



Bibliometric Analysis: Trend of Digital Literacy and Scientific Literacy Research in Indonesia Biology Learning

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ABSTRACT

This study aims to analyze research trends related to digital literacy and scientific literacy in Indonesia biology learning and find future research opportunities. The method used is a literature review with bibliometric analysis. The bibliometric analysis utilizes the Google Scholar database, sourced from Journals and Proceedings with a publication period of 2012-2022. Search for articles used PoP application and bibliometric mapping used VOSviewer. The results of analysis obtained 18 articles related to digital literacy, 100 articles related scientific literacy, and 1 article related to both. The most cited research is related to the use of learning models to increase scientific literacy. The mapping results obtained 2 clusters with 17 items. Research about digital literacy and scientific in Indonesia biology learning began to be widely in 2019-2022. Research on digital literacy and literacy in biology learning is still very much in demand at this time. Digital literacy in biology learning in Indonesia is still rarely studied. In conclusion, research related to digital literacy and scientific literacy is still a research trend in biology learning in Indonesia today. Digital literacy is still rarely researched and can be used as an opportunity in the future in research in the field of biology education.



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Introduction

The 21st century is marked as an era of openness and globalization, where developments in the fields of science, technology, and information are developing rapidly. These developments require humans to have the ability to take advantage of scientific and technology advances. The progress of science and technology in the era of globalization has entered various aspects of life, including the field of education. In this century, various levels of education will be followed by explosions of digital technology and information

and impact the growth of the millennial generation with one of its characteristics, namely proximity to the digital word (Afandi et al., 2019).

Digital technologies continue to influence teaching and learning (Feerrar, 2019). Innovative learning of the 21st century creates human resources to be literate in information, data, and technology which are urgently needed to face life competition and the job market in the current and future era of globalization (Priyanti et al., 2020). Learners need to be equipped with 21st-century skills/abilities (Yuni et al., 2016). 21st-century competencies consist of four main

domains namely digital era literacy, inventive thinking, effective communication, and high productivity (Rahayu, 2017; Turiman et al., 2012; van Laar et al., 2017).

Digital literacy is the ability to understand, analyze, assess, organize and evaluate information using digital technology (Mohammadyari & Singh, 2015). Digitally literate individuals are those who can search efficiently, compare sources, and sort authoritative from non-authoritative, and relevant from irrelevant, documents with software, or perform basic information retrieval tasks (Buckingham, 2006). Having digital literacy requires more than the ability to use software or operate digital devices; it covers a wide range of complex skills such as cognitive, motor, sociological and emotional skills that users need to master to use digital environments effectively (Eshet, 2012). Students need to assess the credibility of information and determine the level of trust they find online, therefore a digital literacy-oriented learning approach is needed by Joel Breakstone.

Apart from digital literacy, scientific literacy is one of the skills needed in the digital era (Turiman et al., n.d.). Scientific literacy can be interpreted as scientific knowledge and skills to be able to identify questions, acquire new knowledge, explain scientific phenomena, draw conclusions based on facts, understand the characteristics of science, awareness of how science and technology shape the natural, intellectual and cultural environment, and a willingness to be involved. and care about issues related to science (Kemendikbud, 2021). Scientific literacy describes an individual's ability to understand laws, theories, scientific phenomena, and things (Dragoş & Mih, 2015). Mohammadyari & Singh (2015) classifies the definition of scientific literacy into two views, which are very concerned with scientific knowledge and appreciate the usefulness of science in a social context. In learning biology, scientific literacy must be applied to improve students' cognitive abilities (Alfionora & Hasnah Putri, 2021).

In fact, the ability to digital literacy and scientific literacy of students in Indonesia is still low. Digital literacy in Indonesia has not yet reached a "good" level based on the Information & Data Literacy Sub-index, with the lowest score (Aptika, 2020). Furthermore, the results of the PISA studies related to scientific literacy in 2015 and 2018 show that Indonesia's average scientific literacy score is below the international average score. The low scores of Indonesian students reflect the low achievement in learning science (Huryah et al., 2017).

Biology is a branch of science that needs to be considered in terms of digital literacy and scientific literacy. Several studies on biology learning related to the analysis of digital literacy skills and science have been carried out. Research related to digital literacy conducted by (Amboni et al., 2021) shows that the digital literacy of class X students of SMAN 3 Batu Ampar in biology learning is classified as a moderate level. Furthermore, research conducted by Fadilah et al., (2020) and Huryah et al., (2017) shows that students' literacy skills are categorized as low. Therefore, digital literacy and learning science literacy in Indonesia need to be improved by conducting deeper investigations through research.

