysis from selected article titles and abstracts.

Research Result / Findings and Discussion

Publication Time. Figure 2 describes the number of research articles published by year from 1956 to 2023. Based on the Scopus dataset related to this research, the topic of data literacy first appeared in 1956. Until 2004, there were no publications at all related to the topic of data literacy. The topic then started to be discussed again in 2005-2008 with a very small number of publications, around 1-3 publications on the topic of data literacy. However, based on Figure 2, 2011 was the year when the trend of data literacy began to be discussed frequently in scientific research. Publications about data literacy continued to increase from year to year until the peak in 2022. Six hundred eighty-three publications discussed data literacy.

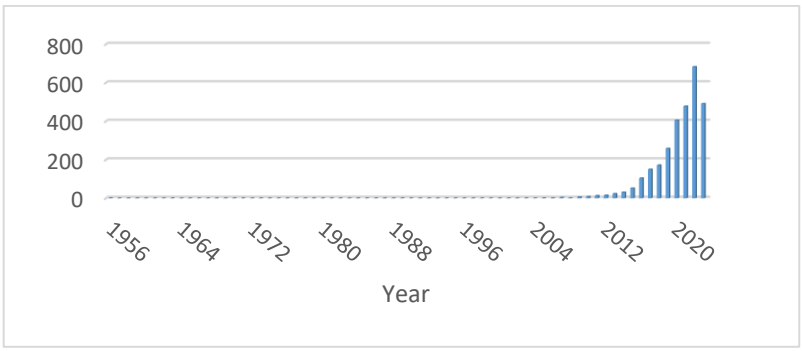

Figure 2. Distribution of Data Literacy Publications on the Scopus Database per Year

Diciplinary Focus. There is much research related to data literacy produced in various disciplines, especially disciplinary fields that include social sciences (43%) and computer science (24%), followed by engineering (7%), business management and accounting (5%), mathematics (4%), arts and humanities (4%), management (4%), pharmacy (4%), psychology (3%) and economics (2%). Figure 3 explains the distribution of literacy data publications in 1956-2023 based on the focus of the discipline as metadata on articles published in the Scopus database.

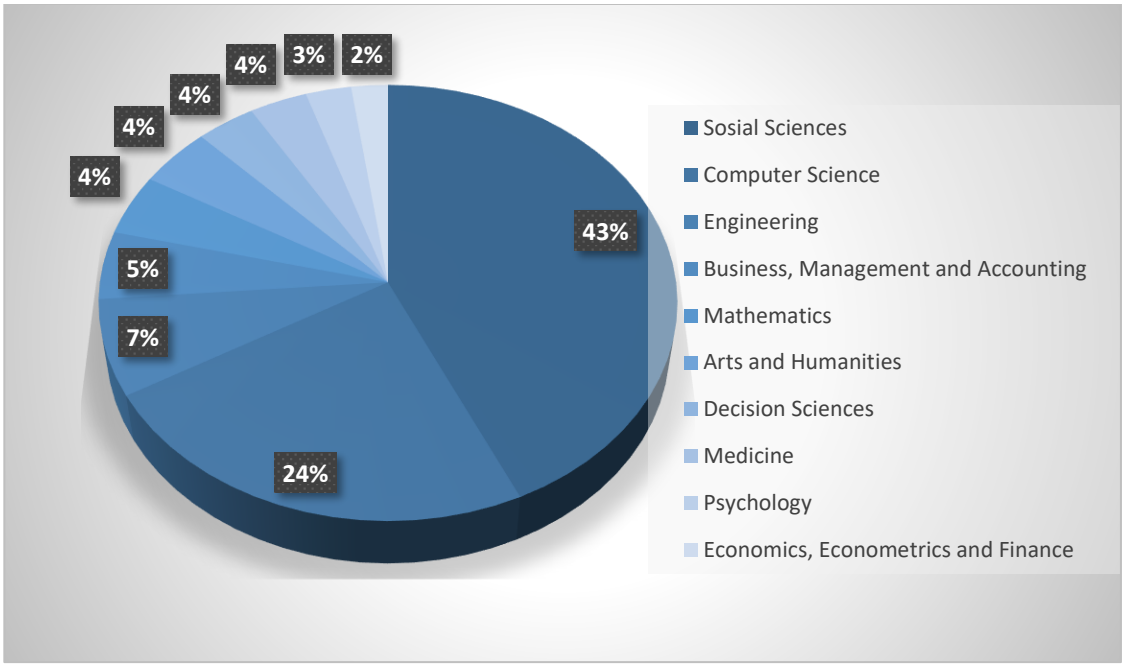

Figure 3. Distribution of Data Literacy Publications 1956-2023 by Disciplinary Fields

