

RESEARCH TREND ON ETHNOMATHEMATICS FROM 2012 TO 2022: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

This paper aims to provide research trends in ethnomathematics from 2012 to 2022 using bibliometric analysis in the Google Scholar database. The sample consisted of 994 documents extracted from the Google Scholar database using the Publish or Perish (PoP) software, which was then analyzed and visualized using Ms.Excel and VoSViewer. The findings revealed an increase in the number of scholarly articles on ethnomathematics. It was discovered that there were five types of documents associated with ethnomathematics research, with journals dominating. The Journal of Physics: Conference Series was a prestigious conference series that included ethnomathematics publications. The visualization of ethnomathematics research trend resulted in four clusters: (1) ethnomathematics practice in the educational landscape, (2) ethnomathematics exploration in learning mathematics, (3) ethnomathematics related to learning materials, and (4) ethnomathematics domain in teaching approach and teaching materials. Cluster 4 provides opportunities for future ethnomathematics research. Researchers could use the findings of this study to identify the global trend of ethnomathematics research and recommend future research directions.

TREND PENELITIAN ETNOMATEMATIKA DARI TAHUN 2012 SAMPAI TAHUN 2022: ANALISIS BIBLIOMETRIK

Kata Kunci:

Analisis bibliometrik

Etnomatematika

Google cendekia

Tren penelitian

ABSTRAK

Penelitian ini bertujuan untuk memberikan deskripsi tren penelitian etnomatematika menggunakan database Google Scholar dari tahun 2012 hingga 2022. Sampel terdiri dari 994 dokumen dari database Google Scholar yang diekstraksi menggunakan perangkat lunak *Publish or Perish (PoP)*, kemudian dianalisis dan divisualisasikan menggunakan Ms.Excel dan *VoSViewer*. Hasil penelitian menunjukkan bahwa jumlah artikel ilmiah tentang etnomatematika meningkat. Ditemukan bahwa ada lima jenis dokumen yaitu jurnal, artikel prosiding, buku, desertasi, dan tesis yang terkait dengan penelitian etnomatematika, dan didominasi oleh jurnal. *Journal of Physics: Conference Series* adalah seri konferensi unggulan yang berisi publikasi tentang etnomatematika. Visualisasi tren penelitian etnomatematika menghasilkan empat kluster: (1) praktik etnomatematika dalam lanskap pendidikan, (2) eksplorasi etnomatematika dalam pembelajaran matematika, (3) etnomatematika terkait bahan pembelajaran, dan (4) domain etnomatematika dalam pendekatan pembelajaran dan bahan ajar. Dari 4 kluster yang menjadi tren penelitian pada etnomatematika, kluster 4 memberikan peluang dan arah untuk penelitian

selanjutnya di bidang etnomatematika. Hal ini bisa menjadi pertimbangan bagi peneliti untuk melakukan penelitian selanjutnya di bidang etnomatematika.

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1. INTRODUCTION

The term ethnomathematics came from three Greek words: *ethno*, *mathema*, and *tics*. It refers to a program that integrates mathematical concepts and methods used by members of different cultural groups, including indigenous communities and other communities, such as worker groups, professional groups, and groups of children within specific age ranges [1-3]. Therefore, ethnomathematics is the study of mathematics through cultures. It emphasizes on cultures of particular members of communities (*ethno*) throughout history to develop techniques and ideas (*tics*) of measurement, calculation, reasoning, and classification, enabling them to elucidate and comprehend the phenomena of social environments and contexts (*mathema*) [2], [4]. In addition, ethnomathematics is a science used to understand how mathematics is adapted from a culture. In this respect, ethnomathematics is a new form of ethnography. Ethnomathematics research is a mathematical activity based on a cultural phenomenon [3]. Cultural research will gain benefit from the presence of ethnomathematics [5]. Even though this is nothing new, as they have generally known *verstehen* (understanding) [6], it nonetheless promotes a fresh look at cultural studies.

Students perceive mathematics as challenging because it examines abstract forms or structures [7], [8]. At the same time, mathematics is essential in developing students' logical, rational, and critical thinking. To fill this gap, the presence of mathematics learning innovation is paramount so that learning mathematics can be more enjoyable and meaningful. Mathematics learning should be started by digging informal knowledge obtained by the students from community life around where they live. One aspect that can be developed for this learning innovation is the local culture. Ethnomathematics as a culturally based mathematics can contribute to the student's learning experiences in mathematics [9]. These experiences can be in the form of knowledge, attitudes, and behavioral patterns.