One of the researches that needs to be done first is literature study research with bibliometric analysis. Bibliometric analysis has been widely used to analyze research trends (sources). Therefore, this study aims to analyze research trends related to digital literacy and scientific literacy in biology learning in Indonesia and to find future research opportunities.

Method

This type of research is library research. This study used a literature review method with a bibliometric approach. Bibliometric analysis is a method for exploring and analyzing scientific work (Donthu et al., 2021). Article searches use harzing publish or perish (PoP) software, while mapping analysis uses VOSviewer. The PoP application is a software that can access data using Google Scholar publications to obtain information about citations and convert them into several statistics (Aulianto et al., 2019). Meanwhile, VOSviewer is an application developed to build and view bibliometric maps by offering text-mining functions in building and visualizing networks/relationships (correlation) in article citations/problems. VOSviewer can create publication maps based on networks (co-citation) or based on keywords (Hudha et al., 2019). This research data is secondary data in the form of articles related to digital literacy and scientific literacy in biology learning in Indonesia. The retrieved articles are limited to journal articles and proceedings with a span of the last 10 years from 2012 to 2022. Articles are searched from Google Scholar using the PoP application. An article search was conducted on October 17, 2022, with the keywords: Digital Literacy, Science Literacy, and Indonesian Biology Learning. The PoP search results are then imported into Microsoft Excel to be sorted according to research themes. The results of the sorted articles are then downloaded and entered

into the Mendeley Application and exported in *ris format files. Furthermore, the file is analyzed using VOSviewer to visualize and analyze research trends. VOSviewer analysis results are displayed in 3 visualizations, namely Network Visualization, Overlay Visualization, and Density visualization.

Results and Discussion

Searching or searching for articles in this study uses the PoP application by paying attention to indicators such as keywords, year range of publication, author's name, number of citations, etc. Search results using PoP yielded 997 articles from various types of documents. These documents include books, journal articles, proceedings articles, articles in book chapters, digital repository articles, and so on. However, after analysis, 119 articles met the criteria, namely articles published in scientific journals or proceedings with the theme "Digital Literacy and Scientific Literacy in Biology Learning in Indonesia". The articles obtained were classified into 3, namely: (1) 18 articles containing digital literacy, (2) 100 articles containing scientific literacy, and (3) 1 article containing both. The distribution of these articles by year of publication can be seen in Figure 1.

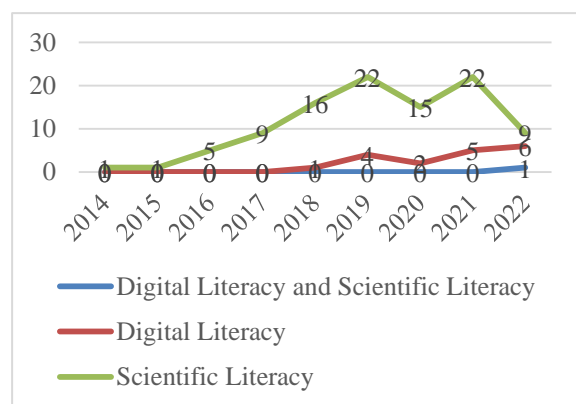


Figure 1. Distribution of Digital Literacy and Scientific Literacy Publications in Indonesia Biology Learning

Figure 1 illustrates the distribution of research on Digital Literacy and Scientific Literacy in Biology Learning in Indonesia from 2012-2022. Based on Figure 1, the growth of research on Digital Literacy and Scientific Literacy in Biology Learning in Indonesia has decreased and increased. In 2012-2013 research related to digital literacy and scientific literacy has not been of interest to researchers in the field of biology education. However, starting in 2014 research related to scientific literacy began to be carried out, and until 2020 there has been a very significant increase. Likewise, in scientific literacy research, starting from 2018 to 2022. Even research related to both of them will begin to be carried out in 2022 by Yusuf et al., (2022). Even so, the two research themes experienced a decline in 2020. This was because, at the end of 2019, the world and even Indonesia were hit by the Covid-19 pandemic. So, research in various education sectors experienced a decline. The basic reason is that the Covid-19 pandemic has had a significant impact on educational research because almost everything is focused on Covid-19 (Husaeni & Nandiyanto, 2022).

