# Artikel Biblio

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# Bibliometric analysis on ethnomathematics

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**ABSTRACT**

The many roles and definitions of ethnomathematics are evidence that ethnomathematics still needs further literature review to see how ethnomathematics is in life. So the researcher conducted analytical research on ethnomathematics to explore the characteristics of publications in the field of ethnomathematics and find research trends in ethnomathematics. To facilitate the analysis, the researchers used bibliometric analysis. The data used is sourced from the Scopus database. The science mapping steps taken are study design, data collection, data analysis, data visualization, and interpretation. From the analysis, 580 documents were obtained that had been published from 1984 to 2023 with the core of the study being learners, mathematical concepts, learning mathematics and physics. Based on this information, it is clear that ethnomathematics still needs to be explored more deeply, considering that most documents are not articles. As for the novelty of ethnomathematics research in the future, the most suitable is mathematics learning because ethnomathematics plays an important role in learning mathematics. As for the characteristics of ethnomathematics research, apart from the lack of material in the form of articles, it turns out that ethnomathematics which is currently developing is a learning system in mathematics. Even ethnomathematics can improve high-order thinking skills.

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## 1. INTRODUCTION

According to Kilpatrick et al. (2001: 15), mathematics is a universal science that is the basis of various kinds of science. The development of science and technology today cannot be separated from the role of mathematics. Mathematics also plays a role in advancing human thinking power (Fitriani & Putra, 2022). Mathematics becomes part of the culture, applied and used for innovative analysis. This indicates, that mathematics is a cultural product that has developed in every culture and subculture. The development of mathematics and the development of culture are inseparable (Kristial et al., 2021).

d'Ambrosio (1985) developed ethnomathematics, which is the study of mathematical concepts inherent in all cultures, to characterize mathematical processes in distinguishable cultural grouping. Ethnomathematics is the study of the relationship between mathematics and culture. Ethno-mathematicians draw attention to the fact that mathematics (its techniques and truths) is a product of

culture, with each culture and subculture developing its mathematics that is useful to them (Gerdes, 1994).

The emergence of the idea of ethnomathematics is a broader view of what the relationship between mathematics and the real world is like (Rafiepour & Afsaneh, 2022). This can be seen from the etymological definition of ethnomathematics which comes from the Greek: techné-tics means ways, styles, arts, and techniques; mathema means doing and knowing, learning and explaining, dealing with situations and solving problems; and ethno means different and specific natural and socio-cultural environments. Thus, the definition of ethnomathematics is the way human groups produce ways, styles, arts and techniques of doing and knowing, learning and explaining, dealing with situations and solving problems in their natural and socio-cultural environment (D'Ambrosio, 2018).

Ethnomathematics acts as a mathematical mindset in society regarding culture and can be integrated into the school curriculum. Students are anticipated to be able to comprehend mathematics and culture through the use of ethnomathematics, which will also make it simpler for educators to impart cultural values that are a component of national identity (Nuryadi et al., 2023). This is because ethnomathematics tries to reposition mathematics from the cultural basis of different societies to connect and revive students' critical reasoning and dialogue so that students have critical, democratic thinking and are tolerant of cultural differences and view them as opportunities for mathematics education. Consequently, ethnomathematics seeks to support students in achieving academic success, being passionate, and developing their mathematical creativity as a pedagogical innovation in the mathematics teaching and learning process (Suherman & Vidákovich, 2022a). Because ethnomathematics primarily stems from the idea and concept that mathematics is a culturally based human activity that develops from the way society responds to phenomena linked to mathematics, it also enables students to apply mathematics in everyday life (Hendriana et al., 2022).

Numerous publications and studies on ethnomathematics have been produced (Muhammad, 2023). This can be seen from the many roles of ethnomathematics in life, especially in mathematics learning, such as the opinion of Owusu & Obuo Addo (2023) who said ethnomathematics is a constructivist teaching strategy to facilitate meaningful learning. In a multicultural nation, ethnomathematics can also be a fruitful method for teaching students about their own culture and how to produce mathematical concept ideas while also understanding the cultures of others (Suherman & Vidákovich, 2022b). Ethnomathematics is also a learning method that has special ways of learning mathematics by linking real things to certain cultures or communities so that students can better understand them (Hidayat, 2022).

