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Mapping Ethnomathematical Research Directions and Trends in the Scopus Database: A Bibliometric Analysis

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Abstract: Although research on ethnomathematics has been widely carried out, there is still little empirical evidence reporting the mapping and trends of ethnomathematical research in Scopus-indexed journals. The purpose of writing this article is to map trends in ethnomathematical research in Scopus-indexed journals in the range from 1986 to 2022. The fundamental tenet of ethnomathematics is to study, appreciate, and exclusively take into account the application of mathematics by ethnic groups. In other words, in understanding mathematics to look attractive, it is necessary to make a connection between everyday life and the realm of abstract mathematics. Scopus is a resource for further research, identifying scientific uniqueness and gaps. This study uses bibliometric analysis methods using VOSviewer, article searches using Publish or Perish (version 8), and SEforRA applications. Bibliometric research provides a reliable and impartial way to gauge the contribution of an article to knowledge advancement and is a tool that is often used to analyze trends and performance on certain subjects. These findings reveal an increasing trend in ethnomathematical research and identify some topics or keywords that could form the basis for additional studies. In conclusion, for future studies, bibliometric analysis will provide information and knowledge about the evolution of ethnomathematical research.

Keywords: *Bibliometric, ethnomathematical research, mapping, Scopus database.*

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Introduction

Scopus is an indexing tool that includes citations and abstracts for a variety of articles, books, and conferences. Specific requirements and procedures must be followed for a journal, proceeding, or book to be included in the Scopus database. Because of these stipulated conditions, Scopus is used as one of the benchmarks for productivity of a certain quality (Purwoko, 2016). Benchmarks, which are clearly stated on the Credit Score Assessment (CSA) Directorate General of Higher Education (DGHE) website, are written on pages that are often referred to by scientific journals, namely Web of Science (WoS) and Scopus. The CSA and DGHE website administrator also write that lecturers look for journals for publication that are entered in the Scopus database or WoS. In addition to DGHE Indonesia, the Australian Research Council also uses the Scopus for Excellent in Research for Australia (ERA) 2015. ERA uses relevant citation information in certain fields of science to obtain expert panel information, which will determine the quality of research results (Chan, 2014).

Scopus indexes scientific journals in various disciplines, and there are about 33 million publication data that have been recorded in Scopus, which was carried out as early as 1996. As of January 2018, Scopus has indexed several 22,800 journals, including 5,200 titles of open-access scientific journals. The Scopus database also provides bibliometric information about productivity by authors, institutions following the country in a field or discipline, and information on index or citation quotes, which is how often a journal is referred to and quoted by other speakers (Osman & Yussof, 2020); Anyi et al., 2009; Bodaghi et al., 2015).

Besides Scopus, there is an earlier database used by the Quacquarelli Symonds (QS) World University Ranking to provide world-class university rankings, namely WoS, previously known as the WoS. The WoS database is published by a

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publishing body, namely WoS, in the United States. However, WoS focuses more on publications from the West, particularly from the United States, and gives priority to journals published in English (Bontis & Serenko, 2009). According to Nisonger (2004) that the WoS, which is a website page published by WoS, only indexes twenty percent of journals published in countries other than the United States and two percent of journals published in languages other than English.

When compared to WoS, publication coverage indexed by Scopus is found to be more international. Scopus not only indexes publications from the West but also indexes publications from countries in Asia (Huang, 2011; Marginson, 2009). In addition, Scopus also indexes publications in other languages more than WoS (Bontis & Serenko, 2009). This wider publishing index coverage gives the Scopus database an advantage, so it has been selected by the QS World University Ranking as the database that provides publishing bibliometric notices in providing ranking reports of the world's leading universities, replacing the WoS database (Holmes, 2010; Huang, 2011; Sowter, 2008).

Scopus indexes various elements of scientific publications obtained from external publishers, such as publication titles, abstracts, keywords, author names and related affiliations, references, and drug terms (Berkvens, 2012). One of the elements of publications indexed by Scopus is a research-related problem in the field of ethnomathematics. However, in various countries whose ethnomathematics research is published in the journal, Scopus has different tendencies; for example, in Indonesia, ethnomathematics research has increased significantly from year to year, while in Turkey, ethnomathematics research is still relatively lacking.

In Indonesia, there have been many studies or publications related to ethnomathematics. Starting from cultures that are raised and connected with ethnomathematics learning or exploration to the role of ethnomathematics in education. Among them is research conducted by (Lubis et al., 2018) on ethnomathematics exploration in "*Gordang Sambilan*" (*Gordang Sambilan* is a traditional musical instrument from one of the ethnic groups from North Sumatra) musical instruments, research (Mahuda, 2020) on ethnomathematics exploration of "*lebak batik*" motifs and research by (Rahmawati & Muchlian, 2019) on ethnomathematics exploration of "*Minangkabau*" (Minangkabau is a place name in West Sumatra) houses in West Sumatra. The research related to ethnomathematics in mathematics learning in Indonesia, such as research conducted (Fauzi & Lu'luilmaknun, 2019) on ethnomathematics in "*Dengklak*" games as a medium for learning mathematics.

Cases from other countries, for example, Turkey. Reviewing the literature reveals that while research in the area of ethnomathematics is being undertaken internationally, Turkey has produced very few of these studies (Ergene et al., 2020). There have only been a few postgraduate theses, essays, papers, and one translation book produced in Turkey. These sources include research on the conceptualization of mathematical ideas by students and their associations with lesson material that incorporates aspects of their own culture (Aktuna, 2013), as well as studies on how students interpret this process and engage in activities. Additionally, one study used a qualitative paradigm to explore how pupils with various cultural values thought mathematically (Ergene et al., 2020). Additionally, there are experimental research that looked at how ethnomathematics affected scholastic performance and attitude toward mathematics (Kara & Yontar Togrol, 2010). It may be claimed that the connection between Turkish culture and mathematical education has not been fully shown due to the small number of ethnomathematics research papers undertaken in Turkey, which is acknowledged as a relatively young research subject.

The lack of ethnomathematics research results in countries such as Turkey and other countries, as well as the significant increase in ethnomathematics research in Indonesia Muhammad et al. (2023), it provides differences and gaps in the number of ethnomathematics publications in Scopus-indexed journals. Then it is necessary to conduct research on the development of ethnomathematics research publications from year to year from each country in Scopus-indexed journals. Improving the quality and number of ethnomathematics research publications in international journals indexed by Scopus will provide novelty that helps researchers from various countries to find their research topics. In addition, the importance of including cultural elements in the mathematics curriculum will have an impact on increasing students' understanding of mathematics learning. To improve the results of ethnomathematics research in international journals indexed by Scopus. Thus, the purpose of writing this article is to map ethnomathematics research trends in Scopus-indexed journals through bibliometric analysis.

Literature Review

Through D'Ambrosio's papers and his lectures at many conferences, ethnomathematics has developed and become more well-known since the first one was started in 1977. D'Ambrosio (1999) presented "Why Teach Mathematics," a comprehensive explanation of why mathematics should be included in the school curriculum, during the third International Congress on Mathematics Education (ICME3) in Karlsruhe in 1976. I suggest that this should cover a discussion of the nature of knowledge as it relates to mathematics, paying particular attention to history, philosophy, and cognition in general rather than focusing specifically on philosophy, the history of mathematics, and theories about the study of mathematics. How come that? due to extensive and skewed mathematical cognition, as well as the history and philosophy of mathematics. We must adopt a transdisciplinary perspective if we want to understand the nature of mathematics knowledge across cultures. Rayna Green organized a segment on "Native American Science" for the AAAS

(American Association for the Advancement of Science), Annual Meeting in February 1978. D'Ambrosio (1999) used the term "ethnomathematics" in his article to describe the mathematics of the original culture. However, the term "ethnomathematics" has traditionally been used to refer to mathematical depictions of foreign cultures, especially those that do not have a written language and are oppressed by colonialism. D'Ambrosio and Almeida (2017) further say that in all early civilizations, we found what we now call mathematics related to and generally fused with or almost indistinguishable from other forms of knowledge, which are now identified as art, religion, music, technology, and science. All seem mixed and indistinguishable as forms of knowledge, the first stages of human history, and the personal lives of each of us. All these forms of knowledge are products of human rational thinking and are considered expressions of modern human behavior. Ethnomathematics entered science, and specifically mathematics education, in Indonesia for the first time in 2013 (Karnilah, 2013). Starting with the Baduy community, who developed their mathematics to handle a range of challenges in daily life despite obtaining formal education, is beginning this investigation. Since then, studies on ethnomathematics in diverse Indonesian cultures have started to be created and published in a variety of Indonesian journals. This is motivated in part by the fact that Indonesia is home to a wide variety of cultures, from Sabang to Merauke, which draws scholars and educators to study ethnomathematics in many cultures in Indonesia (Hidayati & Prahmana, 2022).

The research and appreciation of the mathematics employed by ethnic groups, as well as taking into account simply Western mathematics, is the basic tenet of ethnomathematics. In other words, it is intrigued by the relationship between the concrete world and the realm of abstract mathematics. D'Ambrosio (2001) had this as his primary goal when he began this program, there is a predominance of measuring, counting, and modeling processes when mathematics is used. These processes were gradually organized according to their logical structure in various medieval practices, such as mercantile arithmetic, the geometrical potential used in constructions, designs, painting, drawing, and astrological practices.

Cognitive, conceptual, educational, epistemological, historical, and political are six additional aspects in the discussion of ethnomathematics (Rosa et al., 2016). The study of ethnomathematics explores the complex linkages and correlations involving mathematics concepts and other cultural factors aspects like English, arts, and crafts, architecture, and education (Gerdes, 2015). Alternatively, because it links mathematics with locally developed and used cultural practices, ethnomathematics enables making connections between real-world experiences and mathematical institutions. It can aid in the comprehension of mathematical ideas. Additionally, it emphasizes the significance of communities in the school environment (Rosa & Orey, 2010). The ethnomathematical connection, to put it briefly, refers to the relationship between institutionalized mathematics and mathematics as seen in ordinary human behavior.

Rodríguez-Nieto and Alsina (2022) has examined the typology of internal and external links between measuring systems in this context of ethnomathematical linkages, but they can also be found during the design process, counts, explanations, places, play, estimations, and additional universal pursuits. An external connection is "promoted when a unit of measurement (conventional or non-conventional) is used similarly in different systems of measurement in different daily practices". An internal connection is "the relationships that a subject makes between units of measurement (conventional or non-conventional) of the same system of measurement used in an everyday practice". It should be mentioned that these links depend on the context and application that the person provides according to the measurement unit in his or her everyday practice.

Castro Inostroza et al. (2020) focused on the usage of the meter, centimeter, inch, and tolerance in their investigation into the mathematical concepts used by a carpenter in the construction of furniture and ships. Paternina-Borja et al. (2020) examined the designs of masks and molds to look for measurements made with fingers and pencils and symmetries. García García and Bernardino Silverio (2019) noted geometric knowledge like the parabola, circumference, parallel lines, and usage of the hand span in the development and use of the "*güilile*" carrying basket.