Scientific Publications on Data Literacy. Figure 4 shows the distribution of articles published by the top 10 journals from 1956 to 2023 based on the Scopus database. ACM International Conference Proceeding Series and Conference on Human Factors in Computing Systems-Proceedings accounted for 4.73% of the retrieved articles. The journals Communications in Computer and Information Science, Lecture Notes in Computer Science, and Frontiers in Education accounted for 3.18% of all data literacy articles reviewed in this study.

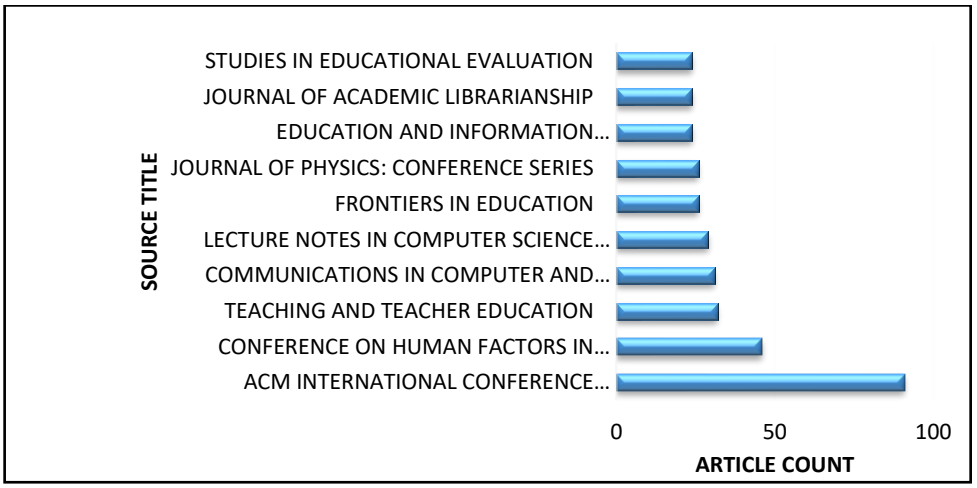

Figure 4. Distribution of Articles by Journal from 1956 to 2023 Based on Scopus Database

Prolific Author. The top five productive authors about data literacy on number of publications and nationality are Schildkamp (29/Dutch), Koltay (19/Hungary), Raffaghelli (15/Spain), Mandinach (14/San Francisco), and Poortman (14/Dutch). The data in this study is based on the Scopus database of 2896 articles specifically used in this study.