The reason there is so much research on ethnomathematics in mathematics learning is that ethnomathematics is very important in improving students' mathematical abilities. This is due to the fact that ethnomathematics highlights the value of community in the educational setting by connecting mathematics to regionally developed and utilized cultural practices, allowing connections to be made between everyday experiences and institutional mathematics (Rodríguez-Nieto & Alsina, 2022). Ethnomathematics also allows students to question themselves and reflect on their journey to become more aware, more critical, more appreciative, and more confident in mathematics and its use in problem-solving (Acharya et al., 2021). Even the application of ethnomathematics in mathematics learning has a significant influence on students, deepening students' understanding of mathematics, and helping students see mathematics as part of their daily lives and develop meaningful relationships (Ergene et al., 2020). So it can be concluded that ethnomathematics serves to improve cognitive and emotional attitudes (Shahbari & Daher, 2020).

The many roles and definitions of ethnomathematics are evidence that ethnomathematics still needs further literature review to see how ethnomathematics is in life. So the researcher conducted analytical research on ethnomathematics to explore the characteristics of publications in the field of ethnomathematics and find research trends in ethnomathematics.

## 2. METHODS

This study employs bibliometric analysis, utilizing information from the Scopus database (www.scopus.com). The reason for using bibliometric analysis is that see the distribution of the number of publications and citations from various literature (Herawati et al., 2022). The science mapping steps taken are study design, data collection, data analysis, data visualization, and interpretation (Lee et al., 2022). The study's methodology involved bibliometric analysis of a particular subject using the Scopus literature database. Data were retrieved from Scopus on February 6, 2024, with the keyword ethnomathematics. There were 580 documents from 1984 to 2023. Bibliographic data for 580 documents that have been obtained are stored as CSV (comma-separated values) files. The saved data contains the author's name, organization, article title, keywords, abstract, and various citation data. The collected data was imported into Bibliometrics R to draw network maps and visualize them. Data reduction techniques were used to visualize the results after the results were analyzed. This is because if the threshold is set too low, the data will be too sparse; if it is set too high, the data will be too vast. The authors will thus construct a visualization map size barrier by readability and a review of the literature. The only quantitative bibliometrics resource in RStudio is the Bibliometrics R package. This makes it easier to analyze and add new functions in R because it is an object-oriented and functional programming language. Finally, the data was interpreted. The structure that was highlighted was the conceptual structure. The goal is to investigate the relationships and influences between structural elements (authors, publication groups, and concepts) as well as their function in the main concerns of the subject of research.

## 3. FINDINGS AND DISCUSSION

Through bibliometric analysis, it becomes apparent how important science mapping is. This tactic makes use of quantitative methods' accuracy, and "numbers tell a rich story" in many cases is unexpected. This is because the method focuses, at least in part, on "visualizing relationships" between various facets of literacy. The results of this quick scoping study offer insightful information about the variety of ethnomathematics publications that explain the past and forecast the future (Lee et al., 2022).

### *3.1. Annual Scientific Production*

Based on Figure 1, 580 documents have been published from 1984 to 2023. From 1984-2008, the number of documents published was relatively small, even in 1987 and 1993, no documents were published. Meanwhile, from 2009-2023, there was an increase in the number of documents published. The most published documents occurred in 2023 with 79 documents. Apart from Figure 2, the annual growth rate reached 11.86%. This indicates that ethnomathematics has grown rapidly in recent years, especially in mathematics learning. This is because ethnomathematics is proven to improve learning outcomes (Soebagyo et al., 2021).