According to Sunzuma and Maharaj (2019), in-service teachers have a solid understanding of ethnogeometry since they can find mathematics in things like round houses, pottery, carpentry, welding, and stitching are examples of traditional dances. This knowledge is crucial for teaching geometry. Additionally, according to Sunzuma and Maharaj (2020), teachers must be prepared to incorporate ethnomathematical techniques into geometry lessons. The development of tortillas in Mexican culture was examined by Rodríguez-Nieto (2021) for the ethnomathematical relationships between geometric notions (cylinder, circumference, measurement of regions, volume, etc.). Additionally, he suggested scenarios for teaching mathematics using GeoGebra and paper and pencil that focused on the creation of the "tortilla." According to D'Ambrósio and Knijnik (2020), data collection techniques for ethnomathematics include fieldwork to observe the customs of various cultural groups based on ethnography, conducting videotaped interviews, taking field notes, and creating drawings, which are then thoroughly analyzed in terms of what people do and why they do it.

Although research on ethnomathematics has been widely carried out, there is little empirical evidence reporting the mapping and trends of ethnomathematical research in Scopus-indexed journals in Indonesia, more ethnomathematical research results are published in Science and Technology Index (SINTA) accredited journals, the Garba Rujukan Digital (GARUDA) portal, or Google Scholar. Some research focuses relating to ethnomathematics or cultural contextualization. Three categories can be used to group the ethnomathematics research that has already been done; the first one includes

the study of ethnomathematics about practical mathematical notions in cultural life. According to (Mania & Alam, 2021; Maryati, 2019; Muhtadi et al., 2017), the creation of cultural, craft, and fashion sites in Indonesia and the Philippines involved the application of ethnomathematical concepts for estimating, measuring, and patterning (Rubio, 2016). Studies examining the use of ethnomathematics in mathematics curriculum and pedagogy are included in the second category. These studies have been done, for example, in Hawaii (Furuto, 2014), Israel (Fouze & Amit, 2018), and Indonesia (Hartinah et al., 2019), particularly in the teaching of geometry (Sunzuma & Maharaj, 2019; Supriadi, 2019; Verner et al., 2013). The third field of study highlights the competence of teachers in teaching mathematics through ethnomathematics such as in Papua New Guinea (Owens, 2014) and Indonesia (Sintawati et al., 2019).

In the last decade, there has been a lot of research on ethnomathematics. There is also ethnomathematics research in the form of a literature review or in the form of bibliometric analysis. Bibliometric databases have entered the lives of scientists, which are commonly used for: (i) tracing scientific documents, (ii) providing information on the impact of individual scientific output and/or research institutions, and (iii) supporting the selection of scientific journals to be intended for publication (Franceschini et al., 2016). Bibliometric indices are used in various fields of academic research to statistically examine the quality, influence, and impact of existing publications in the field, making it easier for researchers to review and analyze scientific publications (Hassan et al., 2019). No studies have conducted a survey of international publications in a given time based on the Scopus database. Scopus is an abstract and indexing database with full-text links produced by Elsevier (Burnham, 2006). The Scopus database was developed by Elsevier, combining the characteristics of PubMed and WoS. The Scopus academic database was chosen because of its higher growth rate, which provides access to a collection of information commonly used for research and writing, and offers basic search, quick search, author search, advanced search, and search source.

Several studies on ethnomathematics using bibliometric analysis have been widely carried out, including research by Kristia et al. (2021) on bibliometric analysis of the term "Ethnomathematics" taken from Google Scholar media. Another study by Salsabilah et al. (2022) on a review of the development of ethnomathematics research in traditional games. The sources used are still from scientific works on first-level higher education. Research by Pradana et al. (2022) on ethnomathematics in the Scopus database, then research by Muhammad et al. (2023) on ethnomathematics research trends in mathematics learning. From several previous studies, there has been no bibliometric analysis that examines ethnomathematics whose data comes from the Scopus database. Therefore, this study seeks to map ethnomathematics-related trend research by collecting and analyzing articles from the Scopus database.

Based on the description above, the formulation of the problem regarding this research is as follows:

RQ1: What is the trend of ethnomathematics research in the Scopus database?

RQ2: How are ethnomathematics articles classified?

RQ3: What are the ethnomathematics topics in the Scopus database that have the opportunity for further research in the future?

Methodology

This study uses bibliometric analysis methods using VOSviewer and article searches using the PoP. Bibliometric research provides a reliable and impartial way to gauge the contribution of an article to knowledge advancement and is a tool that is often used to analyze trends and performance on certain subjects (Yang et al., 2013). Bibliometric research is used to better understand evolution in the study of educational philosophy in the academic community, with the hope of finding research gaps and novelty as the basis for further research. Although research on bibliometric analysis has been done in many other fields, no one has done it in the field of ethnomathematics. It would be very interesting to study bibliometric analysis in ethnomathematical studies.

The type of validity used in this research is the validity of the content. The contents' validity describes the instrument's ability to measure the content that must be measured. That is, the measuring instrument is able to reveal the content of a concept or variable to be measured. In addition to using the validity of the content, the author also collects research data online through the PoP and VOSviewer applications where the data on journal websites and bibliometric analysis applications of PoP and VOSviewer are certainly valid. In this study, reliability measurement was carried out by conducting documentation to obtain data on the keywords needed through the Scopus.com website, where the data in it is certainly consistent and trustworthy.

The data analysis stage requires descriptive analysis and tissue extraction. The developed approach in extracting tissues requires units or elements ready for analysis. This is necessary so that the analysis results can be integrated with the data network. For example, in co-word analysis, using the main words or keywords on a document to describe the conceptual structure of a field of research study (Callon et al., 1991)

Bibliometric analysis is the application of quantitative methods used to analyze published data. The bibliometric analysis did not provide in-depth information regarding the background, methods, and results of the studies reviewed (Kuzhabekova et al., 2015). However, bibliometric analysis has the ability to analyze large amounts of bibliographic data and also produces valuable information about the development of a study by year, author, source, country, and others.

The software used for bibliometric analysis in this study is PoP with Scopus, SEforRA, and VOSviewer databases to map data.

Research using bibliometric analysis has proven to discover novelties and research trends (Adegoriola et al., 2021; Agbo et al., 2021; Du et al., 2021; Kulakli & Osmanaj, 2020; Niu et al., 2021; Xia et al., 2021; Zyoud, 2021). The Scopus database provides the article papers. This is based on the reliability of Scopus as a global publication platform for researchers. From 1986 until 2022, the phrase "Ethnomathematics" was used as a filter to look for titles, abstracts, and keywords. The general research procedures were: (a) determine the topic "Ethnomathematics" with the PoP application; (b) optimize Scopus Elsevier; (c) download RIS and CSV; (d) analyze RIS data using VOSViewer software (Adegoriola et al., 2021; Wang et al., 2021; Yang et al., 2017); (e) analysis of CSV data using Microsoft Excel; (f) interpretation; (g) get profiles and updates on ethnomathematics research trends. According to Tranfield et al. (2003) the method used in this research consists of five stages as follows (Figure 1).

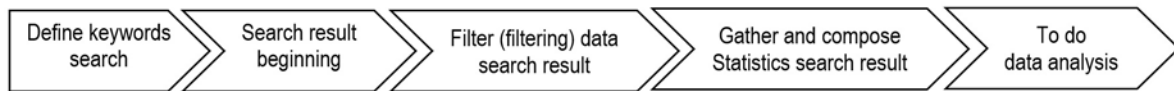


Figure 1. Five Steps of Bibliometric Analysis Method

Determining Search Keyword

The keyword used as a reference in this research is "ethnomathematics". In addition to keywords, the article's year of publication is also considered in mining articles. There are two article mining with two different tools. PoP is the first tool in searching for articles with ethnomathematics keywords with a time span of 1986 to 2022. While SEforRA is the second tool to search for articles with ethnomathematics keywords in the time span of 1999 (Herdianto et al., 2021). The journal article database platform chosen is Scopus. Articles from the Scopus database are used as the basis for obtaining good-quality articles. Scopus is a multidisciplinary database that collects articles from internationally reputed journals published by Elsevier, Springer, Wiley, Taylor & Francis, Emerald, Nature, and others.

Initial Search Results

The search results using the tools PoP and SEforRA provide data, respectively, on a many as 200 journal articles with the year published between 1986-2022 and 362 journal articles with the year published between 1999-2022. Article data in RIS and CSV format.

Filtering

Data The collected article data is still in the RIS file and CSV file format, so the CSV file needs to be converted into a xlsx file format so that it can be processed easily in Microsoft Excel while reading the RIS file requires Mendeley reference management software. Furthermore, the journal data in xlsx file format is processed and filtered according to the needs of the analysis.

Collecting and Compiling Search Result Statistical Data

After the article data is filtered and processed, data is generated, including the evolution of the last six years (2016-2022), the Top 10 articles with the most citations, the Top 10 publishers and journals, and other data needed in the analysis.

Performing Data Analysis (Bibliometrics)

VOSviewer software was used for the bibliometric analysis. VOSviewer has the proficiency in working effectively with large amounts of data and provides attractive and communicative data visualization, analysis and data investigation facilities (Van Eck & Waltman, 2014). Then VOSviewer may also create publication maps, author maps, journal maps, or keyword maps based on shared networks based on co-citation networks (Van Eck & Waltman, 2020).

Results

The Evolution of Ethnomathematical Publications

Data on the development of ethnomathematical articles produced in this research took place from the Scopus-Elsevier database. Based on the database taken from the PoP tools (Figure 2) with the following details: the keywords used are ethnomathematics; data search year is not limited and PoP automatically provides a range of publishing years between 1986 to 2022; data source is scoped; the number of papers that can be taken is 200 articles. The oldest article based on these data is an article published in 1986 with the title Ethnomathematics written by Ascher and Ascher (1986). Although we will need to utilize Western nomenclature when describing it, Ascher and Ascher (1986) notes that the history of western mathematics does not include ethnomathematics.

Table 1. Article Metadata

Citation Metrics	
Publication years	1986-2022
Citation years	36 (1986-2022)
Papers	200
Citations	1132
Cites/year	31.44
Cites/paper	5.66
Authors/paper	1.00
h-index	18
g-index	25

The number of publications of ethnomathematical articles from 1986 to 2022 has increased on average (Figure 2); highest in terms of the number of articles published in 2021, with 41 articles, in 2019 and 2020, with 31 articles, and the least how many articles, were published in 1986, 1989, 1996, 1998, 2003, 2004 and 2007 with 1 article. Based on Figure 3, in the range of 1986 to 2022, the number of published ethnomathematical articles has increased significantly and reached its peak in 2021. After 2000 and above, the Internet began to be widely used and increased the ease of access (Internet traffic, 2024). The significance of the number of articles published has increased linearly with global internet traffic and monthly data usage. Improved infrastructure and media have triggered an increase in publications, moreover driven by the open-access movement (Björk et al., 2010) worldwide, which has led to a massive increase in the publication of scientific articles.

