

## Systematic literature review: Ethnomathematics research in Indonesia

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### ABSTRACT

Ethnomathematics research has developed globally, with significant contributions from various countries, especially from Indonesia. Indonesia has diversity and cultural richness that offers opportunities to strengthen its education system, especially in improving mathematical literacy by connecting learning materials with daily activities and cultural norms owned by students. This article presents a systematic literature review on ethnomathematics research in Indonesia. Ethnomathematics is the study of mathematical practices that grow and develop in the cultural context of local communities. This study aims to provide a clear picture of the development of ethnomathematics research in Indonesia, especially in terms of research year, research methodology, regional distribution, level of education, types of cultural products, and types of media used. This study uses a systematic literature review with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) rule with data sources from ERIC and Scopus. Data was collected without the criteria of the year, with the aim of finding out when ethnomathematics began to be developed in Indonesia. Next, this study differs from previous ethnomathematics systematic literature review studies, focusing on different research scopes, data sources, and objectives. The results show that ethnomathematics emerged in Indonesia in 2016. Utilising an ethnomathematics approach can improve students' mathematical literacy in Indonesia by using more comprehensive research methods (quantitative, mix-method, R&D) and focusing on examining the cultural richness of the Javanese tribes in Central Java, East Java, and DIY, which are still underresearched and through traditional cultural products. In addition, it is hoped that ethnomathematics research can be expanded to other levels of education other than junior high school and utilise digital learning media.

## INTRODUCTION

National education is based on Pancasila and the 1945 Constitution of the Republic of Indonesia, which is rooted in religious values, national culture, and responsiveness to the demands of changing times. *Program for International Student Assessment* (PISA) is one of the indicators that Indonesia needs to use to find out the condition of Indonesia's education when compared to other countries. The results of PISA 2022 show a decline in the mathematical literacy of Indonesian students. Indonesia's mathematical literacy score decreased by 13 points compared to the results of PISA 2018 (OECD, 2022b). Therefore, Indonesia must continue to work to improve students' mathematical literacy skills so that they can compete globally. One component of the assessment of mathematical literacy in the PISA study is the context. The context in the mathematical literacy

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component is a representation of mathematical problems that arise in various situations, both personal, work, social, and scientific (OECD, 2022a).

In the social context, mathematical problems are classified that focus on a person's local, national, and global community. The ethnomathematics approach can be one of the solutions to remind students of mathematical literacy. The impact of the implementation of ethnomathematics-based learning according to Soebagyo, et al. (2021): (1) Mathematics learning becomes fun and contextual learning; (2) It can reduce the impression that mathematics is complex and abstract and replace it with the impression that mathematics is fun and honest in every life activity; (3) Getting to know one's own culture and other cultures; (4) Awareness of appreciating and loving one's own culture and other cultures; (5) Part of efforts to systematically preserve culture through mathematics education in particular and education in general.

The term ethnomathematics was first used by D'Ambrosio in 1977 in a speech given at the Annual Meeting of the American Association for the Advancement of Science in Denver, in the United States. The consolidation of ethnomathematics terms culminated in a lecture entitled: Socio-cultural Bases of Mathematics Education, delivered by D'Ambrosio at the opening of the 5th International Congress of Mathematics Education (ICME-5) in Adelaide, Australia, in 1984, which officially established the Ethnomathematics Program as a field of research. In 1985, D'Ambrosio and other ethnomatheans, such as Gloria Gil, created the International Study Group on Ethnomathematics (ISGEm), which launched the Ethnomathematics Program internationally (Rosa, M., & Orey, 2014).