Furthermore, incorporating ethnomathematics or mathematical concepts based on cultural perspectives is one method for encouraging students to become more interested in mathematics [10-12]. Students will be better able to see how math applies outside of the classroom and how it impacts the "real" world as their enthusiasm for the subject rises. Likewise, D'Ambrosio [13] pointed out that ethnomathematics is essential in creating equity and social justice. Through ethnomathematics, students can get help to succeed in school and life, as the core values of ethnomathematics comprise respect, solidarity, and collaboration [14]. Further, Presmeg [15] asserted that integrating ethnomathematics into the lesson plan is mandatory for those who want to educate about respecting and celebrating cultural diversity.

Bibliometric analysis is a method for discovering and interpreting enormous volumes of scientific articles [16]. It helps us dissect a certain topic's evolutionary subtleties and offers light on its developing areas [16]. In line with this, bibliometrics analysis in ethnomathematics research will help the researchers in this field to know the global trend, concept relatedness in ethnomathematics with another field, state of the art, and giving recommendations for future research on ethnomathematics. Furthermore, a bibliometric analysis of ethnomathematics can identify national to international networks and map the development of research trends on ethnomathematics.

Many researchers around the world have conducted research on ethnomathematics. Research on ethnomathematics bibliometric analysis that concentrates on research trends on ethnomathematics in mathematics learning in the Indonesian context from 2017 to 2022 [17]. Furthermore, research was carried out on ethnomathematics research on traditional Indonesian games in learning mathematics [18]. In addition, research on ethnomathematics uses bibliometric analysis that focuses on various cultures in Indonesia for five years from 2015 to 2020 [19]. This research uses databases from journals accredited by the Ministry of Education, namely SINTA 1 and SINTA 2. Other research on ethnomatematics uses bibliometric analysis [20]. This study used the Scopus database in the last three years (2020-2022) using traditional culture and ethnomathematics keywords. From these previous studies, there has yet to be a bibliometrics analysis examining ethnomathematics that focuses on ethnomathematics studies globally and used databases over the last ten years from google scholar. This gap in the literature emphasizes the need for further research on bibliometrics analysis in ethnomathematics to highlight the trend of ethnomathematics studies over the last ten years.

This study aims to analyze the research trend on ethnomathematics during 2012-2022 to assist educational researchers in understanding the global landscape of ethnomathematics, namely, the profile of ethnomathematics publication output, the top and most cited authors, ethnomathematics publication patterns, and visualization of ethnomathematics research trend from 2012 to 2022.

2. METHOD

This study followed the guidance of a bibliometric analysis [16], [21]. The complete stages are portrayed in Figure 1.

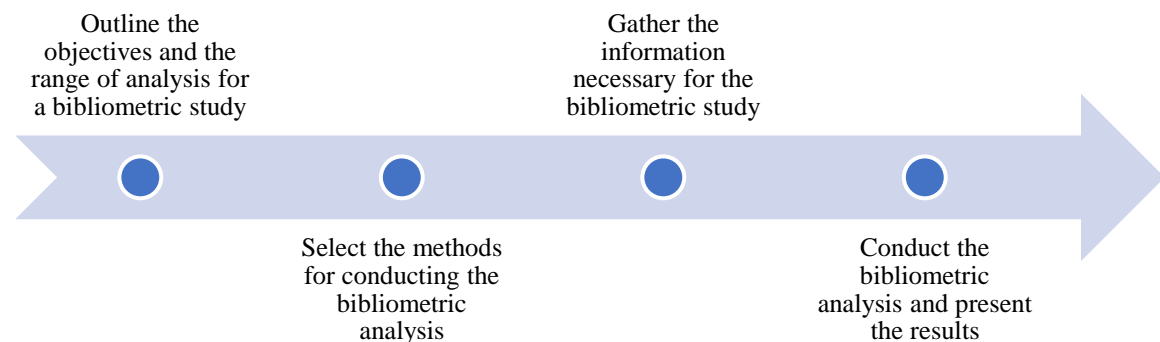


Figure 1. Four Stages of Bibliometric Procedures [16], [21]