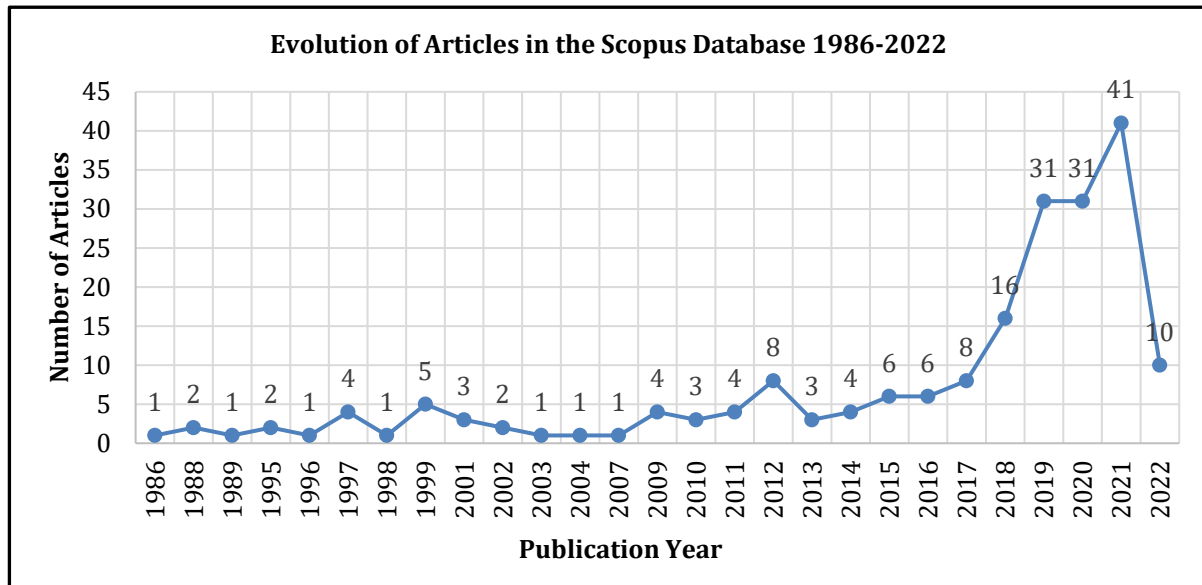


Figure 2. Graph of the evolution of ethnomathematical articles in the Scopus database 1986-2022

Of the 200 published papers from 1986-2022, the types of publications consist of 49,95% articles, 1% books, 5,5% book chapters, 41,50% conference papers, 1% editorial, 0,5% note and 1% review. We can see that most types of publications are in the form of articles and conference papers, and the least in the form of notes. The complete type of data publication is seen in Table 2.

Table 2. Publication Types

Type	Paper	Percentage
Article	99	49,5%
Book	2	1%
Book Chapter	11	5,5%
Conference Paper	83	41,5%
Editorial	2	1%
Note	1	0,5%
Review	2	1%
Total	200	100%

Based on Table 3, the highest number of published articles that are included in the Scimago journal rank is in 2021; as many as 89 articles distributed in Q1=1; Q2=5; Q3=26; Q4=0; NQ=1; NI=56, whereas in 2000, 2002, 2004, 2005, 2006 and 2009, the number of articles published was at least 1 article each. The number of articles included in Quartile (Q) 1 Scimago journal rank is 11 (3%) out of 362 articles published from 1999 to 2022. This shows that articles written with ethnomathematical themes are articles of high quality. Enough when compared to the articles published in Quartile (Q) 3, which reached 100 articles or 28%. When viewed in more detail, 2019 was the peak of the highest number of articles entered in Q3, with a total of 29 published articles.

Table 3. Scimago Journal Ranks

Year	Scimago Journal Rank						Sub Total	Year	Scimago Journal Rank						Sub Total
	Q1	Q2	Q3	Q4	NQ	NI			Q1	Q2	Q3	Q4	NQ	NI	
1999	0	0	0	0	0	7	7	2012	1	0	1	0	0	0	2
2000	1	0	0	0	0	0	1	2013	0	0	0	0	0	2	2
2001	0	0	0	0	0	6	6	2014	0	0	1	1	1	0	3
2002	0	0	0	0	1	0	1	2015	2	0	1	0	0	3	6
2004	1	0	0	0	0	0	1	2016	0	0	0	0	1	6	7
2005	0	0	0	0	0	1	1	2017	0	0	3	0	1	12	16
2006	0	0	0	0	0	1	1	2018	0	0	10	0	1	17	28
2007	0	0	0	0	0	2	2	2019	0	3	29	2	2	32	68
2008	0	0	0	0	0	3	3	2020	3	3	28	2	0	41	77
2009	0	0	0	0	0	1	1	2021	1	5	26	0	1	56	89
2010	1	0	0	0	1	2	4	2022	0	2	1	1	0	30	34
2011	1	0	0	0	0	1	2								
Total									11	13	100	6	9	223	362
Percentage									3	3,6	28	1,7	2,5	62	

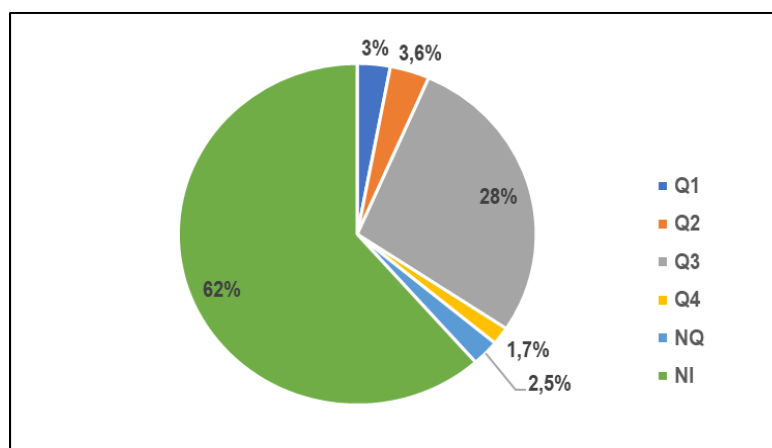


Figure 3. Quartile (Q) Distribution Diagram in Scimago (1999-2022)

Ranked in the Top 10

Referring to the results that have been obtained from the bibliographic analysis, there are several findings as follows. (a) R. Vital is the most cited author, with 72 citations. (b) The end of innocence: A critique of "ethnomathematics" was written in 1997 and published in the journal Educational Studies in Mathematics. (c) In conclusion, this study focuses on culture research in the particular context of South Africa and demonstrates the conceptual challenges encountered in

both its development and its integration into educational practice. Using the context of South Africa and conceptual tools from critical mathematics education, this paper investigates a critique of ethnomathematics.

Table 4. Ranked in Top 10 Authors and Citations

No.	Authors	Title	Year	Cites	Cites/year	Publication Source
1	R. Vithal	The end of innocence: A critique of 'ethnomathematics'	1997	72	2.88	Educational Studies in Mathematics
2	B. Barton	Making sense of ethnomathematics: Ethnomathematics is making sense	1996	45	1.73	Educational Studies in Mathematics
3	A. Pais	Criticisms and contradictions of ethnomathematics	2011	39	3.55	Educational Studies in Mathematics
4	M. Ascher	Ethnomathematics	1986	37	1.03	History of Science
5	D. Muhtadi	Sundanese ethnomathematics: Mathematical activities in estimating, measuring, and making patterns	2017	36	7.20	Journal on Mathematics Education
6	S. Rowlands	Where would formal, academic mathematics stand in a curriculum informed by ethnomathematics? A critical review of ethnomathematics	2002	30	1.50	Educational Studies in Mathematics
7	W. Widada	Realistic mathematics learning based on the ethnomathematics in Bengkulu to improve students' cognitive level	2018	29	7.25	Journal of Physics: Conference Series
8	I. Risdiyanti	Ethnomathematics: Exploration in Javanese culture	2018	28	7.00	Journal of Physics: Conference Series
9	S. Adam	A Comment on: Rowlands & Carson "Where would formal, academic mathematics stand in a curriculum informed by ethnomathematics? A critical review"	2003	27	1.42	Educational Studies in Mathematics
10	A.S. Abdullah	Ethnomathematics in perspective of Sundanese culture	2017	25	5.00	Journal on Mathematics Education

Country of Origin

Search author's country of origin and total number Citations from each country are searched for in the 2016-2022 range, with the PoP tool giving results as shown in Table 5. The highest number of citations for each country was Indonesia making the largest contribution of 85.43% followed by the USA, Philippines, and Zimbabwe at 2.56% and 2.78%, respectively.

Table 5. Country of Origin of Author and Number of Citations

No.	Country of Origin	Number of Papers	Percentage	Total Citation	Percentage
1	USA	5	2.95%	12	2.56%
2	Philippines	1	0.59%	13	2.78%
3	Zimbabwe	7	4.14%	13	2.78%
4	Israel	2	1.18%	6	1.28%
5	Spanish	3	1.77%	6	1.28%
6	South Korea	1	0.59 %	3	0.64%
7	French	2	1.18%	4	0.85%
8	Colombia	1	0.59%	1	0.21%
9	Brazil	8	4.73%	10	2.14%
10	Turkey	2	1.18%	0	0%
11	UAE	1	0.59 %	0	0%
12	Portugal	1	0.59%	0	0%
13	China	1	0.59%	0	0%
14	Indonesia	134	79.29%	399	85.43%
	Total	169	100%	467	100%

In Table 5, it can be seen that the most productive country in producing ethnomathematical research papers is Indonesia, with 134 papers or 79.29%, with a total number of citations of 399 or 85.43%. This shows that Indonesia, which is rich in customs and ethnicities, has the potential to provide many ethnomathematical research results.

Journals That Publish Ethnomathematical Research Articles

Findings about various journals containing ethnomathematical research between 1986 and 2022 can be seen in Table 6. The largest number of Cites Per Author journal sources is History of Science with 37 Cites Per Author, followed by Educational Studies in Mathematics with 32.87, Educational Research and Reviews with 22, and American Anthropologists with 21.

Table 6. Journals That Publish Ethnomathematical Research Articles

No	Journal Source	Article Total	Cites	Cites Per Year	Cites Per Author
1	Journal of Physics: Conference Series	71	210	0.97	2.95
2	ZDM - International Journal on Mathematics Education	12	142	0.72	11.83
3	Educational Studies in Mathematics	8	263	1.93	32.87
4	Bolema - Mathematics Education Bulletin	7	20	0.45	2.85
5	Journal on Mathematics Education	7	102	4.43	14.57
6	AIP Conference Proceedings	5	7	1.17	7
7	International Journal of Scientific and Technology Research	5	31	2.06	6.2
8	Eurasia Journal of Mathematics, Science and Technology Education	3	11	1.66	3.66
9	For the Learning of Mathematics	3	14	0.73	4.66
10	Historia Mathematica	3	29	0.33	9.66
11	Revista Latinoamericana de Investigacion en Matematica Educativa	3	13	0.5	4.33
12	Alternative Forms of Knowing	2	5	0.25	2.5
13	Elementary Education Online	2	3	0.75	1.5
14	International Journal of Evaluation and Research in Education	2	0	0	0
15	International Journal of Mathematical Education in Science and Technology	2	2	1	1
16	International Perspectives on the Teaching and Learning of Mathematical Modelling	2	10	0.56	5
17	IOP Conference Series: Earth and Environmental Science	2	1	0.5	0.5
18	Journal of Advanced Research in Dynamical and Control Systems	2	4	0.58	2
19	Mathematics Teaching-Research Journal	2	0	0	0
20	Mediterranean Journal of Social Sciences	2	3	0.19	1.5
21	Teaching Mathematics and its Applications	2	15	0.85	7.5
22	A Companion to Cognitive Anthropology	1	12	1.09	12
23	ACM International Conference Proceeding Series	1	0	0	0
24	American Anthropologist	1	21	0.84	21
25	Applied Sciences (Switzerland)	1	4	2	4
26	Archive for History of Exact Sciences	1	6	0.18	6
27	Australian Journal of Teacher Education	1	0	0	0
28	Critical Studies in Teaching and Learning	1	0	0	0
29	Education Policy Analysis Archives	1	0	0	0
30	Educational Research and Reviews	1	22	1.69	22
31	Equity in Discourse for Mathematics Education	1	6	0.6	6
32	Ethnography and Education	1	1	1	1
33	Ethnomathematics of Negev Bedouins' Existence in Forms, Symbols and Geometric Patterns	1	4	0.57	4
34	Ethnomathematics: A Multicultural view of Mathematical Ideas	1	12	2.4	12
35	Fronteiras	1	1	0.14	1
36	History of Science	1	37	1.03	37
37	Homme (France)	1	2	0.5	2
38	Human Rights in Language and STEM Education	1	1	0.17	1
39	International Journal of Education in Mathematics, Science and Technology	1	1	1	1