D'Ambrosio (1985), it reveals that ethnomathematics is the study of mathematics that takes into account cultural considerations, such as where mathematics arises, by understanding the reasoning and mathematical systems they use. Ethnomathematics studies are used to support existing mathematical knowledge. Bishop (1992), it is revealed that mathematics is a form of culture. As a form of culture, mathematics has been integrated into all aspects of people's lives. So, until now, mathematics has been inseparable from the culture and values of society. While according to Marsigit, et al. (2018), ethnomathematics is a science used to understand how mathematics is adapted from a culture. Thus, ethnomathematics in Indonesia can be understood as the study of mathematical practices that grow and develop in the cultural context of local communities. It includes an understanding of how mathematics is adapted, manifested, and used in various aspects of Indonesia's cultural life.

Ethnomathematics has been a global trend that has lasted for the past few decades (Tamur et al., 2023). Ethnomathematics research is carried out in various countries and cultural contexts around the world, namely Zimbabwe, the United Arab Emirates, Turkey, Nepal, Indonesia, and South Africa (Hendriyanto et al., 2023). In addition, other countries such as the United States, Colombia, India, and Brazil have also made significant contributions to publishing research in the field of ethnomathematics (Deda et al., 2024). Overall, it can be concluded that ethnomathematics research has developed globally, with significant contributions from various countries, especially from Indonesia. This shows that research from Indonesia dominates data collection in ethnomathematics studies (Hendriyanto et al., 2023). In addition, in the research, the most prolific writer in this field is Widada from Indonesia. Furthermore, based on data from Google Scholar and Scopus, one of the journals and proceedings from Indonesia dominates the top four most significant contributors in publishing ethnomathematics research, namely the Unnes Journal of Mathematics Education (Deda et al., 2024).

Indonesia has a diverse and rich culture that offers opportunities to strengthen its education system, especially in the field of mathematics, by connecting learning materials with daily activities and cultural norms owned by students (Turmuzi et al., 2023). The ethnomathematics approach to mathematics learning has evolved significantly over the past few decades, especially for teaching academic mathematics in schools (Machaba, & Dhlamini, 2021). Therefore, research on the trend of using ethnomathematics approaches needs to be carried out comprehensively. This aims to provide a clear picture of the development of ethnomathematics research in Indonesia, especially in mathematics learning (Hendriyanto et al., 2023).

Based on the literature review, several relevant studies conduct a systematic literature review of ethnomathematics. However, the research has not been carried out comprehensively and has some

differences from the research to be conducted. Research conducted by Hendriyanto, et al. (2023) and Deda, et al. (2024), the scope of ethnomathematics research taken is global, while this research is focused only on Indonesia. Research conducted by Turmuzi, et al (2023). The focus of the research is also in Indonesia, but the data source used comes from SINTA. Meanwhile, in this study, the data sources used came from ERIC and Scopus. Furthermore, the research conducted Turmuzi, et al. (2024), the following year, it is related to the influence of ethnomathematics learning on ability, while in this study, ethnomathematics research is general. Some aspects studied in previous studies have indeed been studied, but not comprehensively. The things that have not been explored in depth in the field of ethnomathematics in Indonesia are the distribution of study areas, the types of cultural products studied, and the types of learning media used.

Therefore, this study aims to conduct a more comprehensive systematic literature review of ethnomathematics research in Indonesia in the last decade. Using the ERIC and Scopus databases, this study will explore the trends or developments of publications in the field of ethnomathematics in a *systematic literature review* with the *Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)* rule. Based on this, this study emphasises the trend of ethnomathematics research in Indonesia with six questions, namely:

- 1) What is the number and growth of ethnomathematics research publications in Indonesia in a certain period?
- 2) What are the research methodologies used?
- 3) What is the distribution of regions in Indonesia that apply ethnomathematics the most?
- 4) What is the percentage of ethnomathematics research publications in Indonesia at various levels of education?
- 5) What are the types and percentages of each type of cultural product studied in ethnomathematics learning in Indonesia?
- 6) What are the types of media used in learning ethnomathematics in Indonesia?