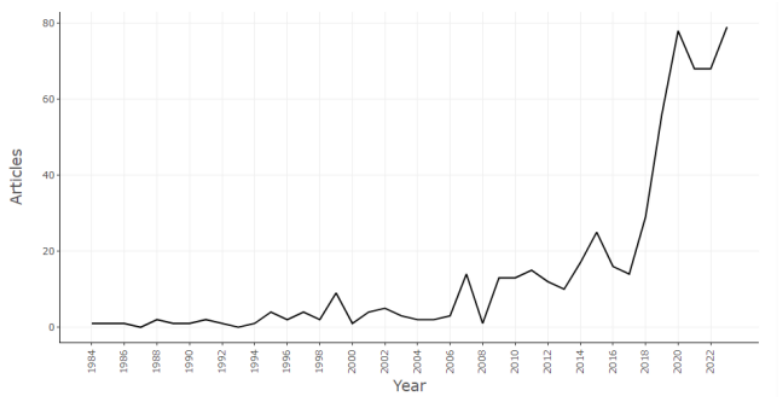



**Figure 1.** Annual scientific production chart.




**Figure 2.** Main Information.

### *3.2. Country of Publication*

There are 44 corresponding author countries of which there are the top ten countries among the countries listed. The top ten countries can be seen in Table 1, where Indonesia has the most document publications, second is Brazil, and third is the United States. Indonesia also has document publications that far outperform other countries. This is because Indonesia is one of the largest multicultural countries in the world, this can be seen from Indonesia's complex, diverse and extensive socio-cultural and geographical conditions (Lestari, 2016). In fact, each region in Indonesia has different cultural characteristics (Aprianti et al., 2022). This research also shows that there are authors who collaborate with other research or cite each other's documents. According to Moshobane et al. (2022), Papers from Multiple Country Publications (MCP) are better than those from Single Country Publications (SCP) because they receive more citations.

**Table 1**. Corresponding Author's Countries.

| Country | Article | SCP (*Single Country Publications*) | MCP (*Multiple Country Publications*) |
|---|---|---|---|
| Indonesia | 159 | 145 | 14 |
| Brazil | 57 | 54 | 3 |
| United States of America | 27 | 25 | 2 |
| Colombia | 7 | 5 | 2 |
| France | 7 | 7 | 0 |
| Israel | 7 | 7 | 0 |
| Spain | 7 | 6 | 1 |
| Australia | 6 | 4 | 2 |
| Norway | 6 | 5 | 1 |
| South Africa | 6 | 6 | 0 |

### *3.3. Publication Source*

The ten sources with the most publications can be seen in Figure 3, where the top three sources are Journal of Physics: Conference Series (111), AIP Conference Proceedings (63) and BOLEMA - Mathematics Education Bulletin (35). Based on Figure 3, it can be concluded that most sources are not articles. Thus, there is still a lot of uncharted territory in ethnomathematics.

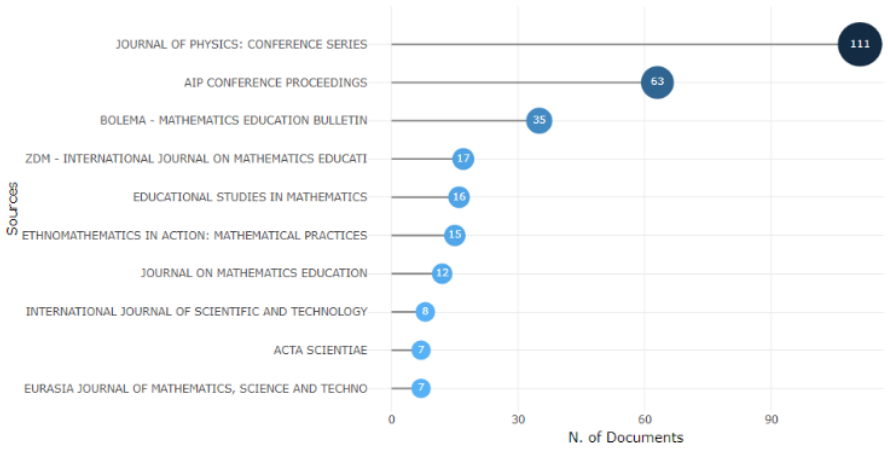



**Figure 3.** Most relevant sources.

### *3.4. Authors Publication*

D'Ambrosio U was the pioneer of the birth of ethnomathematics. That said, he's not the most relevant author. The list of the ten most relevant authors can be seen in Figure 4, where the top three authors are Rosa M (19), Orey DC (17), and D'Ambrosio U (16). Notable is also the network visualization in Figure 5, which illustrates the relationships among writers in ethnomathematics research, including co-authorships and author citation relationships, indicating common study variables or perspectives. Figure 6, is the relationship between documents, including citation relationships, where it is clear that 1985-1 are the most cited documents.