Table 6. Continued

No	Journal Source	Article Total	Cites	Cites Per Year	Cites Per Author
40	International Journal of Engineering and Technology (UAE)	1	4	1	4
41	International Journal of Inclusive Education	1	1	0.5	1
42	International Journal of Innovation, Creativity and Change	1	2	0.67	2
43	International Journal of Interactive Mobile Technologies	1	0	0	0
44	International Journal of Recent Technology and Engineering	1	2	0.67	2
45	International Journal of Science and Mathematics Education	1	3	0.5	3
46	Internationalisation and Globalisation in Mathematics and Science Education	1	1	0.07	1
47	IOP Conference Series: Materials Science and Engineering	1	4	1	4
48	Journal for the Education of Gifted Young Scientists	1	17	5.67	17
49	Journal of Curriculum Studies	1	0	0	0
50	Journal of Intercultural Studies	1	11	0.55	11
51	K-12 Mathematics Education In Israel: Issues and Innovations	1	2	0.5	2
52	Malaysian Journal of Mathematical Sciences	1	13	2.17	13
53	Margens	1	0	0	0
54	Mathematics	1	1	1	1
55	Mathematics Enthusiast	1	0	0	0
56	Milli Egitim	1	0	0	0
57	Participatory Educational Research	1	0	0	0
58	Perfiles Educativos	1	1	0.17	1
59	Philosophia Mathematica	1	2	0.06	2
60	PNA	1	8	2	8
61	Pollack Periodica	1	2	0.2	2
62	Procedia - Social and Behavioral Sciences	1	2	0.17	2
63	Proceedings of the 17th International Conference on Computers in Education, ICCE 2009	1	3	0.23	3
64	Researching Possibilities in Mathematics, Science and Technology Education	1	1	0.08	1
65	Revue d'Histoire des Sciences Humaines	1	2	0.4	2
66	Science Technology and Human Values	1	23	0.92	23
67	Sustainability (Switzerland)	1	0	0	0
68	The Nature and Development of Mathematics	1	1	0.2	1
69	Trans/Form/Acao	1	0	0	0
70	Turkish Journal of Computer and Mathematics Education	1	0	0	0
71	Universal Journal of Educational Research	1	3	1.5	3
72	Volkskunde	1	1	0.1	1
73	ZDM - Mathematics Education	1	2	0.17	2

There are 73 journals that publish ethnomathematical research. From Table 5, it can be seen that the Scopus journal that publishes the most ethnomathematical articles is the Journal of Physics: Conference Series with a total of 71 articles, the next is ZDM - International Journal on Mathematics Education with 12 articles, Educational Studies in Mathematics eight articles, Bolema - Mathematics The Education Bulletin and Journal on Mathematics Education have seven articles each, AIP Conference Proceedings five articles and the International Journal of Scientific and Technology Research also five articles. The highest number of citations is the journal Educational Studies in Mathematics with 263 citations, followed by the Journal of Physics: Conference Series with 210 citations, ZDM - International Journal on Mathematics Education with 142 citations, and the Journal on Mathematics Education with 102 citations. The Journal for the Education of Gifted Young Scientists produces the most citations per year with an average of 5.67 per year, followed by the Journal on Mathematics Education with an average of 4.43 per year. While the average citation per author is mostly produced by History of Science with 37 citations, followed by Educational Studies in Mathematics with 32.87 citations.

The Top Article Ethnomathematics for All Year

The authors with the highest number of citations and their research findings can be seen in Table 7. The best essay by R. Vital makes a recommendation based on the findings of his research, which show that theory construction and theory criticism are not two separate activities but rather interrelated processes. Critique is essential not only for the formation of new and different theoretical perspectives today but also for changing focus, weakening, bolstering, or strengthening the current position. As B. Barton presented the findings of his study, he said that comprehending mathematics' cultural roots can help us better appreciate its breadth and its potential to provide an enthralling, beautiful, and useful viewpoint on the world.

Table 7. The Top Article Ethnomathematics for all Year

Document title	Authors	Finding	Recommendations
The end of innocence: A critique of 'ethnomathematics'	R. Vithal	We concur with D'Ambrosio's statement that "in the previous 100 years, we have seen significant gains in our knowledge of nature and human affairs, and we are convinced that the ethnomathematical movement has good intentions and a broad range of issues" in the creation of fresh technologies. However, this century has demonstrated to us reprehensible human conduct. new and unprecedented means of insecurity and mass destruction. Only unjustified famine, awful diseases, drug misuse, and moral decline rival these things in severity, a permanent degradation of the ecosystem. This dilemma is significantly influenced by the academics' lack of introspection and value evaluation, especially in the scientific fields, in both teaching and research. Most of these marvels and horrors of science and technology were made possible thanks to breakthroughs in mathematics, both in research and instruction.	Although resistance to criticism is not a unique occurrence of ethnomathematics, it is crucial that it continues to be described, and criticism of mathematics education plays a significant role in this. Theory development and theory criticism are interrelated processes rather than two distinct activities. Not just for today's production of fresh and alternative theoretical viewpoints, but also for shifting emphasis, weakening, bolstering, or strengthening the current position, criticism is crucial. Therefore, claiming that theory critique can be made too soon if the theory is still in its infancy is unjustified.
Making sense of ethnomathematics: Ethnomathematics is making sense	B. Barton	Diverse perspectives on the kaleidoscope of our world produce different patterns. Therefore, ethnomathematics is a tool that helps us better understand our world, both as we see it and as others do. This essay has made an effort to develop a framework for discussing culture and mathematics. It accomplishes this by recognizing our goals as authors and speakers. The resulting map, the analysis that follows, and the concept of ethnomathematics that follows could all aid in classifying ethnomathematical research and activities. Without a doubt, mathematics is a valuable component of human thinking and is worthwhile to pursue. Its current function in many nations and civilizations is unquestionably a limited representation of its potential. The goal of mathematics education is to increase everyone's comprehension of mathematics. Changes in the status and uses of mathematics in our culture are required to achieve this. This transformation is made possible by an ethnomathematical understanding of the mathematics education endeavor.	Because ethnomathematical education is active, it will result in the revitalization of mathematics through its study. Understanding mathematics' cultural roots can help us better appreciate its extent and its potential to offer a fascinating, aesthetic, and practical perspective on the world.

Table 7. Continued

Document title	Authors	Finding	Recommendations
Criticisms and contradictions of ethnomathematics	A. Pais	The development of a critique of what is considered to be mathematical knowledge through the confrontation of knowledge from many cultures is one of the main characteristics of ethnomathematics study. It is currently impossible to dispute the presence of various approaches to dealing with numbers, space, and patterns. However, because schools are not open spaces of shared knowledge, it is difficult to move from this awareness to the goal of integrating it into a school setting in order to be spread through school instruction. Contrarily, curriculum revisions are strictly enforced, especially where mathematics is involved. Contrary to D'Ambrosio, I do not believe that ethnomathematics has apparent educational implications. I have drawn attention to the somewhat naive method in which this bridging is accomplished, even while I do believe in the good intentions of teachers, politicians, or researchers in seeking to bring to school information and practices distinct from those that are transmitted by the official school curriculum. I urge ethnomathematics research to create a more robust theoretical study of the social and political elements that inform its research.	To prevent well-intentioned activities from having outcomes that are contrary to their goals, it is necessary to pay attention to the inconsistencies present in this antagonism. By rejecting any dogmatic perspective and being conscious of the contradictions involved in their teaching goals, ethnomathematics as a research topic benefits.
Ethnomathematics	M. Ascher	The article highlights that the phenomena of "mathematics" being isolated as a distinct conceptual object is one of literacy (the article says "Western", but Medieval India and China give us very congruent conceptual boundaries). The topic of whether different nonliterate mathematical (or protomathematical) thought patterns are actually plausible enough to be placed under one heading is not addressed in this article. Although the author asserts that all literate cultures have evolved from nonliterate cultures, the term "ethnomathematics" presupposes that they do. However, if this is the case, then the traditional treatment of ethnomathematics as illuminating the early history of "our" mathematics is also justified in theory. (However, the outdated method is still unwarranted ethnocentrism.)	It's necessary to sketch nonliterate people's mathematical concepts. I started reading ethnographic literature with the knowledge that it would not be an easy undertaking. Most anthropologists had a weak grasp of mathematics and hardly ever raised pertinent issues. Ideas that a person interested in mathematics may have explored further or recorded more precisely may not have been recognized for what they were. Fortunately, at least few anthropologists included data that can be exploited, sometimes even without their knowledge, and other recent research have focused especially on related concepts.
Sundanese ethnomathematics: Mathematical activities in estimating, measuring, and making patterns	D. Muhtadi	The ideals ingrained in daily practical Sundanese culture guide Sundanese in executing mathematical tasks. This is represented in the activity measure, which is based on utilized things, and the estimate, which is based on long-standing cultural practices. Sundanese use mathematical principles are quite stringent for the size of the fundamental ideas and activities that create patterns. Knowledge divisions on the execution of the fundamental ideas of size and pattern Pihuntuan in creating specific geometric patterns were truly inspiring for the development of mathematical ideas. However, the use of mathematical ideas to measure the action of mathematical principles does not adhere to the established (seen from how to make generalizations are false).	Whether or whether a mathematical idea is rigorously implemented by Sundanese, Sundanese cultural activities can encourage comprehension of already-existing mathematical concepts and the formation of mathematical notions that need additional exploration. In other words, Sundanese culture serves as a model that can be used to develop alternative mathematical understandings.

Table 7. Continued

Document title	Authors	Finding	Recommendations
Where would formal, academic mathematics stand in a curriculum informed by ethnomathematics? A critical review of ethnomathematics	S. Rowlands	Mathematics is universal because, despite the fact that certain cultural factors have an impact on it, these factors do not define the veracity of mathematics: The Chinese separately created "Pascal's triangle" millennia before Pascal, while the Greeks independently created Pythagoras' theorem, a century and a half later. Mathematics is universal and spans all cultures, including those of ancient Greece, China, and Pascal's France. In the classroom, this universalism must be emphasized rather than, for example, the geometrical designs found in traditional crafts. According to the African educationalist Ogunniyi, education should not be intended to replace or discredit a traditional culture but rather to prepare people for the problems of the modern world. In contrast to the everyday obstacles given by traditional culture, these contemporary challenges can best be tackled by a liberal education that places current science and universal mathematics at the center of its curriculum.	Although colonial powers have ruled over oppressed nations using mathematics as a formal academic subject, this does not mean that mathematics is inherently repressive. It is oppressive because the dominant social group uses it exclusively as a source of power; democratizing it would solve this problem.