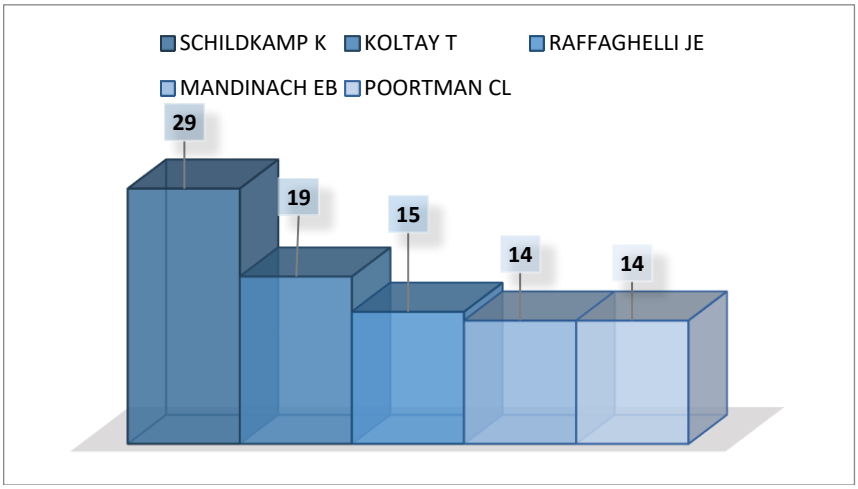

Figure 5. Most Productive Writer

Most Cited Publications. Table 1 shows the top ten cited references, total citations, and average citations per year in the Scopus database collection. The results of the most cited references are consistent with the findings of this study regarding the main disciplinary areas, i.e., for research topics related to data literacy (i.e., computer science and education), journals (i.e., Conference on Human Factors in Computing Systems) and authors (i.e., Mandinach, E. B.).

Table 1. References Cited, Total Citations, and Average Citations per Year in the Scopus Database Collection

References cited	Number of Citations	Average citations/year
Swan, M., (2012). *Sensor Mania! The Internet of Things, Wearable Computing, Objective Metrics, and the Quantified Self 2.0. Journal of Sensor and Actuator Networks, 1(3), 217–253.*	721	60,08
Clements, D.H., & Sarama, J. (2009). Learning and Teaching Early Math: The Learning Trajectories Approach (1st ed.). Routledge.	298	19,87
Lepri, B., Oliver, N., Letouzé, E. *et al.* Fair, Transparent, and Accountable Algorithmic Decision-making Processes. *Philos. Technol.* **31**, 611–627 (2018).	275	45,83
Long, D., & Magerko, B. (2020). What is AI Literacy? Competencies and Design Considerations. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*.	252	63,00
Mandinach, E. B., (2012). A Perfect Time for Data Use: Using Data-Driven Decision Making to Inform Practice, Educational Psychologist, 47:2, 71-85	248	20,67
Mandinach, E. B., & Gummer, E. S. (2013). A Systemic View of Implementing Data Literacy in Educator Preparation. *Educational Researcher*, *42*(1), 30–37.	236	21,45
Mihailidis, P., & Viotty, S. (2017). Spreadable Spectacle in Digital Culture: Civic Expression, Fake News, and the Role of Media Literacies in "Post-Fact" Society. *American Behavioral Scientist*, *61*(4), 441–454.	220	31,43
Widén, J., Carpman, N., Castellucci, V., Lingfors, D., Olauson, J., Remouit, F., Bergkvist, M., Grabbe, M., Waters, R., (2015). *Variability assessment and forecasting of renewables: A review for solar, wind, wave and tidal resources. Renewable and Sustainable Energy Reviews, 44(), 356–375.*	217	24,11
Aoun, J. E., (2017). Robot-Proof Higher Education in the Age of Artificial Intelligence	207	29,57
Abbas, J., Aman, J., Nurunnabi, M., & Bano, S. (2019). The Impact of Social Media on Learning Behavior for Sustainable Education: Evidence of Students from Selected Universities in Pakistan. *Sustainability*, *11*(6), 1683. MDPI AG.	206	41,20

State Scientific Productiveness. The results of the analysis of the data literacy dataset from the Scopus database regarding the most productive countries are shown in Figure 6. Countries with the highest number of publications are visualized in dark blue. The fainter the color means that, the fewer the scientific publications in that country. From Figure 6, it can be seen that the United States is the country that has the most scientific publications on data literacy, with a total of 2,120 documents recorded, followed by Germany with 467 documents.

