Bibliometric analysis of research on mathematical literacy in Indonesia

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Abstract. Many researchers research mathematical literacy, but there are no articles that discuss how research has developed over a certain period in Indonesia. This article aims to discuss how bibliometric analyses research mathematical literacy during Indonesia's last ten years. Besides, knowing the description of mathematical literacy research trends in the future. There were 46 bibliometric analyses of articles taken from the Scopus database. Articles were analyzed using Scopus Applications and VOSviewer version 1.6.12. The results showed that 46 articles analyzed in international journals were either still valid or discontinued by Scopus. Furthermore, the term mathematical literacy is most dominant in research and article writing. Finally, research on mathematical literacy is still up-to-date researched in the future, especially related to the learning and assessment process, curriculum development that supports mathematical literacy, and the involvement of teachers, parents, and society in supporting students' improvement' mathematical literacy.

1. Introduction
Mathematical literacy is one of the fundamental qualifications that students must have. The tendency for students to overcome daily problems would be much stronger if students have strong mathematical literacy [1,2]. The OECD notes that students with mathematical literacy will affect the ability of students to formulate, execute, and interpret complicated daily issues [3,4].

Many researchers in Indonesia concentrate on research related to mathematical literacy (e.g. research related to the development of problems of mathematical literacy [5-8], evaluation of student mathematical literacy [9-14], development of learning media [14], and reinterpretation of the sense of mathematical literacy [15]. On the basis of these studies, no article describes how mathematical literacy research has been investigated in Indonesia and its future trends.

It makes the author interested in conducting a bibliometric study since there is no comprehensive knowledge related to the growth of mathematical literacy research. This article therefore examines how the bibliometrics of mathematical literacy research are and how potential developments in mathematical literacy research can be represented.
2. Methods

2.1. Search strategy and data extraction
In this study, on January 15, 2021, the literature research for all published mathematical literacy papers was carried out using the Scopus database. The Scopus database was selected because it is considered an impact reference source for peer-reviewed scientific literature and an interdisciplinary source contributing to a broad view of scientific publications. This database is one of Indonesia’s most common sources among researchers and scholars. Moreover, Scopus provides a broad coverage of content and provides very comprehensive citation analysis results [16].

The search was carried out by the subject field including article title, abstract, and keywords using the term "mathematical literacy" OR "numeracy" OR "quantitative literacy" OR "PISA". For the review, all references indexed and released from 2010 to 2020 have been used. The search restrictions for papers are restricted to the country (Indonesia) the type of document (article, conference paper, review, and conference review), the subject area (social science and mathematics), the type of source (journal and conference proceeding), and the language (English), resulting in 74 documents.

The .ris format, including citation information, bibliographical information, abstract, and keywords is exported from the Scopus database. Then, to ensure that all the metadata is complete, the .ris file is imported into Mendeley. The 74 documents were checked in Mendeley by their titles, and we selected 46 related publications.

![Figure 1. Systematic process to select literature.](image)

2.2. Data analysis and visualization
Bibliometrics performed with Scopus and VOSviewer applications (version 1.6.12) [17]. Documents by year, documents by source, documents by author, documents by affiliation, and documents by type were analyzed by the Scopus Application. In addition, the VOSviewer program analyzes the co-authorship visualization of the network using .ris file that exported from Mendeley. The largest set of connected items consists of 37 items. Finally, in order to define the key research subjects, the VOSviewer software also analyzes the co-words of network visualization, overlay visualization, and density visualization. The most extensive set of related items consists of 119 items.
3. Results and discussion

3.1. Scopus application results

A total of 46 papers published from 2010-2020 have been bibliometrically analyzed. The first result reveals that there was no publication in the Scopus database in both 2010 and 2011. In 2019, there were 16 papers in most mathematical literacy journals, while in 2020, it dropped to 11 articles. The increase in the number of publications does not increase per year on a regular basis, and it is unpredictable. You can see it in Figure 2 below.

Figure 2. The number of mathematical literacy papers by year.

As shown in Table 1 below, the 46 papers published over the past 10 years are classified into 15 international journals.