The data used in this research was based on the database Google Scholar. Publish or Perish (PoP) was used to search and filter articles systemically [22] in Google Scholar. The data were collected on October 20, 2022. In the initial research using the keywords ethnomathematics, it was found 1032 publications. After filtering the initial search results, it was found that 38 documents were double-counted. This research sample comprises 994 publications with ethnomathematics in titles, abstracts, and keywords from 2012 to 2022. The data were documented in (.ris) and (.csv) files. Then these data were processed in different bibliometric and network analysis software: Microsoft Excel and VOSviewer. A text-mining feature provided by VOSviewer can create and display a correlation in a citation of an academic paper or publication [23]. VoSViewer software was utilized to determine the ethnomathematics research trend by providing specific information about

the map of bibliometric graphs [24-26]. The data were collected to examine the worldwide research activity on ethnomathematics in general and to determine the research trends and performance, including the type of publications, document sources, the top and the most cited authors, and the publications trend between 2012 and 2022. The author searched online using the keywords “ethnomathematics” in the title.

3. RESULTS AND DISCUSSION

3.1 Publication Output and Documents Sources

Between 2012 and 2022, there were 994 documents associated with ethnomathematics research in the Google Scholar database, with five types of documents. There were 823 journals, accounting for 82.80% of total production, with proceeding papers (104 documents, 10.46%), books (64 documents, 6.44%), dissertations (2 documents, 0.20%), and theses (1 document, 0.10%) following. This study included books, dissertations, and theses to obtain a global trend of ethnomathematics research that was not limited to journals and proceeding papers. Figures 2 and 3 depict ethnomathematics research publications between 2012 and 2022. The number of ethnomathematics documents published each year has significantly increased. Before 2018, less than 100 documents were produced annually, but between 2019 and 2022, more than 100 were produced annually. Although it decreased slightly from 2013 to 2014 and 2021 to 2022, the trend between 2015 and 2021 increased significantly. Research on ethnomathematics decreased in 2022 compared to 2021 and 2020 because the data used in this research were collected on October 20, 2022. At the end of 2022, it was expected that research articles on ethnomathematics would increase for the remaining two months of 2022.