R. Vithal found that we concur with D'Ambrosio's statement that "in the previous 100 years, we have seen significant gains in our knowledge of nature and human affairs, and we are convinced that the ethnomathematical movement has good intentions and a broad range of issues" in the creation of fresh technologies. B. Barton mentions that diverse perspectives on the kaleidoscope of our world produce different patterns. Therefore, ethnomathematics is a tool that helps us better understand our world, both as we see it and as others do. This essay has made an effort to develop a framework for discussing culture and mathematics. A. Pais found that the development of a critique of what is considered to be mathematical knowledge through the confrontation of knowledge from many cultures is one of the main characteristics of ethnomathematics study. It is currently impossible to dispute the presence of various approaches to dealing with numbers, space, and patterns. However, because schools are not open spaces of shared knowledge, it is difficult to move from this awareness to the goal of integrating it into a school setting in order to be spread through school instruction. Furthermore, M. Ascher stated that although the author asserts that all literate cultures have evolved from nonliterate cultures, the term "ethnomathematics" presupposes that they do. However, if this is the case, then the traditional treatment of ethnomathematics as illuminating the early history of "our" mathematics is also justified in theory. (However, the outdated method is still unwarranted ethnocentrism.)

Co-Authorship

Analysis Finding correlations between diverse studies based on research documents created by researchers is possible with co-authorship analysis. Analysis of co-authorship networks can help overcome and significantly contribute to scientific advancement. Co-authorship networks are a tool to reveal the direction of collaboration and identify researchers and institutions leading research (Fonseca e Fonseca et al., 2016; Morel et al., 2009). After the article data mining process with the Publish or Perish (PoP) tools is completed, a file with the RIS format will be obtained (downloaded) which will then be the input data requested by VOSviewer to perform bibliometric analysis. One of the bibliometric analyzes that will be carried out is the co-authorship analysis.

The results of the co-authorship analysis carried out by VOSviewer are as follows (Figure 5). In general, it can be read that the relationship between one author and another is the line that connects one author's name with another author's name. The more lines connecting one name to another indicates that the author has collaborated to research the same research article (Van Eck & Waltman, 2014). More details will be explained as follows. (a) Figure 5a: there is no relationship link between authors in one article with another article. This can be seen from no line connecting one author to another. (b) Figure 5b: depicts the timeline of publication from 2008 to 2022; indicated by the more yellow color, the more recent the year of publication, on the contrary, the darker bluish color indicates the longer the publication year (Van Eck & Waltman, 2014). Author with the latest articles published by Sunzuma G. (c) Figure 5a with the largest circle shows the most productive authors with the highest number of documents. The most prolific writer is Widada, W with nine papers. (d) Figure 7c: is the publication density of the author, the clearer the yellow color indicates that the author has a lot of published articles, while the color fades, the fewer articles are published. The author with the highest number of publications by Widada, W.

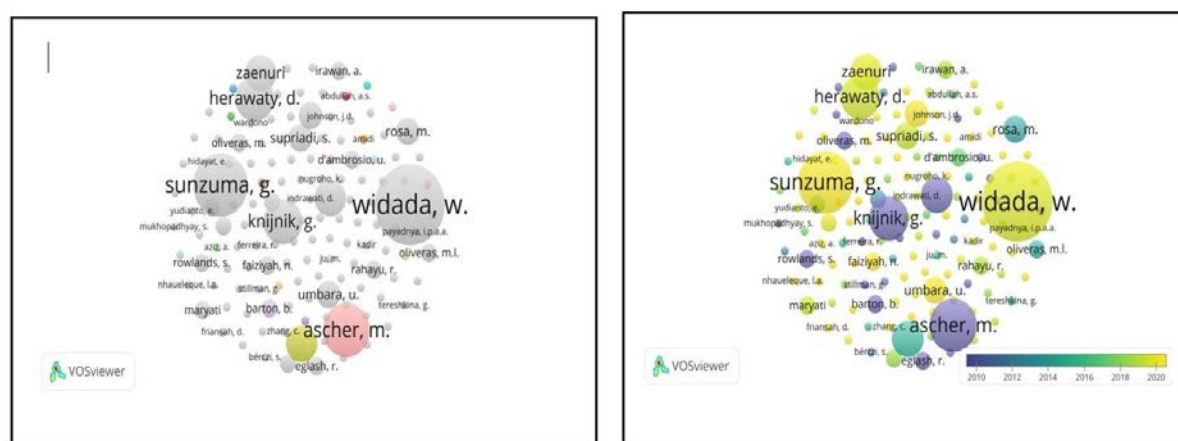


Figure 4a-4b. Network and Overlay Visualization

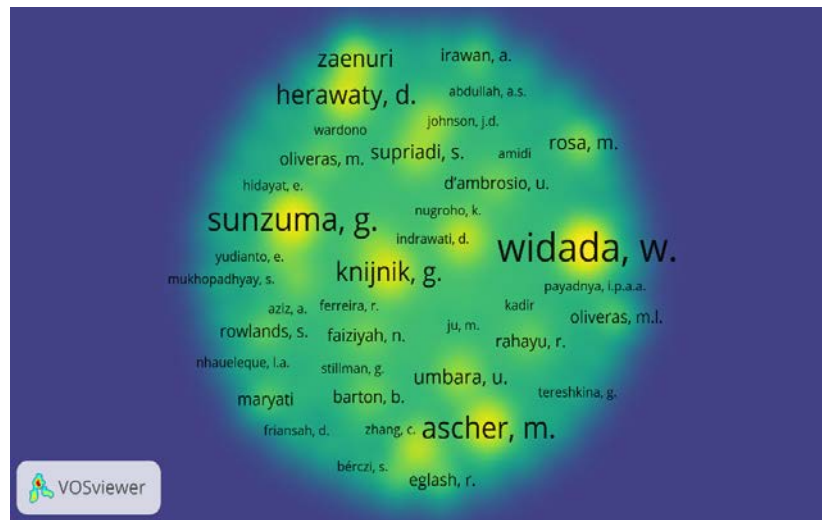


Figure 4c. Density Visualization

Co-Word

Analysis The results of co-word analysis based on keywords become a reference for co-occurrence mapping of important or specific terms contained in certain articles. Knowledge mapping is a technique for representing a scientific field in bibliometrics. By building a landscape map that may illustrate scientific issues, visualization is accomplished. (Royani et al., 2013)

VOSviewer will display terms related to ethnomathematics with as many as 60 terms with a minimum of 2 occurrences. By default, VOSviewer will display 60% (Van Eck & Waltman, 2014) of 60 terms but in this analysis, it is determined that all 60 terms will appear. The most frequently used terms are ethnomathematics (106), mathematics (20), student (18), exploration (17), ability (15), ethnomathematics approach (11), and geometry (11).

Table 8. Frequently Appearing Keyword Terms

Terms	Occurrences	Relevance
mathematics	20	0.54
ability	15	0.49
ethnomatematics	14	0.42
exploration	17	0.3
ethnomatematic	106	0.19
student	18	0.13
geometry	11	0.95
ethnomathematics approach	11	1.4

After the keyword terms are raised by VOSviewer, then VOSviewer displays a network visualization based on those keyword terms (Figure 5). Some of the important findings discussed in this study are as follows. (a) Ethnomathematics, mathematics, exploration, ability, and mathematical approach are terms that are often used in ethnomathematical research, which are characterized by large circle nodes compared to other terms. (b) It consists of 9 term clusters, which are marked with different colors for each cluster (Figure 6). (c) Examples of using network visualization: It can be seen (Figure 8) that the terms are represented by notations 1,2,3, 4, and 5. In finding the novelty of the research, something new is needed and has never been connected at all between the terms in the network. The terms that were notated from 1 to 5 previously were five separate keywords and had never been connected at all. When between 1 to 5 of the notations are connected in the same study, it means that there is something new from research conducted by creating new relationships which are expected to produce new findings as well.

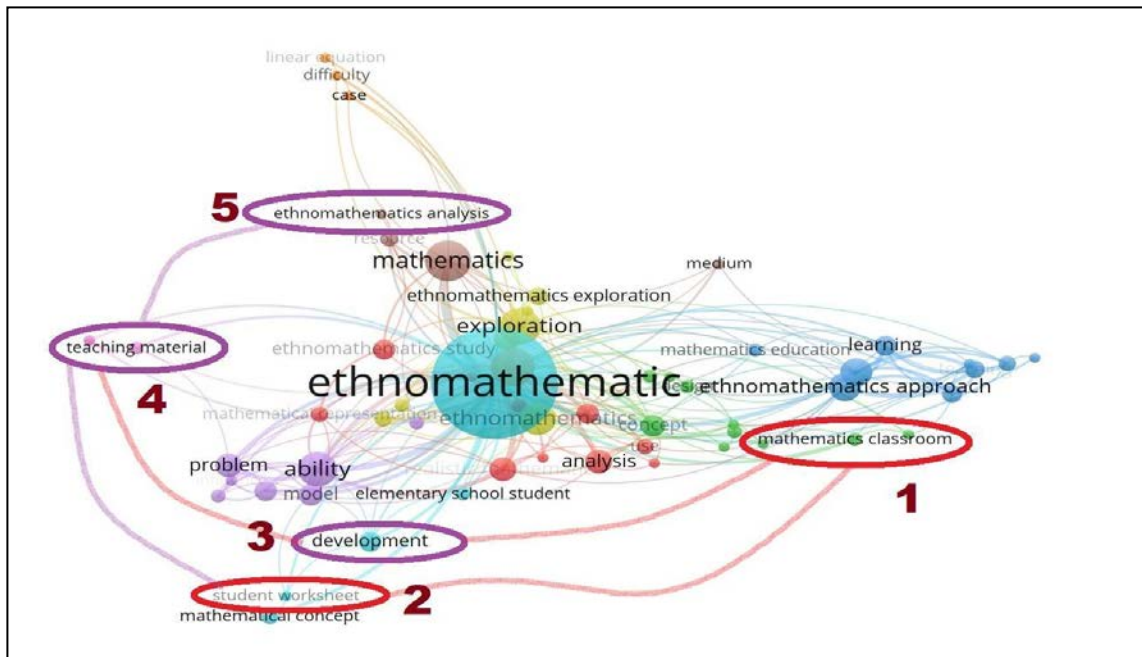


Figure 5. Network Visualization Map of the Development of Ethnomathematics Research

To find in which cluster a term and keyword is located, it can be done by a mapping process between Table 8 and Table 9, which is then plotted in Figure 5. An example is the keyword term Exploration (17 times occurrence) entered into cluster 4 with dark yellow as the cluster color. In addition to the network visualization of the development of ethnomathematical research, the overlay and density visualization of ethnomathematical research is also displayed, which can be explained as follows. According to the keyword terms represented by color gradations ranging from dark blue to bright yellow in the overlay visualization, each published article's new year of publication can be seen, or in other words, revealing traces of study history from year to year. For example, for research with the keywords "learning, development and mathematical concepts" which are bright yellow. It can be concluded that these three keywords were published in 2022, so they are relatively new articles published by their authors. Each yellow keyword term on the visualization overlay will be thoroughly examined to keep up with contemporary trends in global ethnomathematical research.