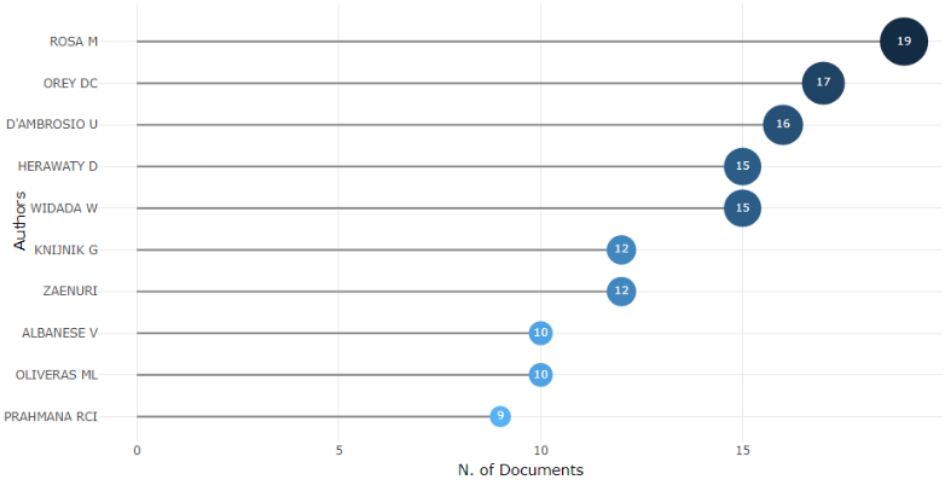



**Figure 4.** Most relevant authors.

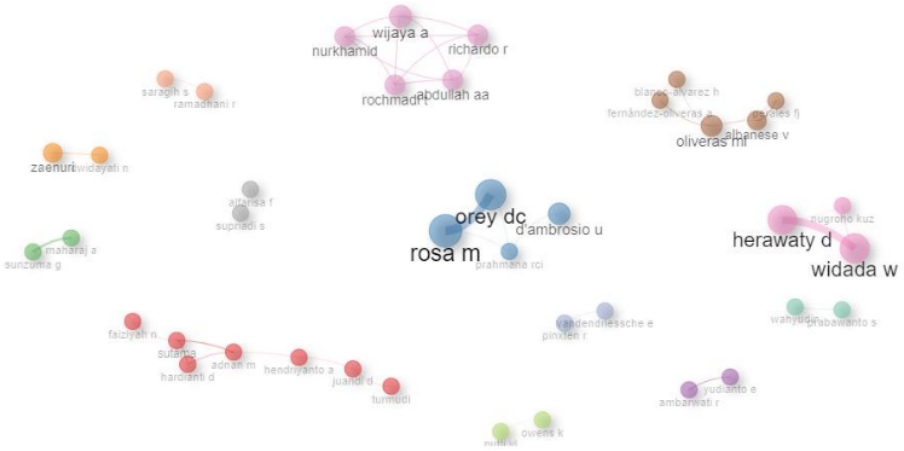



**Figure 5.** Collaboration network.

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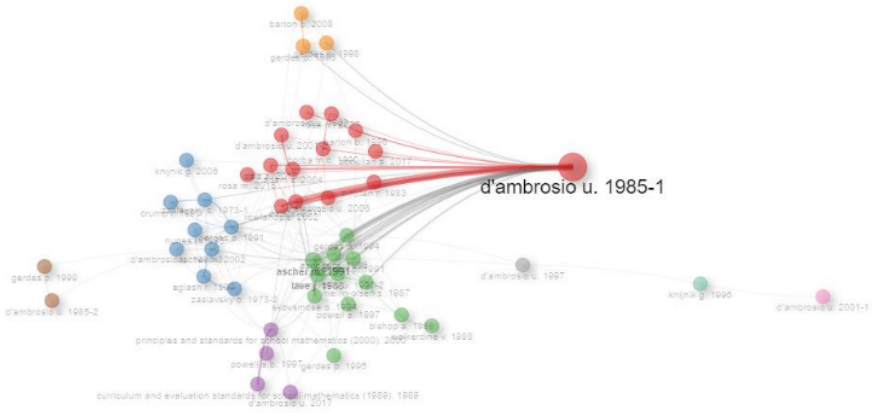