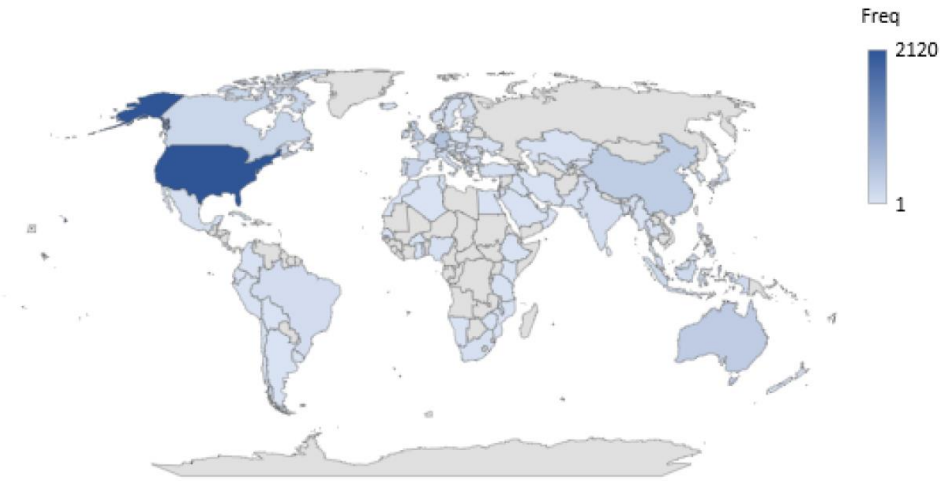

Figure 6. Most Productive Countries Writing Articles on Data Literacy

Keyword Co-occurrence Analysis. After the filtering process described in the data processing and analysis, a keyword co-occurrence network was generated by identifying groups of keywords in the 2896 selected publications with a high frequency of occurrence and a high degree of association. Figure 7 shows the network visualization of the co-occurrence of keywords (at least 2). It can be seen that "data literacy" is the most common keyword with 412 co-occurrences. The circle size can be this on the keyword "data literacy." The larger the circle, the more keywords have been widely used by researchers related to data literacy.

The results of the network visualization in Figure 7 shows that there are 8 clusters with 221 items regarding data literacy, namely, (1) Cluster 1 (in red) consists of 61 items; (2) cluster 2 (in green) consists of 33 items; (3) cluster 3 (in dark blue) consists of 30 items; (4) cluster 4 (yellow coloured) consists of 24 items; (5) cluster 5 (purple colored) consists of 23 items; (6) cluster 6 (black colored) consists of 22 items; (7) cluster 7 (orange colored) consists of 18 items; and (8) cluster 8 (brown coloured) consists of 12 items.

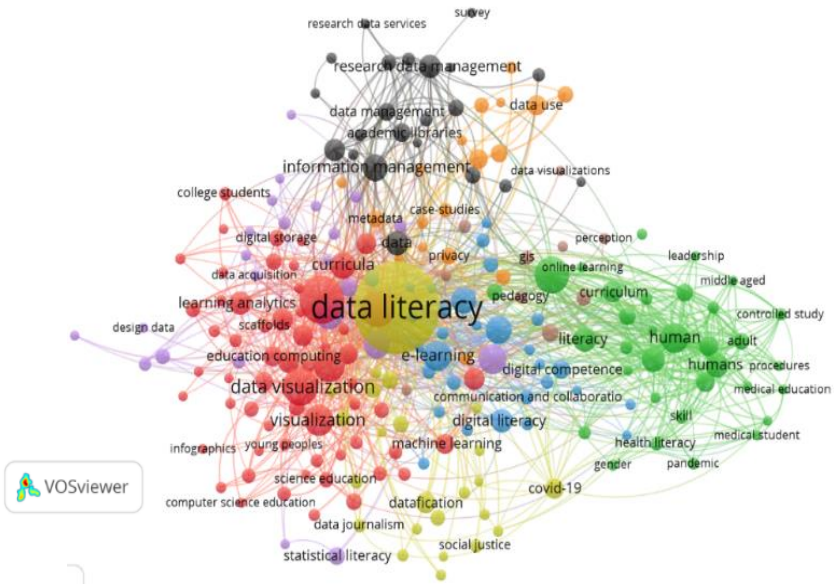

Figure 7. Network Visualisation of Keyword Co-occurrence

The clusters show that the research focuses on data literacy, meaning there are eight research focuses. The first research focus is the keyword with the largest circle in cluster 1, namely, students. The second research focus is the keyword with the largest circle in cluster 2, namely, information literacy and human. The third research focus is the keyword with the largest circle in cluster 3, namely, e-learning. The fourth research focus is the keyword with the largest circle in cluster 4, namely data literacy. The fifth research focus is the keyword with the largest circle in cluster 5, namely education. The sixth research focus is the keyword with the largest circle in cluster 6, namely information management. The seventh research focus is the largest circle in cluster 7, namely professional development and data use. The eighth research focus is the largest circle in cluster 8, namely learning. The eight research focuses above can be a reference for future researchers to determine research themes.