Table 9. Keyword Clusters and the Color of Each Cluster

Cluster	Term	Cluster	Term
Cluster 1 (10 items) Colour: red	analysis	Cluster 4 (8 items) colour: dark yellow	community
	bengkulu		context
	case study		ethnomathematics
	elementary school		ethnomathematics exploration
	ethnomathematics study		exploration
	Indonesia		ornament
	mathematical represent		secondary school
	realistic mathematics		study
	students ability		ability
	use		ethnomathematics nuance
Cluster 2 (10 items) Colour: green	concept	Cluster 5 (7 items) colour: violet	influence
	design		mathematical problem
	didactical design		model
	ethnomathematics activities		problem
	mathematics classroom		understanding
	pattern		development
	possibility		elementary school student
	primary school		ethnomathematic
	reflection		mathematical concept
	Sundanese ethnomathematic		student worksheet

Table 9. Continued

Cluster	Term	Cluster	Term
Cluster 3 (9 items) Colour: dark blue	ethnomathematics approach	Cluster 7 (4 items) colour: orange	Case
	geometry		difficulty
	integration		linear equation
	learning		student
	mathematical idea	Cluster 8 (4 items) colour: chocolate	ethnomathematics analysis
	mathematics education		mathematics
	teaching		medium
	variable		resource
	view		
Cluster 9 (3 items) colour: pink	junior high school student		
	teaching material		
	tembe nggoli		

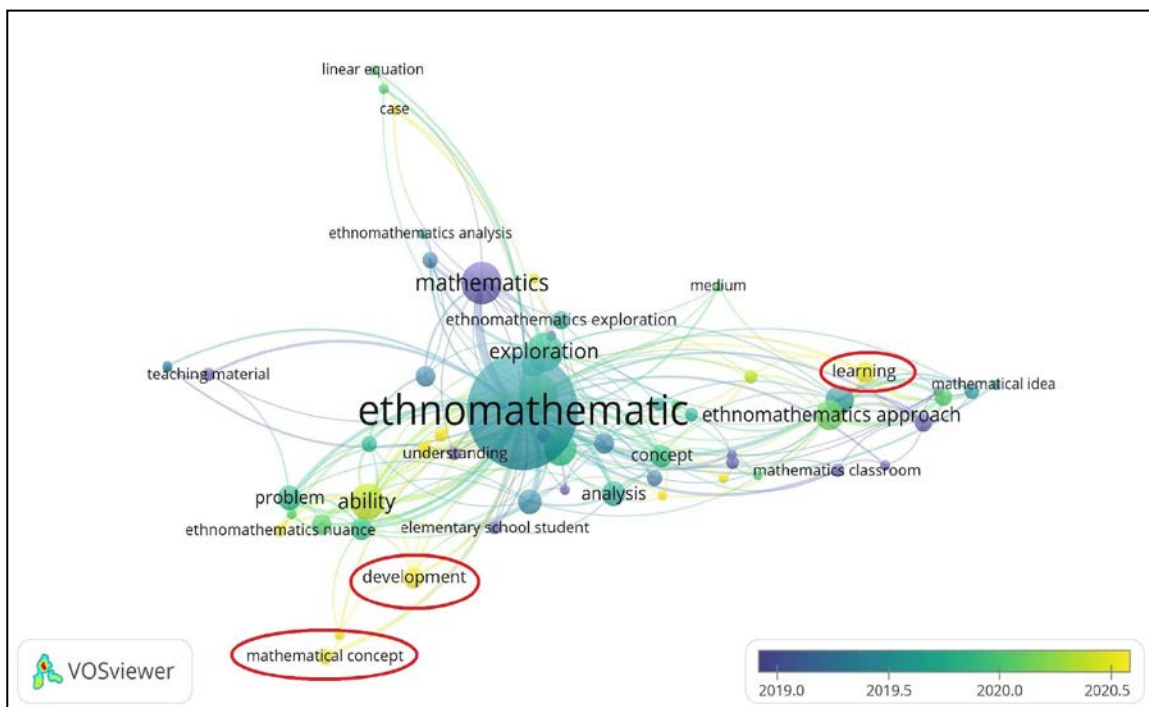


Figure 6. Overlay Visualization.

The density visualization of ethnomathematical research results from the VOSviewer analysis is shown in Figure 7. Density visualization describes the density or emphasis of the research group (Van Eck & Waltman, 2014). Density can be used as a basis for viewing research topics that are still rarely done. It is getting faded or blurred in color describing the terms or keywords of the topic, and there is still not much research; on the contrary, if the color is getting brighter yellow, it indicates that the object of research on that topic has been done frequently and very often. The examples shown in Figure 10 are topics that are still rarely studied are those circled in white. The underlying colors in these five topics are faded and almost invisible. It can be concluded that the topics of the mathematics classroom, development, mathematical concepts, teaching materials, and cases have a high probability of producing novelty if they are studied. do research, while topics with the keywords (mathematics, exploration, ethnomathematics exploration, ethnomathematics approach, and ability) are experiencing research saturation because they have been studied a lot, shown in bright yellow colors.

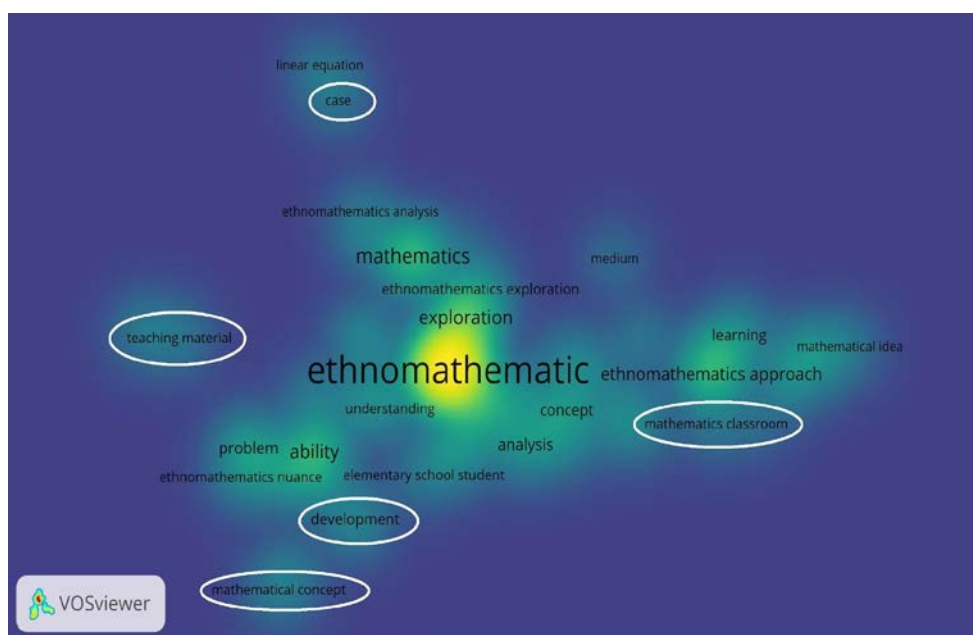


Figure 7. Density Visualization

Conclusions

In this study, research trends were revealed, along with the results of the bibliometric analysis of articles. The results of the bibliometric analysis show that the most used keywords in articles related to ethnomathematics are ethnomathematics (106), mathematics (20), student (18), exploration (17), ability (15), ethnomathematics approach (11), and geometry (11).

The results showed that most of the articles focused on ethnomathematics related to mathematics, students, exploration, ability, ethnomathematics, and geometry approaches. When the distribution of the number of articles using keywords is considered on a year-over-year basis, it is clear that the latest articles mainly focus on learning, understanding, ability, development, mathematical concepts, and case studies. The rare research is ethnomathematics related to classrooms, there are only two ethnomathematics research articles related to classrooms, namely research by Oliveras and Blanco-Álvarez (2016) which discusses the Integration of ethnomathematics in the mathematics classroom. Possibilities and limitations and research by Kusumaningsih et al. (2020) which discusses Ethnomathematics for congruence concept: A didactical design in a mathematics classroom. So, for future ethnomathematics research, it is necessary to associate ethnomathematics with classrooms; this will be a novelty. The next keyword that rarely appears in ethnomathematics research is ethnomathematics analysis, which contains only one article. Research on ethnomathematics analysis was only conducted by Alvian et al. (2021) who discussed Identifying geometrical objects in "Sumur Gumuling Tamansari": An ethnomathematics analysis.

To see ethnomathematics topics that have the opportunity for further research in the future is to pay attention to the frequency of occurrences or occurrences in VOSviewer. The frequency term that has more appearances explains that the term is the trend of ethnomathematics research at this time. Meanwhile, the frequency of terms that have fewer appearances explains that these terms can be an opportunity for further research in the future (Kristia et al., 2021).

The illustration of the trends in bibliometric studies spanning 1986-2022, as shown in Figure 2, resembles a graph in Kristia et al. (2021). Other studies also support this finding, as well as research conducted by (Pradana et al., 2022). Meanwhile, from 2021 to 2022, it decreased again. Although this research was conducted on different topics, there are similarities or almost the same trends that the culmination of a large number of studies is 2019. Entering 2020 to early 2022, the number of studies decreased again. This is because in that year many schools were closed so researchers could not conduct direct studies of the human aspect (Martín-Sómer et al., 2021; Mukhtar et al., 2020). The education sector was affected by the COVID-19 crisis at all levels from preschool to university and also led to the cancellation of various academic congresses. This has an impact on the lack of mobilization of researchers, including in the field of ethnomathematics.

In general, the development of ethnomathematics research in the Scopus database has an increasing trend from 1986 to 2022. R. Vithal is the author with the most cited works, while Indonesia is the country with the highest number of publications. After the keyword term is raised by VOSviewer, VOSviewer displays a visualization network based on the keyword term. Some of the important findings in this study are that keywords such as ethnomathematics, mathematics, exploration, ability, and mathematical approaches are terms often used in ethnomathematics research. Research topics with keywords such as math classes, development, concept mathematics, teaching materials, and cases have a high probability of generating novelty if further research is carried out in the future. Meanwhile, topics with the keywords

(mathematics, exploration, ethnomathematics exploration, ethnomathematics approaches, and abilities) experience research saturation because they have been widely researched.

Ethnomathematics research related to classrooms and ethnomathematics analysis is rare. So, this will be a novelty for future ethnomathematics research to associate ethnomathematics with the classroom. The next keyword that rarely appears in ethnomathematics research is ethnomathematics analysis, which contains only one article. To see ethnomathematics topics that have the opportunity for further research in the future is to pay attention to the frequency of occurrences or occurrences in VOSviewer. The more widely emerging term explains that the term is becoming the current trend of ethnomathematics research. Meanwhile, the frequency with which fewer terms appear explains that they could be an opportunity for further research in the future.

It is necessary to conduct ethnomathematics research with the following topics and connect them to each other, such as research in mathematics classes, development research, research on mathematical concepts, research on teaching materials, and case study research have a high probability of generating novelty if further research is carried out in the future. For authors from countries where there is still a minimal number of publications in ethnomathematics research, it is necessary to increase the number of their papers by conducting research collaborations with authors from countries that have produced many papers in the field of ethnomathematics. Cooperation between authors in various countries will improve the quality of ethnomathematics research and can share experiences with mathematical concepts connected with the culture of each country.