One way to assess the quality of a scientific publication is to count the number of times the work has been cited by other researchers. Quoting a scientific work means having a useful meaning in the field of science (Herawati et al., 2022). The greater the number of citations or citations from an article, means that the research results are used as references in other studies. (Supinah & Soebagyo, 2022). Articles with the highest number of citations are presented in Table 1.

Table 1. Digital Literacy and Scientific Literacy Articles with the Highest Number of Citation

No	Author Name	Article Title	Title Journal	Number of Citations
1	Afriana et al. (2016)	Implementation Project-Based Learning Integrated STEM to Improve Scientific Literacy Based on Gender	Jurnal Inovasi Pendidikan IPA	333
2	Setiawan (2019)	Peningkatan Literasi Saintifik melalui Pembelajaran Biologi Menggunakan Pendekatan Saintifik	Journal of Biology Education	199
3	Setiawan & Mufassaroh (2019)	Menyusun Soal Literasi Saintifik untuk Pembelajaran Biologi Topik Plantae dan Animalia	Biosfer	147
4	Ismail et al. (2016)	STEM-Based Virtual Lab Effectiveness in Improving the Scientific od Students with Gender Differences	Jurnal Inovasi Pendidikan IPA	68
5	Ristante et al.,	From A Reader to A Scientist:	Biosfer	63

	(2018)	Developing Cirgi Learning to Empower Scientific Literacy and Mastery of Biology Concept		
6	Ismail et al., (2016a)	STEM Virtual Lab: An Alternative Practical Media to Enhance Student's Scientific Literacy	Jurnal Pendidikan IPA Indonesia	62
7	Purwani et al., (2018)	Analysis of Student's Scientific Literacy Skills Through Socioscientific Isssue's Test on Biodiversity Topics	Journal of Physics: Conference Series	36
8	Ahied et al., (2020)	Improving Students Scientific Literacy through Distance Learning with Augmented Reality-Based Multimedia Amid the Covid-19 Pandemic	Jurnal Pendidikan IPA Indonesia	25
9	Banila et al., (2021)	Penerapan Blended Learning dengan Pendekatan STEM untuk Meningkatkan Kemampuan Literasi Sains Siswa pada Pembelajaran Biologi di Masa Pandemi	Journal of Biology Learning	25
10	Suwono et al., (2017)	Scientific Literacy of a Third Year Biology Student Teachers: Exploration Study	LSCAC Conference Proceedings The 4 th International Conference on Languange, Society and Culture in Asian Contexts	24

The data in Table 1 illustrates that the article with the title has the highest number of citations, namely "the Implementation Project-Based Learning Integrated STEM to Improve Scientific Literacy Based on Gende" by Afriana et al., (2016). The article was published by the Yogyakarta State University Science Education innovation journal in 2016. This Science Education Journal is an accredited journal and has a rank 2 indexed by SINTA. The results of the study show that implementing PjBL-integrated STEM increases scientific literacy. The theme of this research can be used as a reference source for further research on the use of learning models to improve scientific literacy skills.

Furthermore, 122 articles on digital literacy and scientific literacy that have been analyzed are visualized using VOSviewer. The results of the VOSviewer analysis are displayed in 3 visualizations, namely Network Visualization (Figure 2), Overlay Visualization (Figure 3), and Density visualization (Figure 4). In network visualization, keyword relationships are represented by networks or lines connecting terms (Husaeni et al., 2022). Each keyword is marked with a colored circle, the size of the circle is positively correlated with the appearance of the keyword in the title and abstract (Husaeni et al., 2022). Therefore, the size of the circle is determined by the frequency

of its appearance, the more often the keyword is used, the bigger the circle will be (Hufiah et al., 2021).