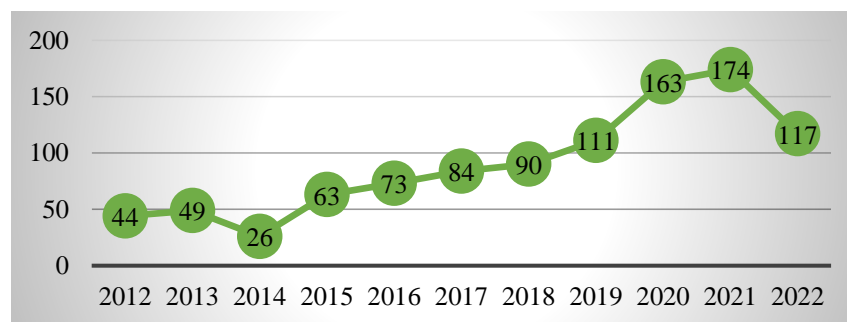


Figure 2. The Number of Documents on Ethnomathematics in 2012-2022

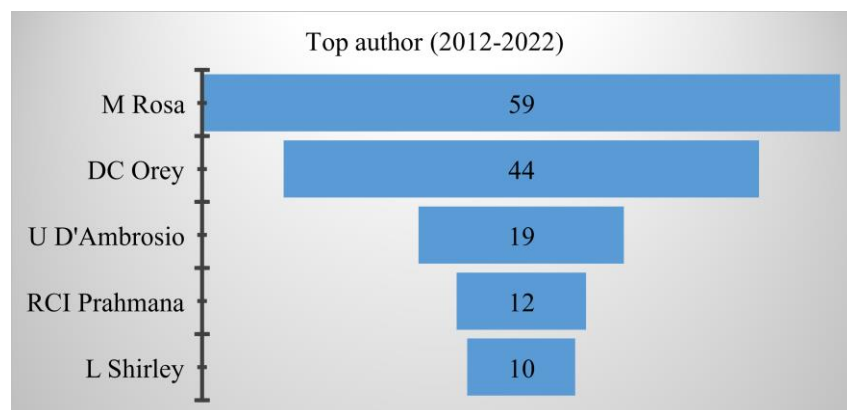


Figure 3. The Number of Ethnomathematics Articles Based on Source Categories

3.2 Top Authors and the Most Cited Authors in Researching Ethnomathematics

This part will discuss the most cited and the top authors in researching ethnomathematics in the last ten years, from 2012 to 2022. Figure 4 depicts the top five most prolific ethnomathematics researchers regarding their productivity. M Rosa, DC Orey, U D'Ambrosio, RCI Prahmana, and L Shirley were the most productive authors in this field. In general, the performance of authors corresponds to the year's most cited article, as shown in Table 1. Meanwhile, Table 2 displays the most frequently cited papers from 2012 to 2022. It was noted that the articles of D Muhtadi, RCI Prahmana (2017), FS Sirate (2012), AS Abdullah (2017), A Arisetyawan, D Suryadi, T Herman, C Rahmat (2014), and W Widada, D Herawaty, A Lubis (2018) were the top 5 citations between 2012 and 2022.

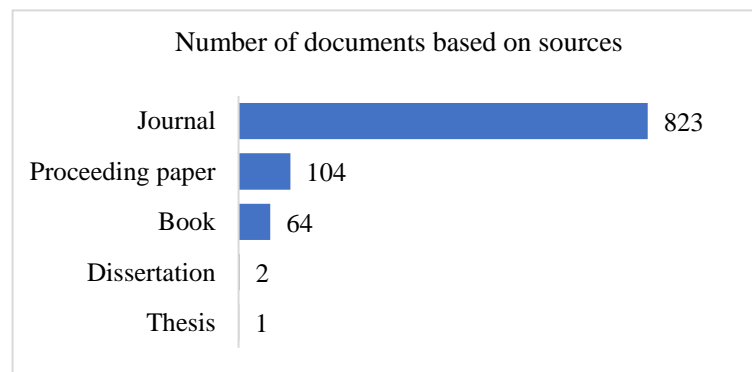


Figure 4. Top Five Authors in Ethnomathematics Research from 2012-2022

Table 1. The Most Cited Article or Document from 2012 to 2022

Author(s)	Sources	Σ Citations
M Ascher	Ethnomathematics: A multicultural view of mathematical ideas, pp. 1-214, Book	955
D Muhtadi, RCI Prahmana	Sundanese Ethnomathematics: Mathematical Activities in Estimating, Measuring, and Making Patterns. <i>Journal on Mathematics Education</i> , 8(2), 185-198.	142
FS Sirate	Implementasi Etnomatematika dalam Pembelajaran Matematika pada Jenjang Pendidikan Sekolah Dasar. <i>Lentera Pendidikan: Jurnal Ilmu Tarbiyah dan Keguruan</i> , 15(1), 41-54.	130
AS Abdullah	Ethnomathematics in Perspective of Sundanese Culture. <i>Journal on Mathematics Education</i> , 8(1), 1-16.	127
A Arisetyawan, D Suryadi, T Herman, C Rahmat	Study of Ethnomathematics: A lesson from the Baduy Culture. <i>International Journal of Education and Research</i> , 2(10), 681-688.	124

3.3 Publication Patterns of Ethnomathematics Research in 2012-2022: Sources Titles

The most contribution journal or proceeding on ethnomathematics research are included in Table 2. Journal of Physics: Conference Series was a preeminent conference series containing publications on ethnomathematics. Meanwhile, Revista Latinoamericana de Etnomatematica, Unnes Journal of Mathematics Education, Journal on Mathematics Education (JME), and *Revista Internacional de Pesquisa em Educação Matemática* were the most prominent journals covering this field.

Table 2. Number of Ethnomathematics Documents in 2012-2022 across Source Titles

No	Sources Titles	Number of documents
1	Journal of Physics: Conference Series	101
2	Revista Latinoamericana de Etnomatemática	19
3	Unnes Journal of Mathematics Education	18
4	Journal on Mathematics Education (JME)	9
5	Revista Internacional de Pesquisa em Educação Matemática	8

3.4 Visualization Ethnomathematics Research Trend in 2012-2022 Based on VoSViewer Software

Using *VoSViewer* software, the author illustrated the research trends on this issue among the 994 papers on ethnomathematics research found in the Google Scholar database. This endeavor helps identify research novelty in this field. Figure 5 depicts ethnomathematics research in its entirety. Researchers on ethnomathematics worldwide constituted four main clusters which are indicated with red, green, yellow, and blue. The first cluster (red color) is related to ethnomathematics practice in the mathematics education landscape. The second cluster (yellow) was related to ethnomathematics exploration in mathematics learning. The third cluster (green color) was ethnomathematics associated with learning materials, and the last group (blue) was the ethnomathematics domain in teaching approach and teaching materials. Looking more into detail in cluster 4, the teaching approach and teaching materials, particularly realistic mathematics concerning the ethnomathematics approach, could be a new direction for future research on ethnomathematics.