The limitation of this study is that the data we collect is limited to the Scopus database. The Scopus database was processed through the PoP application and the VOSViewer application without directly retrieving data from premium data provided by Scopus, so our analysis of the co-author is still incomplete.

Authorship Contribution Statement

Turmuzi: Conception and design of study, data curation, methodology, investigation, validation, resources, writing - review & editing. Astawa: Writing - review & editing. Suharta: Data curation, investigation, validation, resources, writing - review & editing. Suparta: Data curation, investigation, validation, resources, writing - review & editing.

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References

- Adegoriola, M. I., Lai, J. H. K., Chan, E. H., & Darko, A. (2021). Heritage building maintenance management (HBMM): A bibliometric-qualitative analysis of literature. *Journal of Building Engineering*, 42, Article 102416. <https://doi.org/10.1016/j.jobbe.2021.102416>
- Agbo, F. J., Oyelere, S. S., Suhonen, J., & Tukiainen, M. (2021). Scientific production and thematic breakthroughs in smart learning environments: A bibliometric analysis. *Smart Learning Environments*, 8, Article 1. <https://doi.org/10.1186/s40561-020-00145-4>
- Aktuna, H. E. (2013). Sixth grade students' perceptions of and engagement in ethnomathematical tasks in the area measurement concept [Master's thesis, Middle East Technical University]. OpenMETU. <https://hdl.handle.net/11511/23103>
- Alvian, D. N., Agustito, D., Arigiyati, T. A., Harini, E., & Widodo, S. A. (2021). Identifying geometrical objects in Sumur Gumuling Tamansari : An ethnomathematics analysis. *Journal of Physics: Conference Series*, 1778, Article 012021. <https://doi.org/10.1088/1742-6596/1778/1/012021>
- Anyi, K. W. U., Zainab, A. N., & Anuar, N. B. (2009). Bibliometric studies on single journals: A review. *Malaysian Journal of Library and Information Science*, 14(1), 17-55. <https://bit.ly/3RjFtpB>
- Ascher, M., & Ascher, R. (1986). Ethnomathematics. *History of Science*, 24(2), 125-144. <https://doi.org/10.1177/007327538602400202>
- Berkvens, J. (2012). What international aid organizations can learn from international adult learning : Experiences from Cambodia. *The Journal of Agricultural Education and Extension*, 18(4), 347-368. <https://doi.org/10.1080/1389224X.2012.691783>
- Björk, B.-C., Welling, P., Laakso, M., Majlender, P., Hedlund, T., & Gudnason, G. (2010). Open access to the scientific journal literature: Situation 2009. *PLoS ONE*, 5(6), Article e11273. <https://doi.org/10.1371/journal.pone.0011273>
- Bodaghi, N. B., Sanni, S. A., & Zainab, A. N. (2015). In competition with ISI: The perceptions of chief editors of Malaysian local journals. *Learned Publishing*, 28(4), 251-260. <https://doi.org/10.1087/20150404>

- Bontis, N., & Serenko, A. (2009). A follow-up ranking of academic journals. *Journal of Knowledge Management*, 13(1), 16-26. <https://doi.org/10.1108/13673270910931134>
- Burnham, J. F. (2006). Scopus database: A review. *Biomedical Digital Libraries*, 3(1), Article 1. <https://doi.org/10.1186/1742-5581-3-1>
- Callon, M., Courtial, J. P., & Laville, F. (1991). Co-word analysis as a tool for describing the network of interactions between basic and technological research: The case of polymer chemistry. *Scientometrics*, 22, 155-205. <https://doi.org/10.1007/BF02019280>
- Castro Inostroza, A., Rodríguez-Nieto, C. A., Aravena Pacheco, L., Loncomilla Gallardo, A., & Pizarro Cisternas, D. (2020). Nociones matemáticas evidenciadas en la práctica cotidiana de un carpintero del sur de Chile [Mathematical notions evidenced in the daily practice of a carpenter from south Chile]. *Revista Científica*, 39(3), 278-295. <https://www.redalyc.org/pdf/5043/504372924003.pdf>
- Chan, J. (2014, September 11). *Australian research council selects elsevier's Scopus for ERA 2015*. PR Newswire. <http://bit.ly/3XKFax4>
- D'Ambrosio, U. (1999). Ethnomathematics and its first International Congress. *ZDM - Mathematics Education*, 31, 50-53. <https://doi.org/10.1007/s11858-999-0008-8>
- D'Ambrosio, U. (2001). In My Opinion: What is ethnomathematics and how can it help children in schools? *Teaching Children Mathematics*, 7(6), 308-310. <https://doi.org/10.5951/TCM.7.6.0308>
- D'Ambrosio, U., & Almeida, M. D. C. (2017). Ethnomathematics and the emergence of mathematics. In J. Adams, P. Barmby & A. Mesoudi (Eds.), *The nature and development of mathematics: Cross disciplinary perspectives on cognition, learning and culture* (pp. 69-85). Routledge.
- D'Ambrósio, U., & Knijnik, G. (2020). Ethnomathematics. In S. Lerman (Eds.), *Encyclopedia of mathematics education* (pp. 283-288). Springer. https://doi.org/10.1007/978-3-030-15789-0_60
- Du, Y.-Q., Zhu, G.-D., Cao, J., & Huang, J.-Y. (2021). Research supporting malaria control and elimination in China over four decades: A bibliometric analysis of academic articles published in Chinese from 1980 to 2019. *Malaria Journal*, 20, Article 158. <https://doi.org/10.1186/s12936-021-03698-y>
- Ergene, Ö., Çağlayan Ergene, B., & Yazıcı, E. (2020). Ethnomathematics activities: Reflections from the design and implementation process. *Turkish Journal of Computer and Mathematics Education*, 11(2), 402-437. <https://doi.org/10.16949/turkbilmate.688780>
- Fauzi, A., & Lu'luilmaknun, U. (2019). Etnomatematika pada permainan Dengklaq sebagai media pembelajaran matematika [Ethnomathematics in dengklaq games as a medium for learning mathematics]. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 8(3), 408-419. <https://doi.org/10.24127/ajpm.v8i3.2303>
- Fonseca, B. d. P. F., Sampaio, R. B., Fonseca M. V. de A. & Zicker, F. (2016). Co-authorship network analysis in health research: Method and potential use. *Health Research Policy and Systems*, 14, Article 34. <https://doi.org/10.1186/s12961-016-0104-5>
- Fouze, A. Q., & Amit, M. (2018). Development of mathematical thinking through integration of ethnomathematic folklore game in math instruction. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(2), 617-630. <https://doi.org/10.12973/ejmste/80626>
- Franceschini, F., Maisano, D., & Mastrogiacomo, L. (2016). The museum of errors/horrors of Scopus. *Journal of Informetrics*, 10(1), 174-182. <https://doi.org/10.1016/j.joi.2015.11.006>
- Furuto, L. H. L. (2014). Pacific ethnomathematics: Pedagogy and practices in mathematics education. *Teaching Mathematics and Its Applications*, 33(2), 110-121. <https://doi.org/10.1093/teamat/hru009>
- García García, J., & Bernardino Silverio, N. (2019). Conocimientos geométricos en la elaboración de un artefacto en una comunidad Nuu Savi [Geometric knowledge in the elaboration of an artifact in a Nuu Savi community]. *IE Revista de Investigación Educativa de la REDIECH*, 10(19), 105-120. <https://www.redalyc.org/journal/5216/521658239006/html/>
- Gerdes, P. (2015, February 16). *Ethnomathematics as a new research field, illustrated by studies of mathematical ideas in African history*. Yumpu. <http://bit.ly/3DWmdZu>
- Hartinah, S., Suherman, S., Syazali, M., Efendi, H., Junaidi, R., Jermisittiparsert, K., & Umam, R. (2019). Probing-prompting based on ethnomathematics learning model: The effect on mathematical communication skills. *Journal for the Education of Gifted Young Scientists*, 7(4), 799-814. <https://doi.org/10.17478/jegys.574275>
- Hassan, S.-U., Visvizi, A., & Waheed, H. (2019). The ' who ' and the ' what ' in international migration research : Data-driven analysis of Scopus-indexed scientific literature. *Behaviour and Information Technology*, 38(9), 924-939.

<https://doi.org/10.1080/0144929X.2019.1583282>

- Herdianto, R., Windyaningrum, N., Masruroh, B., & Setiawan, M. A. (2021). Filsafat pendidikan dan perkembangannya: Kajian bibliometrik berdasarkan database Scopus [Philosophy of education and its development: Bibliometric studies based on scopus database]. *Belantika Pendidikan*, 4(2), 44-56. <https://doi.org/10.47213/bp.v4i2.101>
- Hidayati, F. N., & Prahmana, R. C. I. (2022). Ethnomathematics' research in Indonesia during 2015-2020. *Indonesian Journal of Ethnomathematics*, 1(1), 29-42. <https://bit.ly/3Vc25KQ>
- Holmes, R. (2010). The THE-QS world university rankings, 2004 – 2009. *Asian Journal of University Education*, 6(1), 91-113. <https://bit.ly/4c9BZPF>
- Huang, M.-H. (2011). A comparison of three major academic rankings for world universities: From a research evaluation perspective. *Journal of Library and Information Studies*, 9(1), 1-25. [https://doi.org/10.6182/jlis.2011.9\(1\).001](https://doi.org/10.6182/jlis.2011.9(1).001)
- Internet traffic. (2024, March 25). Internet traffic. In Wikipedia. https://en.wikipedia.org/wiki/Internet_traffic
- Kara, M., & Yontar Togrol, A. (2010). Effects of instructional design integrated with ethnomathematics: Attitudes and achievement. In *Proceedings of International Conference on Life Sciences (ICLS)* (pp. 730-735). ISTES Organization. <https://repository.isls.org/bitstream/1/2746/1/730-735.pdf>
- Karnilah, N. (2013). Study ethnomathematics: Pengungkapan sistem bilangan masyarakat adat Baduy [Study ethnomathematics: Disclosure of the number system of the Baduy indigenous people]. [Master's thesis, Pendidikan University] UPI Repository. <http://repository.upi.edu/385/>
- Kristia, D., Soebagyo, J., & Ipaenin, H. (2021). Analisis bibliometrik dari istilah “Etnomatematika” [Bibliometric analysis of the term “Ethnomathematics”]. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, 1(2), 178-190. <https://doi.org/10.51574/kognitif.v1i2.62>
- Kulakli, A., & Osmanaj, V. (2020). Global research on big data in relation with artificial intelligence (A bibliometric study: 2008-2019). *International Journal of Online and Biomedical Engineering*, 16(2), 31-46. <https://doi.org/10.3991/ijoe.v16i02.12617>
- Kusumaningsih, W., Supandi, S., & Ariyanto, L. (2020). Ethnomathematics for congruence concept : A didactical design in a mathematics classroom. *Journal of Physics: Conference Series*, 1663, Article 012036. <https://doi.org/10.1088/1742-6596/1663/1/012036>
- Kuzhabekova, A., Hendel, D. D., & Chapman, D. W. (2015). Mapping global research on international higher education. *Research in Higher Education*, 56, 861-882. <https://doi.org/10.1007/s11162-015-9371-1>
- Lubis, S. I., Mujib, A., & Siregar, H. (2018). Eksplorasi etnomatematika pada alat musik Gordang Sambilan [Ethnomathematical exploration of the Gordang Sideline musical instrument]. *Edumatika : Jurnal Riset Pendidikan Matematika*, 1(2), 1-10. <https://doi.org/10.32939/ejrpm.v1i2.246>
- Mahuda, I. (2020). Eksplorasi etnomatematika pada motif batik lebak dilihat dari sisi nilai filosofi dan konsep matematis [Exploration of ethnomathematics in batik lebak motifs is seen in terms of philosophical values and mathematical concepts]. *Jurnal Lebesgue: Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, 1(1), 29-38. <https://doi.org/10.46306/lb.v1i1.10>
- Mania, S., & Alam, S. (2021). Teachers' perception toward the use of ethnomathematics approach in teaching math. *International Journal of Education in Mathematics, Science and Technology*, 9(2), 282-298. <https://doi.org/10.46328/IJEMST.1551>
- Marginson, S. (2009). Open source knowledge and university rankings. *Thesis Eleven*, 96(1), 9-39. <https://doi.org/10.1177/0725513608099118>
- Martín-Sómer, M., Moreira, J., & Casado, C. (2021). Use of Kahoot! to keep students' motivation during online classes in the lockdown period caused by Covid 19. *Education for Chemical Engineers*, 36, 154-159. <https://doi.org/10.1016/j.ece.2021.05.005>
- Maryati, R. C. I. P. (2019). Ethnomathematics: Exploration of the muntuk community. *International Journal of Scientific and Technology Research*, 8(6), 47-49. <http://bit.ly/3DoAr56>
- Morel, C. M., Serruya, S. J., Penna, G. O., & Guimarães, R. (2009). Co-authorship network analysis: A powerful tool for strategic planning of research, development and capacity building programs on neglected diseases. *PLoS Neglected Tropical Diseases*, 3(8), Article e501. <https://doi.org/10.1371/journal.pntd.0000501>
- Muhammad, I., Marchy, F., Naser, A. D. M., & Turmudi. (2023). Analisis bibliometrik : Tren penelitian etnomatematika dalam pembelajaran matematika di Indonesia (2017-2022) [Bibliometric analysis: Ethnomathematics research trends in mathematics learning in Indonesia (2017-2022)]. *Jurnal Ilmiah Pendidikan Matematika*, 11(2), 267-279. <https://doi.org/10.25273/jipm.v11i2.14085>