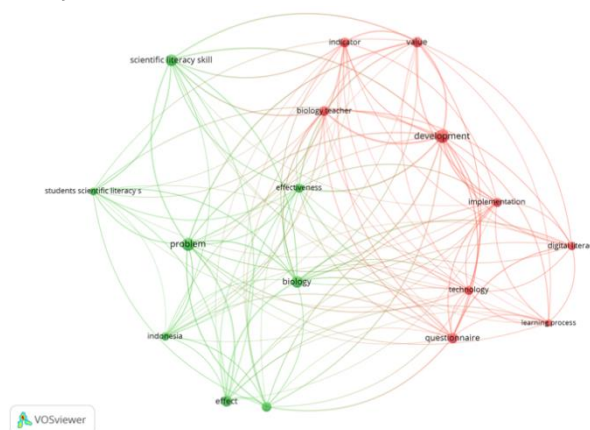


Figure 2. Network Visualization of Digital Literacy and Scientific Literacy in Indonesia Biology Learning

Based on Figure 2, 2 different clusters were found, namely red and green with 17 items. Cluster 1 in red contains items: Biology teacher, development, digital literacy, implementation, indicator, learning process, questionnaire, technology, and value, meaning that cluster 1 illustrates that research trends in biology learning related to digital literacy in Indonesia focus on developing, implementing, technology in the biology learning process applied by teachers. Cluster 2 in green contains biology,

effect, Indonesia, problems, scientific literacy, and students' literacy skills, meaning that cluster 3 describes the effect of learning biology on students' scientific literacy skills.

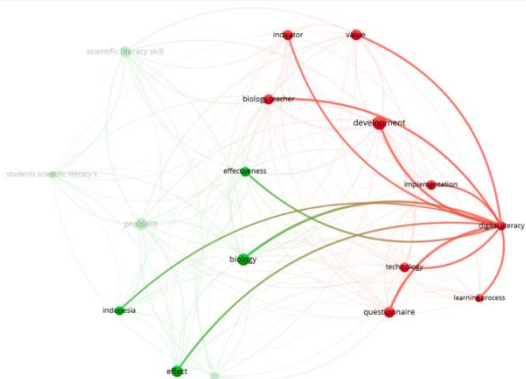


Figure 3. Network Visualization of Digital Literacy in Indonesia Biology Learning

In line with Figure 3, research on biology learning in Indonesia related to digital literacy contains several themes. Amboni et al., (2021); Kahar, (2018); Rosyadi et al., (2022); Sahrir, (2021) conducted research by analyzing digital literacy in biology students, university students, and teachers. Utama et al., (2019), researched biology teachers' perceptions of digital literacy. Furthermore, there is research that links digital literacy with other variables such as social attitudes (Natalia et al., 2020), learning outcomes (Hafiza et al., 2022), mastery of concepts (Hikmahwati et al., 2022), and by students' interest in digital technology, internet costs, and gender (Brata et al., 2022). As well as research on the application of STEAM with PjBL and PBL Learning to improve students' digital literacy skills (Hehakaya et al., (2022). Research on the development of learning media to improve digital literacy skills is most popular and able to increase digital literacy. The media developed are E-books (Diana & Wisanti, 2021), Flibook (Utami & Ducha, 2020), Android based Modul (Syarofatin et al., 2022), Augmented Reality (Nurhasanah et al., 2019), even mobile learning (Kale et al., 2021).

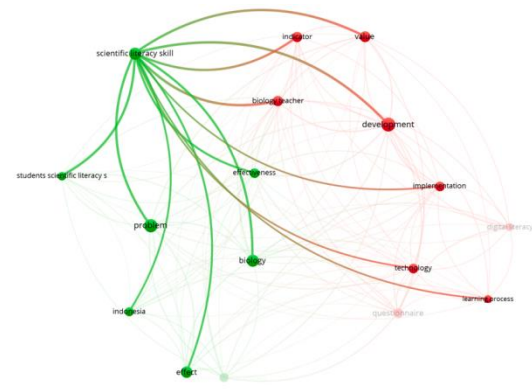


Figure 4. Network Visualization of Scientific Literacy in Indonesia Biology Learning

Based on figure 4., research related to scientific literacy is related to research items such as development, implementation, effectiveness, technology, etc. This is the result of an analysis of 100 articles that have been carried out related to scientific literacy which includes several research themes. Research articles related to the effectiveness of using models, methods, media, and learning approaches in increasing scientific literacy obtained 41 articles. Research on the development of media and learning models that can increase scientific literacy obtained 22 articles. Research by analyzing scientific literacy skills of students, students or teachers obtained 17 articles. Research related to scientific literacy assessment obtained 8 articles. Scientific literacy correlation research with other variables obtained 5 articles. Next is the analysis of scientific literacy in the text books used in learning to obtain 4 articles. Other articles that cannot be classified with the previous theme are around 3 articles. The effectiveness of using learning strategies to increase scientific literacy is the most widely studied. The learning model that is often used is Project Based Learning. (Afriana et al., 2016; Ahmada et al., 2021; Hernawati et al., 2019; Juleha et al., 2019).