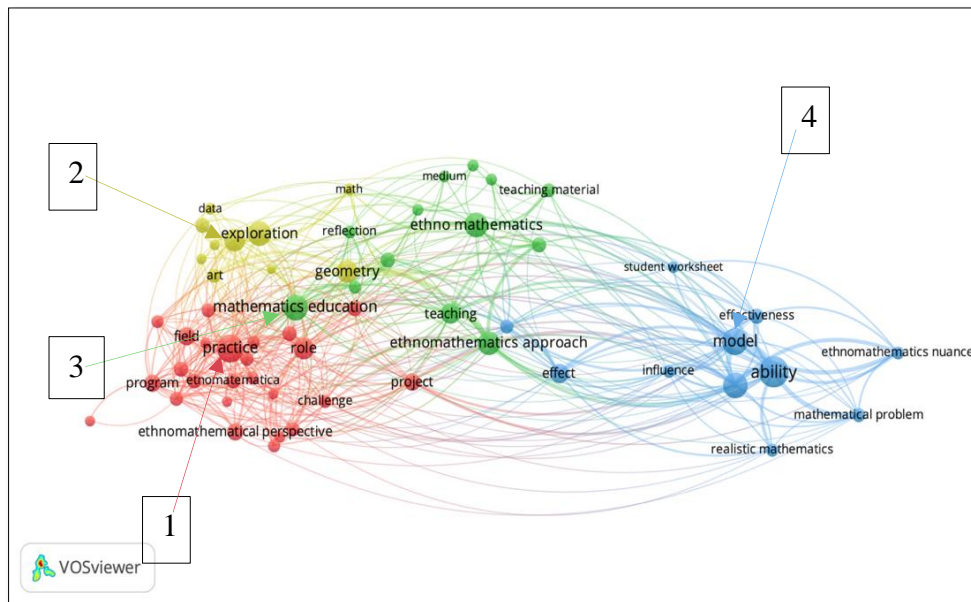


Figure 5. The Whole Picture of Ethnomathematics Research from 2012-2022

3.5 Visualization Ethnomathematics Research Trend in 2012-2022 Based on VoSViewer Software

Using *VoSViewer* software, the author illustrated the research trends on this issue among the 994 papers on ethnomathematics research found in the Google Scholar database. This endeavor helps identify research novelty in this field. Figure 5 depicts ethnomathematics research in its entirety. Researchers on ethnomathematics worldwide constituted four main clusters which are indicated with red, green, yellow, and blue. The first cluster (red color) is related to ethnomathematics practice in the mathematics

education landscape. The second cluster (yellow) was related to ethnomathematics exploration in mathematics learning. The third cluster (green color) was ethnomathematics associated with learning materials, and the last group (blue) was the ethnomathematics domain in teaching approach and teaching materials.

If we broke it down into more detail, we found some connections among variables capturing the research trend and novelty in ethnomathematics. Figure 6 highlights research on ethnomathematics in the educational setting. It is associated with teaching, mathematics education, geometry, exploration, modeling, and ability. Meanwhile, figure 7 depicts how the ethnomathematics approach is interconnected with other specific domains.