**Figure 6.** Citation network

### *3.5. Network Approach*

The first thing done in ethnomathematics research is data collection. The data collected will be analyzed and used as a basis for making decisions to overcome the problems that occur. The problems that occur are related to mathematics learning such as students, mathematics learning, mathematics teachers, and others. This can be seen in Figure 7.

The co-occurrence of keywords is shown by the lines in Figure 7, and the size of each node shows how many documents occur there—the larger the node, the more documents occur. Students are the leading keywords and have a stronger relationship with learning mathematics, mathematical concepts and physics as seen in Figure 7. In line with the opinion of Putri (2017), ethnomathematics uses broad mathematical concepts related to various mathematical activities, including grouping activities, counting, measuring, designing buildings or tools, playing, determining locations, and so on. So that ethnomathematics is very suitable for use in learning mathematics to improve students' mathematical abilities.

The visualization in Figure 7 demonstrates that in addition to identifying pertinent hotspots, it is also capable of identifying the topic of the research as well as the techniques employed for analysis and research. In Figure 7, it is divided into five colors. The blue color discusses more of the problems discussed, where the most prominent keywords are students, learning mathematics, mathematical concepts and physics. The green color talks more about problem solutions, where the most prominent keyword is education computing. The red color discusses research methods, where the most prominent keyword is data collection. The orange color discusses factors that influence research, where the most prominent keywords are teaching materials, design and primary schools. The purple color discusses research material, where the most prominent keyword is a traditional house, houses and ethnomathematics.

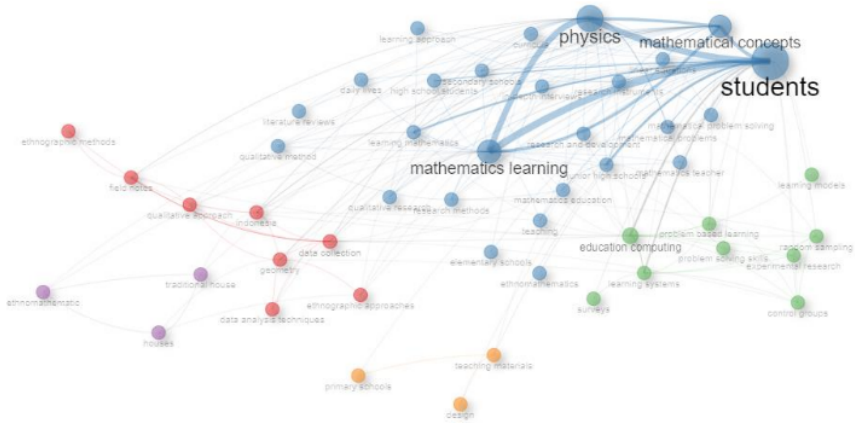



**Figure 7.** Co-occurrence network.

Furthermore, thematic areas are used to show conceptual evolution, proposing a visualization approach to graphically show the thematic evolution of the studied field (Cobo et al., 2011). There are four categories on the thematic map, namely (a) Niche themes: themes that are positioned in the upper left quadrant where development is very fast but lacks relevance for the research structure. (b) Motor themes: themes positioned in the upper right quadrant where the development is very fast and very important for the research structure. (c) Emerging or declining themes: themes positioned in the lower left quadrant are less developed and less relevant to the research structure. (d) Basic themes: themes positioned in the lower right quadrant are less developed but very important for the research structure. Both general and transversal topics are present in this sector (Lee et al., 2022). Based on the explanation of the quadrant, it can be concluded that the higher up, the more research has been done, and the more to the right, the more important and good research to be researched. The thematic map for ethnomathematics can be seen in Figure 8. It can be seen that teaching, design and thinking processes are included in the Basic themes. This indicates that teaching, design and thinking processes are still little researched. Though it is very important in this research. So this is very suitable for future ethnomathematics research novelty.