Based on figures 3 and 4, there is no relationship between digital literacy and scientific literacy. However, there is one study that examines both simultaneously. Research related to digital literacy and scientific literacy with the title "The Relationship Between Digital and Scientific Literacy with Biology Cognitive Learning Outcomes of High School Students" by Yusuf et al., (2022). This study aims to

determine the relationship between digital literacy and scientific literacy together with the cognitive biology learning outcomes of SMA N 16 Semarang during the COVID-19 pandemic. The results of the study show that there is a positive and significant relationship between digital literacy and scientific literacy with cognitive biology learning outcomes.

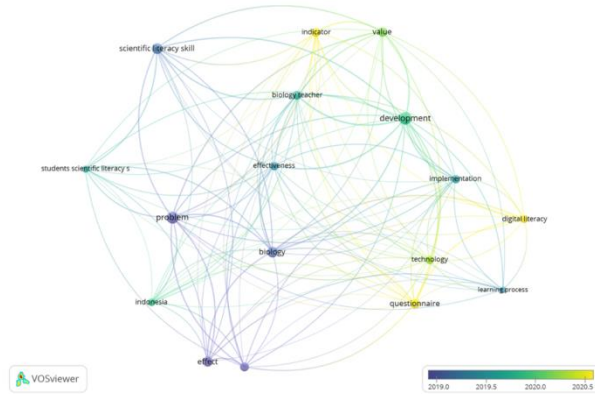


Figure 5. Overlay Visualization of Digital Literacy and Scientific Literacy in Indonesia Biology Learning

Overlay visualization depicts the novelty of the year of publication of each published article based on keywords/terms which are depicted with color gradations from dark blue to bright yellow, or in other words it shows traces of research history from year to year (Herdianto et al., 2021). Based on Figure 3, it shows the latest research related to digital literacy and scientific literacy in biology learning, where the brighter the color of the items, the newer the research is being conducted. From these data it can be seen that more research on this topic was carried out around 2020. Digital literacy is shown in bright yellow, meaning that the research is currently in high demand and includes the latest research.

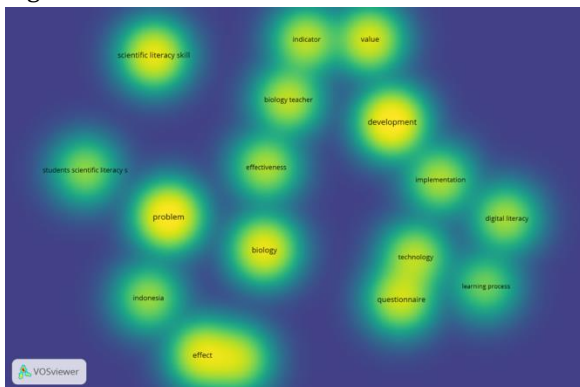


Figure 6. Density Visualization of Digital Literacy and Scientific Literacy in Indonesia Biology Learning

The results of the Density Visualization in Figure 6., show the density or density. Density Visualization can be used as a basis for viewing research topics that are rarely done. The density of the research theme is indicated by a bright yellow color. The brighter the color of a theme means that more research has been done and the dimmer the color means that the theme is rarely researched (Supinah & Soebagyo, 2022). Based on Figure 6., dimly colored themes such as "digital literacy", scientific literacy students and learning process. This means research -research on these items is still very rarely done. Digital literacy is still very rarely researched in Biology lessons in Indonesia. This is evident from figure 1, there are only 18 articles on this subject in the last 10 years. Therefore "digital literacy " are themes that can be used as a reference for further research.

Conclusion

Based on the results and discussion that has been presented, it can be concluded that the trend of article research regarding digital literacy and scientific literacy in biology learning has increased and decreased in the last 10 years. Digital literacy in biology learning in Indonesia is still little researched compared to scientific literacy. Most of the research cited was related to the implementation of learning approaches/models. The most researched themes are related to scientific literacy and digital literacy related to the development of learning media. Digital literacy is still very rarely studied. Therefore the opportunities for digital literacy research are very broad for research.

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