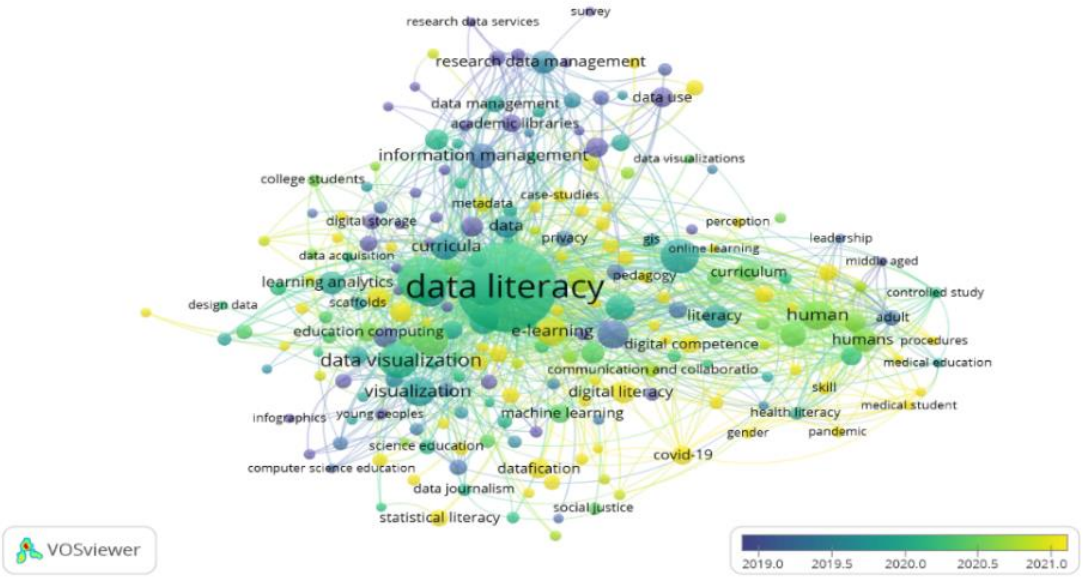

Figure 8. Overlay Visualisation of Shared Keyword Occurrence by Publication Year

Based on Figure 8, there are three different colors: the yellow color shows that the keywords were used together around 2021 to 2023, the blue color shows the use of keywords together around 2019, and the green color shows around 2020. This indicates a change in terms within a certain period. Keywords that become new themes are e-learning, datafication, statistical literacy, data analysis, data-driven, and high education. Based on the results of the discussion above, research or the number of publications related to data literacy in the Scopus database began to appear in 1956 and phased out for 47 years, and then, in 2004, began to increase steadily every year. The most significant number of documents is in the United States. The highest number of publications in the journal "ACM International Conference Proceeding Series" is 91 documents then the article with the highest number of citations, namely (2012) with the title "Sensor Mania! The Internet of Things, Wearable Computing, Objective Metrics, and the Quantified Self 2.0". Journal of Sensor and Actuator Networks, 1(3), 217-253".

Conclusions

Based on the analysis of the results and discussion, the number of publications related to data literacy has been increasing every year since 2012, and this increasing trend continues until 2023. In particular, social science disciplines are the main research focus, contributing 43% of all existing research. ACM International Conference Proceeding Series is the most active journal in publishing articles related to data literacy. Kim Schildkamp, a Dutch researcher, made a significant contribution by publishing 29 papers related to data literacy. However, the most cited work in the literature is Swan et al. (2013) "Sensor Mania! The Internet of Things, Wearable Computing, Objective Metrics, and the Quantified Self 2.0". The United States has the highest number of publications on this topic. Furthermore, several keywords emerged as new themes in data literacy research, including e-learning, datafication, statistical literacy, data analysis, data-driven, and higher education. This indicates that these keywords could be an interesting research focus for further exploration.