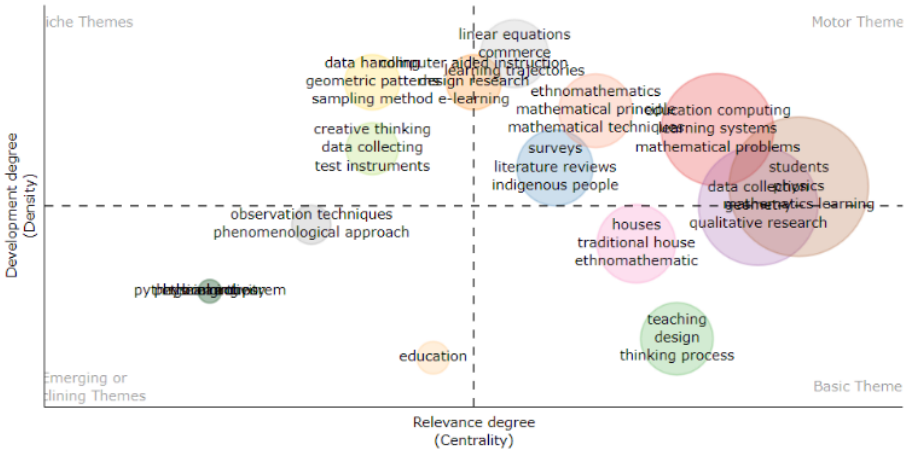



**Figure 8.** Thematic map.

Bibliometrics R has a function to see the evolution of themes in research. In this study, the evolution of themes is divided into two periods, namely 1984-2020 and 2021-2023. The division can only be up to two periods because there are still few documents, especially in the early period, while this research has only developed in the last few years. The evolution of the research can be seen in Figure 9. In the figure, it can be seen that 1984-2020 discussed the theme of data collection, control groups, mathematics education, curricula, students, geometry and Indonesia. Meanwhile, in 2021-2023 the themes discussed will change to four themes, namely students, learning systems, ethnomathematics and higher-order thinking skills. Where the students's theme is a combined theme of mathematics education, curricula, students and geometry. This is because students will not be separated from mathematics education, curricula and geometry. For learning systems, this is a combined theme of data collection and control groups. The ethnomathematics theme is a combination of students' themes, geometry and Indonesia. This is because in Indonesian culture many artifacts can be used for studying geometry, such as traditional houses. Therefore, it can be said that ethnomathematics is not only a subject for classroom instruction but also enables students to use mathematics in real-world situations because it fundamentally departs from the idea that mathematics is a human activity based on a culture that has its roots in how society reacts to mathematical phenomena (Hendriana et al., 2022). The theme of higher-order thinking skills comes from the student theme. This is because students are required to have higher-order thinking skills. But in reality, students make mistakes variety in solving HOTS-type mathematics problems (Aryani & Maulida, 2019). Researchers frequently study this subject, where they use ethnomathematics to try to raise students' HOTS. The reason is that ethnomathematics can make HOTS questions diverse (Murtadlo et al., 2023).