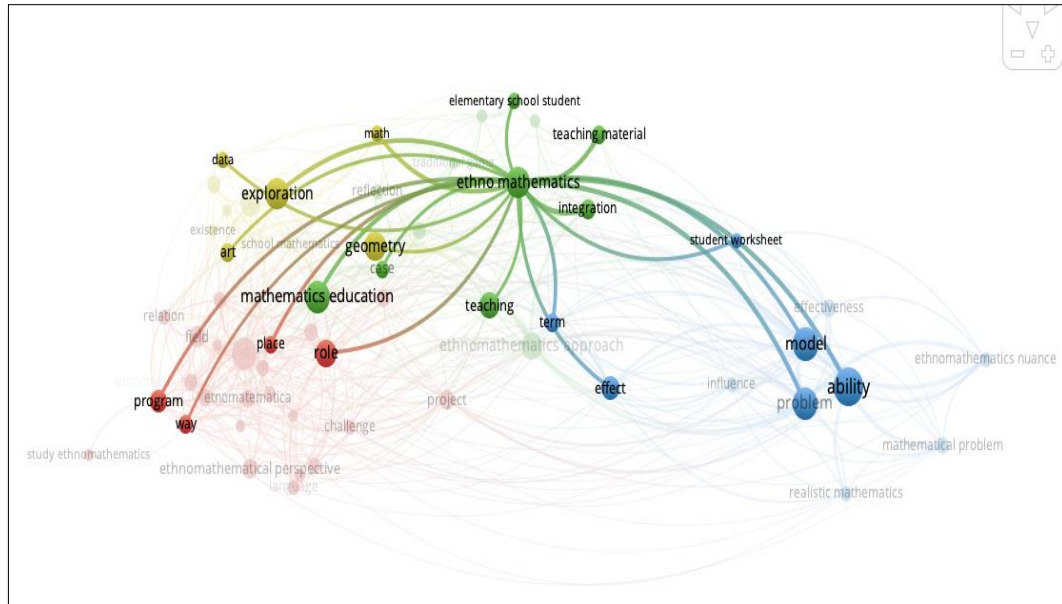


Figure 6. Ethnomathematics in the Educational Setting

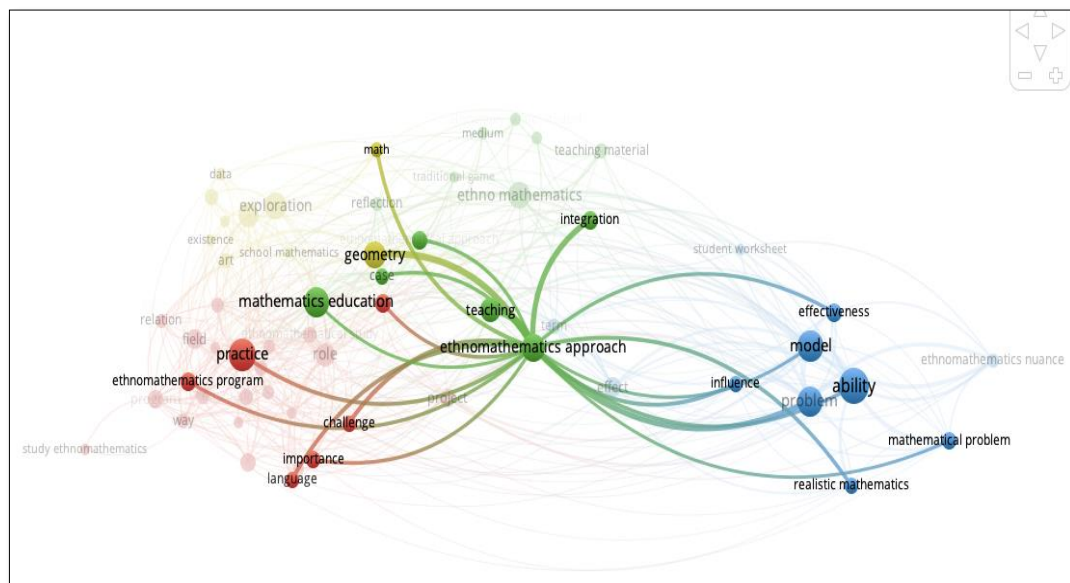


Figure 7. How Ethnomathematics Interconnected with Other Specific Domains

Figure 8 depicts the focus of research on ethnomathematics worldwide on mathematics education, exploration, geometry, teaching, model, ability, and role. The map also showed how ethnomathematics research intersected with other academic fields. Figure

9, on the other hand, encapsulates the top ethnomathematics researcher and his co-authorship. The three most prominent authors were M. Rosa, D.C. Orey, and U. D'Ambrosio. M. Rosa has risen to the top of the list of dominant authors. D.C. Orey, U. D'Ambrosio, RCI Prahmana, L Shirley, W.V. Alangui, M.E. Gavarette, and C. Stathopoulou were among her co-authors. Furthermore, as shown in Figure 9, M Rosa was the most influential researcher in ethnomathematics between 2012 and 2022, as indicated by the largest circle.