However, this research has some limitations, especially regarding database usage. The research only relied on the Scopus database, while many other databases can be used. Therefore, it is recommended that future research consider using data sources from various databases other than Scopus.

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References

Abouzid, M., Główka, A. K., & Karaźniewicz-Łada, M. (2021). Trend research of vitamin D receptor: Bibliometric analysis. *Health Informatics Journal*, *27*(4), 146045822110431. https://doi.org/10.1177/14604582211043158

Carlson, J., Johnston, L., Westra, B., & Nichols, M. (2013). Developing an approach for data management education: A report from the data information literacy project. *International Journal of Digital Curation*, *8*(1), 204–217. https://doi.org/10.2218/ijdc.v8i1.254

Dichev, C., & Dicheva, D. (2017). Towards data science literacy. *Procedia Computer Science*, *108*, 2151–2160. https://doi.org/10.1016/j.procs.2017.05.240

Frank, M., Walker, J., Attard, J., & Tygel, A. (2016). Data literacy - what is it and how can we make it happen? *The Journal of Community Informatics*, *12*(3). https://doi.org/10.15353/joci.v12i3.3274

Gray, J., Gerlitz, C., & Bounegru, L. (2018). Data infrastructure literacy. *Big Data & Society*, *5*(2), 205395171878631. https://doi.org/10.1177/2053951718786316

Harris, J. (2012). *Data is useless without the skills to analyze it*. Havard Business Review. https://hbr.org/2012/09/data-is-useless-without-the-skills

Huang, T., Zhong, W., Lu, C., Zhang, C., Deng, Z., Zhou, R., Zhao, Z., & Luo, X. (2022). Visualized analysis of global studies on cervical spondylosis surgery: a bibliometric study based on web of science database and VOSviewer. *Indian Journal of Orthopaedics*, *56*(6), 996–1010. https://doi.org/10.1007/s43465-021-00581-5

Hung, J. (2012). Trends of e-learning research from 2000 to 2008: Use of text mining and bibliometrics. *British Journal of Educational Technology*, *43*(1), 5–16. https://doi.org/10.1111/j.1467-8535.2010.01144.x

Independent Expert Advisory Group on a Data Revolution for Sustainable Development. (2014). *A world that counts: Mobilising the data revolution for sustainable development*. www.undatarevolution.org/wp-content/uploads/2014/11/A-World-That-Counts.pdf

Kassymova K.G., Tyumaseva Z.I., Valeeva G.V., Lavrinenko S.V., Arpentieva M.R., Kenzhaliyev B.K., Kosherbayeva A.N., Kosov A.V., Duvalina O.N., Dossayeva S.K. (2019). Integrative model of student and teacher stress coping: the correction of relations in educational, professional and personal interaction*. Bulletin of National academy of sciences of the Republic of Kazakhstan*. Volume 3, Number 379, pp. 169-179. https://doi.org/10.32014/2019.2518-1467.83

Li, J., Antonenko, P. D., & Wang, J. (2019). Trends and issues in multimedia learning research in 1996–2016: A bibliometric analysis. *Educational Research Review*, *28*, 100282. https://doi.org/10.1016/j.edurev.2019.100282

Mandinach, E. B., & Gummer, E. S. (2013). A systemic view of implementing data literacy in educator preparation. *Educational Researcher*, *42*(1), 30–37. https://doi.org/10.3102/0013189X12459803

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., & Byers, A. H. (2011). *Big data will become a key basis of competition, underpinning new waves of productivity growth, innovation, and consumer surplus—as long as the right policies and enablers are in place.* https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/big-data-the-next-frontier-for-innovation

Orduña-Malea, E., & Costas, R. (2021). Link-based approach to study scientific software usage: The case of VOSviewer. *Scientometrics*, *126*(9), 8153–8186. https://doi.org/10.1007/s11192-021-04082-y

Oyewola, D. O., & Dada, E. G. (2022). Exploring machine learning: a scientometrics approach using bibliometrix and VOSviewer. *SN Applied Sciences*, *4*(5), 143. https://doi.org/10.1007/s42452-022-05027-7