- Muhtadi, D., Sukirwan, Warsito, & Prahmana, R. C. I. (2017). Sundanese ethnomathematics: Mathematical activities in estimating, measuring, and making patterns. *Journal on Mathematics Education*, 8(2), 185-198. <https://doi.org/10.22342/jme.8.2.4055.185-198>
- Mukhtar, K., Javed, K., Arooj, M., & Sethi, A. (2020). Advantages, Limitations and recommendations for online learning during COVID-19 pandemic era. *Pakistan Journal of Medical Sciences*, 36(COVID19-S4), 27-31. <https://doi.org/10.12669/pjms.36.COVID19-S4.2785>
- Nisonger, T. E. (2004). Citation autobiography: An investigation of ISI database coverage in determining author citedness. *College and Research Libraries*, 65(2), 152-163. <https://doi.org/10.5860/crl.65.2.152>
- Niu, L., Zhao, X., Wu, F., Tang, Z., Lv, H., Wang, J., Fang, M., & Giesy, J. P. (2021). Hotspots and trends of covalent organic frameworks (COFs) in the environmental and energy field: Bibliometric analysis. *Science of the Total Environment*, 783, Article 146838. <https://doi.org/10.1016/j.scitotenv.2021.146838>
- Oliveras, M. L., & Blanco-Álvarez, H. (2016). Integration of ethnomathematics in mathematics classroom: Possibilities and limitations. *Bolema*, 30(55). <https://doi.org/10.1590/1980-4415v30n55a08>
- Osman, Z., & Yussof, N. (2020). Pola dan potensi penerbitan berbahasa melayu dalam indeks Scopus [Malay article publication patterns and potential in Scopus indexed journals]. *Pendeta Journal of Malay Language, Education and Literature*, 11(2), 85-96. <https://doi.org/10.37134/pendeta.vol11.2.7.2020>
- Owens, K. (2014). Diversifying our perspectives on mathematics about space and geometry: An ecocultural approach. *International Journal of Science and Mathematics Education*, 12, 941-974. <https://doi.org/10.1007/s10763-013-9441-9>
- Paternina-Borja, O., Muñoz-Granados, N., Pacheco-Muñoz, E., & Aroca-Araújo, A. (2020). Simetrías inmersas en el proceso de elaboración de la máscara del torito de Galapa [Immersed symmetries in the making Galapa's torito mask]. *Revista de Investigación, Desarrollo e Innovación*, 11(1), 141-157. <https://doi.org/10.19053/20278306.v11.n1.2020.11689>
- Pradana, K. C., Rizki Putra, A., & Rahmawati, Y. (2022). Ethnomathematics on traditional culture : A Bibliometric mapping analysis and systematic review on database Scopus. *International Journal Corner of Educational Research*, 1(1), 1-8. <https://doi.org/10.54012/ijcer.v1i1.61>
- Purwoko. (2016). Analisis artikel civitas akademika Universitas Islam Negeri yang terindex Scopus [Analysis of articles from the academic community of the State Islamic University indexed by Scopus]. *Pustakaloka*, 8(1), 105-120. <https://bit.ly/3x6erw5>
- Rahmawati, Y., & Muchlian, M. (2019). Eksplorasi etnomatematika rumah gadang Minangkabau Sumatera Barat [Exploration of ethnomathematics of the Minangkabau gadang house in West Sumatra]. *Jurnal Analisa*, 5 (2), 124-136. <https://doi.org/10.15575/ja.v5i2.5942>
- Rodríguez-Nieto, C. A. (2021). Conexiones etnomatemáticas entre conceptos geométricos en la elaboración de las tortillas de Chilpancingo, México [Ethnomatematical connections between geometric concepts in the making of tortillas from Chilpancingo, Mexico]. *Revista de Investigación, Desarrollo e Innovación*, 11(2), 273-296. <https://doi.org/10.19053/20278306.v11.n2.2021.12756>
- Rodríguez-Nieto, C. A., & Alsina, Á. (2022). Networking between ethnomathematics, STEAM education, and the globalized approach to analyze mathematical connections in daily practices. *Eurasia Journal of Mathematics, Science and Technology Education*, 18(3), Article em2085. <https://doi.org/10.29333/EJMSTE/11710>
- Rosa, M., D'Ambrósio, U., Orey, D. C., Shirley, L., Alangui, W. V., Palhares, P., & Gavarrete, M. E. (2016). *Current and future perspectives of ethnomathematics as a program*. ICME-13 Topical Surveys. <https://doi.org/10.1007/978-3-319-30120-4>
- Rosa, M., & Orey, D. C. (2010). Culturally relevant pedagogy : An ethnomathematical approach. *Horizontes*, 28(1), 19-31. <https://bit.ly/3wEmXhR>
- Royani, Y., Bachtar, M. A., Tambunan, K., Tupan, & Sugiarto. (2013). Pemetaan karya tulis ilmiah LPNK: Studi kasus LIPI Dan BPPT (2004-2008) [Mapping of LPNK scientific papers: Case studies of LIPI and BPPT (2004-2008)]. *Jurnal Dokumentasi Dan Informasi*, 34(1), 1-28. <https://bit.ly/45fHlGL>
- Rubio, J. S. (2016). The ethnomathematics of the Kabihug tribe in Jose Panganiban, Camarines Norte, Philippines. *Malaysian Journal of Mathematical Sciences*, 10, 211-231. <https://bit.ly/3Xe4Y0y>
- Salsabilah, A. P., Rahmah, A. A., Wulandari, A., & Soebagy, J. (2022). A review of research : Exploring ethnomathematics on Indonesian traditional games in mathematics learning. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, 6(1), 191-202. <https://doi.org/10.31331/medivesveteran.v6i1.1751>

- Sintawati, M., Fitriawanati, M., & Marsigit. (2019). Lesson study to improve competence of mathematics pre-service teacher in developing lesson plan based-on etnomathematics. *International Journal of Scientific and Technology Research*, 8(10), 3400-3404. <http://bit.ly/3WQuNzR>
- Sowter, B. (2008). The times higher education supplement and quacquarelli symonds (THES - QS) World University Rankings: New developments in ranking methodology. *Higher Education in Europe*, 33(2-3), 345-347. <https://doi.org/10.1080/03797720802254247>
- Sunzuma, G., & Maharaj, A. (2019). Teacher-related challenges affecting the integration of ethnomathematics approaches into the teaching of geometry. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(9), Article em1744. <https://doi.org/10.29333/ejmste/108457>
- Sunzuma, G., & Maharaj, A. (2020). Exploring Zimbabwean mathematics teachers' integration of ethnomathematics approaches into the teaching and learning of geometry. *Australian Journal of Teacher Education*, 45(7), 77-93. <https://doi.org/10.14221/ajte.2020v45n7.5>
- Supriadi, S. (2019). Didactic design of sundanese ethnomathematics learning for primary school students. *International Journal of Learning, Teaching and Educational Research*, 18(11), 154-175. <https://doi.org/10.26803/ijlter.18.11.9>
- Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 14(13), 207-222. <https://doi.org/10.1111/1467-8551.00375>
- Van Eck, N. J., & Waltman, L. (2014). Visualizing bibliometric networks. In Y. Ding, R. Rousseau, & D. Wolfram (Eds.), *Measuring scholarly impact* (pp. 285-320). Springer. https://doi.org/10.1007/978-3-319-10377-8_13
- Van Eck, N. J., & Waltman, L. (2020). *VOSviewer manual, version 1.6.16*. Univeristeit Leiden & CWTS. <https://bit.ly/4e8u1b4>
- Verner, I., Massarwe, K., & Bshouty, D. (2013). Constructs of engagement emerging in an ethnomathematically-based teacher education course. *Journal of Mathematical Behavior*, 32(3), 494-507. <https://doi.org/10.1016/j.jmathb.2013.06.002>
- Wang, J., Lim, M. K., Wang, C., & Tseng, M.-L. (2021). The evolution of the Internet of Things (IoT) over the past 20 years. *Computers and Industrial Engineering*, 155, Article 107174. <https://doi.org/10.1016/j.cie.2021.107174>
- Xia, D.-M., Wang, X.-R., Zhou, P.-Y., Ou, T.-L., Su, L., & Xu, S.-G. (2021). Research progress of heat stroke during 1989-2019: A bibliometric analysis. *Military Medical Research*, 8, Article 5. <https://doi.org/10.1186/s40779-021-00300-z>
- Yang, L., Chen, Z., Liu, T., Gong, Z., Yu, Y., & Wang, J. (2013). Global trends of solid waste research from 1997 to 2011 by using bibliometric analysis. *Scientometrics*, 96, 133-146. <https://doi.org/10.1007/s11192-012-0911-6>
- Yang, L., Sun, T., & Liu, Y. (2017). A bibliometric investigation of flipped classroom research during 2000-2015. *International Journal of Emerging Technologies in Learning*, 12(6), 178-186. <https://doi.org/10.3991/ijet.v12i06.7095>
- Zyoud, S. H. (2021). The Arab region's contribution to global COVID-19 research: Bibliometric and visualization analysis. *Globalization and Health*, 17, Article 31. <https://doi.org/10.1186/s12992-021-00690-8>