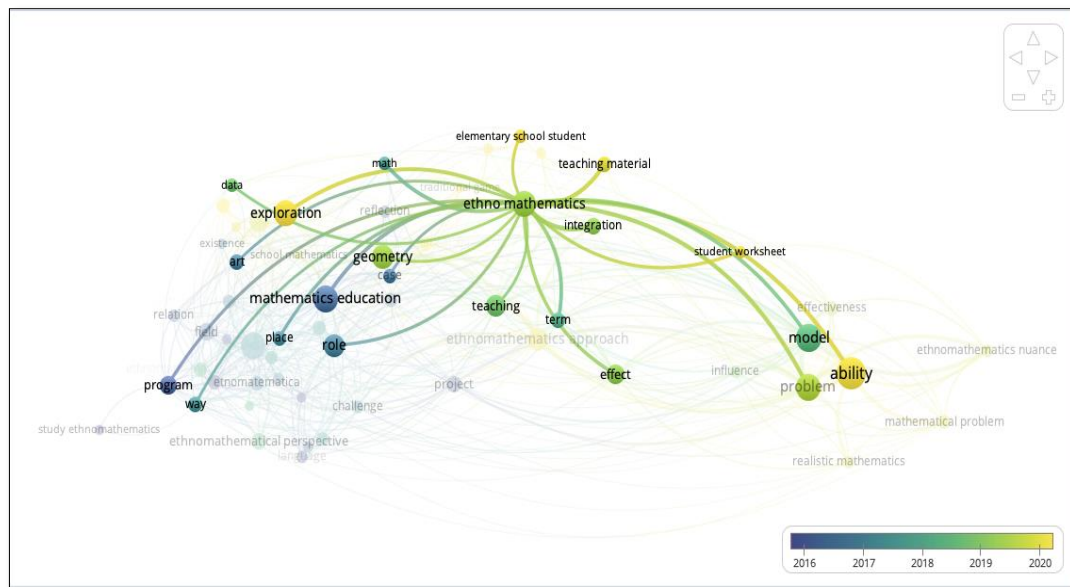


Figure 8. Research Focus on Ethnomathematics from 2012 to 2022

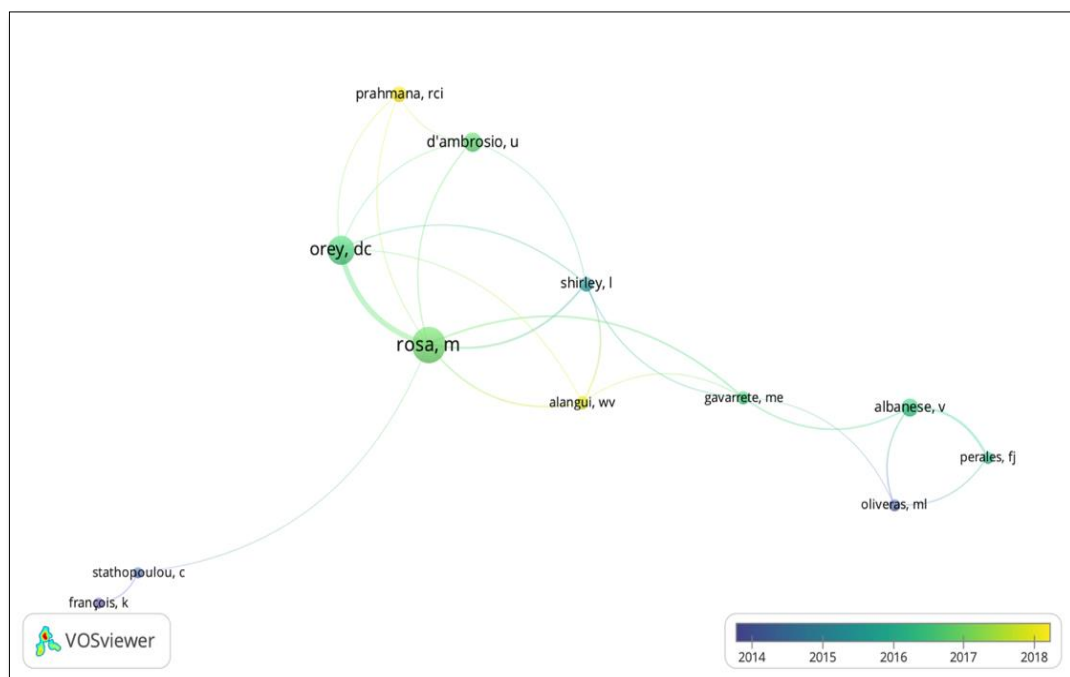


Figure 9. Author and Co-authorships in Ethnomathematics Research from 2012 to 2022