Phoong, S. Y., Khek, S. L., & Phoong, S. W. (2022). The bibliometric analysis on finite mixture model. *SAGE Open*, *12*(2), 215824402211010. https://doi.org/10.1177/21582440221101039

Prado, J. C., & Marzal, M. Á. (2013). Incorporating data literacy into information literacy programs: Core competencies and contents. *Libri*, *63*(2). https://doi.org/10.1515/libri-2013-0010

Pratama, M. A., Supahar, S., Lestari, D. P., Sari, W. K., Putri, T. S. Y., & Adiatmah, V. A. K. (2020). Data literacy assessment instrument for preparing 21 Cs literacy: Preliminary study. *Journal of Physics: Conference Series*, *1440*(1), 012085. https://doi.org/10.1088/1742-6596/1440/1/012085

Rana, S., & Pragati, P. (2022). A bibliometric and visualization analysis of human capital and sustainability. *Vision: The Journal of Business Perspective*, 097226292211057. https://doi.org/10.1177/09722629221105773

Sovacool, B. K., Xu, X., Zarazua De Rubens, G., & Chen, C.-F. (2020). Social media and disasters: human security, environmental racism, and crisis communication in Hurricane Irma response. *Environmental Sociology*, *6*(3), 291–306. https://doi.org/10.1080/23251042.2020.1753310

Stepanova G.A., Tashcheva A.I., Stepanova O.P., Menshikov P.V., Kassymova G.K., Arpentieva M.R., Tokar O.V. (2018). The problem of management and implementation of innovative models of network interaction in inclusive education of persons with disabilities. *International journal of education and information technologies*. Vol. 12, pp. 156-162.

Swan, K., Vahey, P., van 't Hooft, M., Kratcoski, A., Rafanan, K., Stanford, T., Yarnall, L., & Cook, D. (2013). Problem-based learning across the curriculum: Exploring the efficacy of a cross-curricular application of preparation for future learning. *Interdisciplinary Journal of Problem-Based Learning*, *7*(1). https://doi.org/10.7771/1541-5015.1307

Thelwall, M. (2008). Bibliometrics to webometrics. *Journal of Information Science*, *34*(4), 605–621. https://doi.org/10.1177/0165551507087238

van Eck, N. J., & Waltman, L. (2014). Visualizing bibliometric networks. In *Measuring Scholarly Impact* (pp. 285–320). Springer International Publishing. https://doi.org/10.1007/978-3-319-10377-8_13

Wang, W., Dong, X., Qu, J., Lin, Y., & Liu, L. (2021). Bibliometric analysis of Microtia-related publications from 2006 to 2020. *Ear, Nose & Throat Journal*, 014556132110376. https://doi.org/10.1177/01455613211037641

Zeng, R., & Chini, A. (2017). A review of research on embodied energy of buildings using bibliometric analysis. *Energy and Buildings*, *155*, 172–184. https://doi.org/10.1016/j.enbuild.2017.09.025

Zhang, Q., Yue, Y., Shi, B., & Yuan, Z. (2019). A bibliometric analysis of cleft lip and palate-related publication trends from 2000 to 2017. *The Cleft Palate-Craniofacial Journal*, *56*(5), 658–669. https://doi.org/10.1177/1055665618807822

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429–472. https://doi.org/10.1177/1094428114562629

Zyoud, S. H., Waring, W. S., Al-Jabi, S. W., & Sweileh, W. M. (2017). Global research production in glyphosate intoxication from 1978 to 2015: A bibliometric analysis. *Human & Experimental Toxicology*, *36*(10), 997–1006. https://doi.org/10.1177/0960327116678299

Zyoud, Sa'ed H., Shakhshir, M., Koni, A., Shahwan, M., Jairoun, A. A., & Al-Jabi, S. W. (2023). Olfactory and gustatory dysfunction in COVID-19: A global bibliometric and visualized analysis. *Annals of Otology, Rhinology & Laryngology*, *132*(2), 164–172. https://doi.org/10.1177/00034894221082735