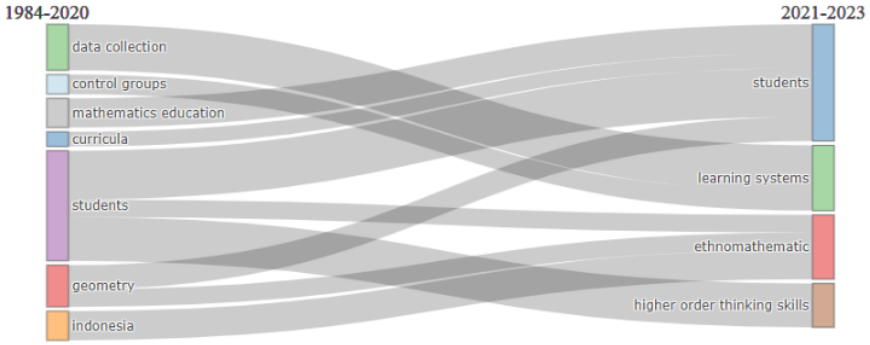



**Figure 9.** Thematic evolution.

Bibliometrics R allows the use of conceptual structure functions to perform multiple correspondence analysis (MCA) to draw the conceptual structure of the field and K-means clustering to identify groups of documents that express common concepts. The Document x Word matrix A, where the words are represented on a two-dimensional map, is subjected to MCA in co-word analysis. The distribution of the points and their relative positions along the dimension are used to interpret the results; the more closely words are represented on the map, the more similar their distribution is (Aria & Cuccurullo, 2017). This can be seen in Figure 10, where the most dots are on math concepts. This indicates that the math concept is the word that represents the most points. Whereas the mathematical abilities of students are diverse. As stated by The National Council of Teachers of Mathematics (2000), five standards of mathematical ability must be possessed by students, namely problem-solving ability, communication ability, connection ability, reasoning ability, and representation ability. This is because ethnomathematics is a branch of science that is used as a medium to understand how mathematical concepts are presented in a culture, as an effort to correlate mathematics and cultural values (Merliza, 2021). So ethnomathematics is very close to mathematical concepts.

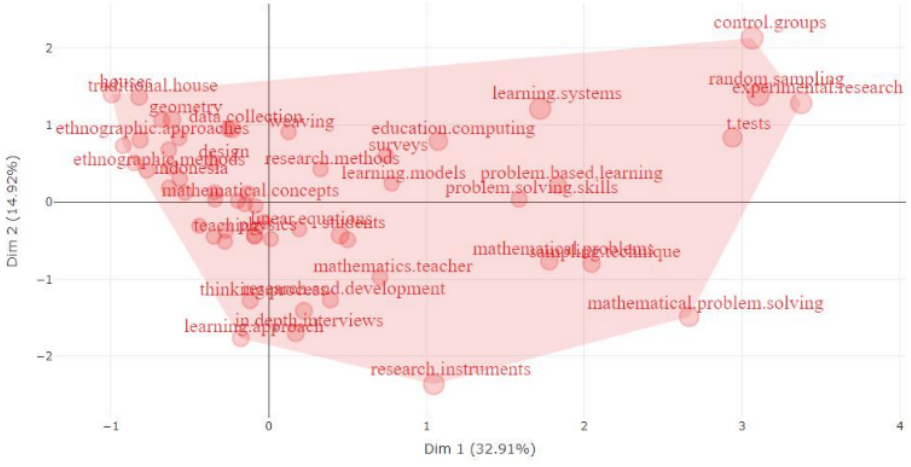



**Figure 10.** Factorial analysis.

## 4. CONCLUSION

Research on ethnomathematics has grown rapidly in recent years, especially in mathematics learning. This is because ethnomathematics has been proven to improve learning outcomes (Soebagyo et al., 2021). Additionally, ethnomathematics offers a more enjoyable and motivating learning environment, which encourages students to take an active interest in their mathematics education and is anticipated to improve their mathematical proficiency (Putra & Prasetyo, 2022). However, ethnomathematics still needs to be explored more deeply, given the lack of material, even from the main source it can be seen that most documents are not articles. The research trend in ethnomathematics is about math learning. Given that there is still little research on teaching and thought processes in ethnomathematics but it is very important, the researcher suggests that future researchers can further explore the theme. As for the characteristics of ethnomathematics research, apart from the lack of material in the form of articles, it turns out that ethnomathematics which is currently developing is a learning system in mathematics. Even ethnomathematics can improve high-order thinking skills (HOTS). This is because ethnomathematics is learning that prioritizes students' direct experience of mathematics so that students easily relate mathematics to real life and so that mathematical concepts are more easily understood and remembered by students (Ardianingsih et al., 2020). So, it is possible to use it to develop learners' mathematical skills.

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