The term ethnomathematics was first introduced by the educator and mathematician from Brazil D'Ambrosio [27] in 1977 during an American Association for the Advancement of Science presentation. Between 2012 and 2022, the number of

ethnomathematics documents increased. Before 2018, it was less than 100 documents, and it will be more than 100 documents each year between 2019 and 2022. During the period 2012-2022, the journal dominated the number of ethnomathematics documents based on sources, with 823 documents, followed by proceeding papers (104 documents), books (64 documents), dissertations (2 documents), and theses (1 document).

Based on data analysis regarding the number of ethnomathematics documents across the top authors, it was found that M.Rosa, D.C Orey, U.D'Ambrosio, RCI Prahmana, and L.Shirley were the most prolific authors. Meanwhile, M.Ascher, with 955 citations, was the most cited author during 2012-2022. It was identified that M.Ascher (2017), D.Muhtadi and RCI Prahmana (2017), F.S Sirate (2012), AS Abdullah (2017), and A.Arisetyawan, D.Suryadi, T.Herman, C.Rahmat (2014) were the top five most cited documents in ethnomathematics research from 2012 to 2022. Journal of Physics: Conference Series was the top source of research papers on ethnomathematics. The findings of this study are mostly in line with the research conducted by Pradana, K. C., Putra, A. R., & Rahmawati, Y. (2022) [20]. These results revealed that U.D'Ambrosio, RCI Prahmana, M.Ascher, and D.Muhtadi ranked as the top author based on the number of publications. In addition, RCI Prahmana and D.Muhtadi were the top most cited documents in the ethnomathematics study [20].

Researchers from all over the world produced four clusters in ethnomathematics research. The first cluster is associated with educational ethnomathematics practice. The second cluster is concerned with the investigation of ethnomathematics in mathematics education. The third cluster dealt with ethnomathematics concerning learning materials, and the fourth dealt with ethnomathematics in the teaching approach and teaching materials. There were three dominant authors and co-authorships in ethnomathematics studies between 2012 and 2022, with M.Rosa as the top author and co-authors and the top and most influential researcher on ethnomathematics among the group from 2012 to 2022.

The findings of this study will assist researchers, particularly those in the field of ethnomathematics, in recognizing the global trend of ethnomathematics studies. From 2012 to 2022, the ethnomathematics trends primarily focused on incorporating ethnomathematics into mathematics teaching and learning. Considering this study's findings, future ethnomathematics research should concentrate on improving mathematics teaching material by incorporating social and cultural backgrounds into the learning and teaching process to develop mathematical thinking, problem-solving skills, and mathematical literacy. These will assist students in improving their mathematical reasoning and problem-solving abilities [28], [29].

4. CONCLUSION

In this study, the author used the bibliometric technique to assess the novelty of research in a specific field of knowledge. The profile of ethnomathematics publication output, the top and most cited authors, publication patterns, and ethnomathematics research trends are all examined in this study. Furthermore, the limitation of this study is that it only uses the Google Scholar database and the keywords ethnomathematics.

The author highlighted some critical points related to ethnomathematics research from 2012 to 2022. The journal's articles were dominated by an increase in the number of ethnomathematics documents from 2012 to 2022. The ethnomathematics research trend visualization includes four clusters: ethnomathematics practice in the educational landscape, ethnomathematics exploration in learning mathematics, ethnomathematics related to learning materials, and ethnomathematics domain in teaching approach and teaching materials. From 2012 to 2022, the research trend on ethnomathematics highlights

that realistic mathematics and ethnomathematics could be new directions for future ethnomathematics research.

The study's findings could help academics recognize the global trend of ethnomathematics research and recommend future research topics. Given the limitations of this study, it is recommended that future research on bibliometric analysis of ethnomathematics research use specific keywords related to ethnomathematics research and use other academic databases such as Web of Science (WoS), Scopus, and Dimensions.

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