Table 1. Classified based on name of journal, number of document, CiteScore, SJR, SNIP and Quartile.

| No. | Name of Journal                                      | Number of Documents | CiteScore | SJR  | SNIP  | Quartile |
|-----|------------------------------------------------------|---------------------|-----------|------|-------|----------|
| 1   | Journal on Mathematics Education                    | 22                  | 3.1       | 0.532| 4.413 | Q2       |
| 2   | International Journal of Scientific and Technology Research | 3                   | 0.2       | 0.123| 0.091 | Q4       |
| 3   | Advanced Science Letters                            | 2                   | 0.4       | 0.126| 0.316 |          |
| 4   | Elementary Education Online                         | 2                   | 0.5       | 0.192| 0.426 | Q3       |
| 5   | European Journal of Educational Research            | 2                   | 0.8       | 0.27 | 6.372 | Q3       |
| 6   | International Journal of Emerging Technologies in Learning | 2                   | 1.7       | 0.326| 0.926 | Q2       |
| 7   | International Journal ff Innovation Creativity and Change | 2                   | 0.5       | 0.225| 5.163 |          |
| 8   | International Journal of Instruction                | 2                   | 1.8       | 0.495| 2.085 | Q2       |
| 9   | Universal Journal ff Educational Research           | 2                   | 0.2       | 0.122| 0.196 | Q4       |
| 10  | Asian Social Science                                | 1                   | undefined | 0.124| 0.308 |         |
| 11  | Mathematics Education Research Journal               | 1                   | 2.5       | 0.817| 1.954 | Q1       |
| 12  | Mathematics Enthusiast                              | 1                   | 0.6       | 0.305| 0.622 | Q4       |
| 13  | New Educational Review                              | 1                   | 0.8       | 0.25 | 0.572 | Q3       |
| 14  | Problems of Education in the 21st Century            | 1                   | 0.3       | 0.247| 1.04  |          |
| 15  | Turkish Online Journal of Educational Technology    | 1                   | 0.4       | 0.126| 0.263 |          |
| 16  | Proceeding of 6th International Conference on Education and Technology (ICET), IEEE Explore | 1                   | N/A       | N/A  | N/A   | N/A      |
It can be shown, based on table 1 above, that 46 papers on mathematical literacy have been published in 15 international journals and in a conference proceeding. Seven papers (15%) of them are published in international journals that Scopus has discontinued. 27 papers in the high quartile (59 percent) were released, and an article published in the proceeding.

3.2. VOSviewer software results
On the subject of mathematical literacy, VOSviewer analyzes the scale of writers' networks. Figure 3 below illustrates how the networks of authors of mathematical literacy research are used.

![VOSviewer network](image)

**Figure 3. Authors’ network.**

Zulkardi is one of the scholars with the most networks (33 networks) with other writers and is the most productive writer on this subject of study. Putri, Kamaliyah, Ahyan, and Lutfianto are amongst his networks. Ahyan's network, meanwhile, comprises four networks: Zulkardi, Darmawijoyo, Turmudi, and Juandi. One of the reasons for many networks is that some of the scholars have been students or lecturers of other scholars and have a dedication to concentrating on mathematical literacy studies. The strength of cooperation in research and publication can be determined by a network of writers.

In addition, mathematical literacy is the most commonly used concept in terms of keywords used in publications, 16 times, with a keyword network of 533. (see figure 4). Currently, mathematical literacy research is mainly related to problem-solving skills, research methods for design, and the PISA system. In addition, research into mathematical literacy is mainly related to the creation of problems using the PISA system, which focuses primarily on the use of the meaning of a case, such as COVID-19. It also applies to the mathematical literacy of students (see figure 5).
Figure 4. Co-word network map.

Figure 5. Overlay visualization of co-word.

Figure 6 below shows that the more research is connected to it, the color deterioration becomes yellow. The researchers seldom perform research related to this matter if it is getting towards the blue direction. The figure shows that most research uses the subject of mathematical literacy itself, which is connected to the development of PISA-like issues (color degradation is getting yellow). There is very little study, however, on good processes of learning and evaluation and the reliability of constructs of the mathematical literacy instrument. In addition, student imagination in daily life with mathematical literacy of students; a mathematics education curriculum that promotes mathematical literacy; it is also uncommon to study among teachers, parents, and the surrounding environment to enhance the mathematical literacy of students.
4. Conclusions

This research shows that mathematical literacy is a research subject that has acquired considerable importance in Indonesia over the last decade. Although the development of documents in the Scopus database does not increase significantly every year, we believe that mathematical literacy research documents have more possibilities outside the Scopus database, such as the Google Scholar database, Crossref, and others.

For scientific researchers who are interested in studying mathematical literacy, the current study can be used as a bibliometric pattern. In this regard, we hope that by providing detailed analyses and structured information on this subject, this study will help to identify researchers' hot spots and gaps. We propose that other researchers review record data from various sources for further mathematical literacy studies.

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