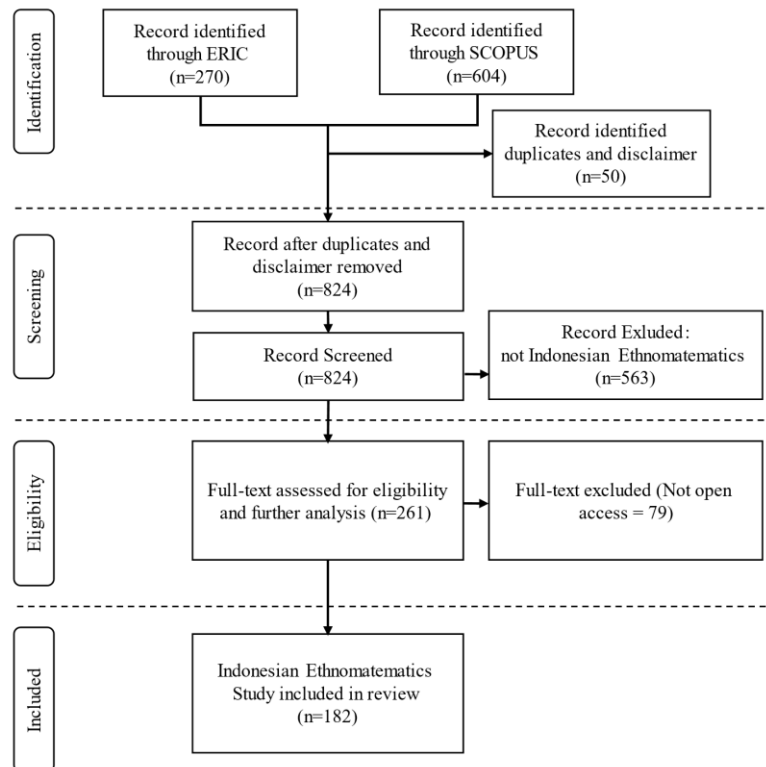
## METHODS

In this study, a systematic literature review was used with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) rule. This method offers a thorough review of the justification of ethnomathematics approaches in mathematics learning. SLR is a technique for obtaining relevant information about a subject that meets predetermined eligibility requirements (Mengist et al., 2020). The PRISMA Protocol provides a uniform and expert-evaluated approach to conducting Systematic Reviews using a checklist of best practices, which helps to ensure the quality and consistency of the review process and reporting of its results (Conde et al., 2020). Thus, PRISMA supports a Systematic Review process that can be accurately and reliably reproduced (Moher et al., 2010). *Identification, screening, eligibility, and Inclusion (data collection)* are fundamental elements of PRISMA.

*Identification* and data search were carried out on the source of the ERIC and Scopus portals on April 2, 2024, at 23.35 WIB. The search results found 874 documents (270 documents from ERIC and 604 from Scopus) with the keyword "Ethnomathematics". This search was carried out without the criteria of the year, with the aim of finding out when ethnomathematics began to be developed in Indonesia. These documents consist of scientific journal articles and conference proceedings. At this stage, 50 documents were identified as duplicates with the help of Mendeley's software.

*Screening* as many as 824 documents underwent manual screening (title and abstract). After the screening phase, 563 documents did not meet the criteria for inclusion of research because they were not ethnomathematics research in Indonesia, so 261 documents remained. *Eligibility*, at this stage, 79 documents cannot be accessed openly, so out of 261 documents, only 182 documents will enter the further analysis stage to answer research questions. *Included* articles selected for further analysis are those that meet the following inclusion requirements: 1) are listed in the ERIC or Scopus databases, 2) discuss ethnomathematics in Indonesia, and 3) are available in an open-access format.

Descriptive statistics are used to present extracted and tabulated data. The findings related to the research question are then presented in a narrative summary. The following is an example of a



**Figure 1.** PRISMA protocol flowchart



**Figure 2.** Distribution of the number of ethnomatematics publications in Indonesia in 2016-2024

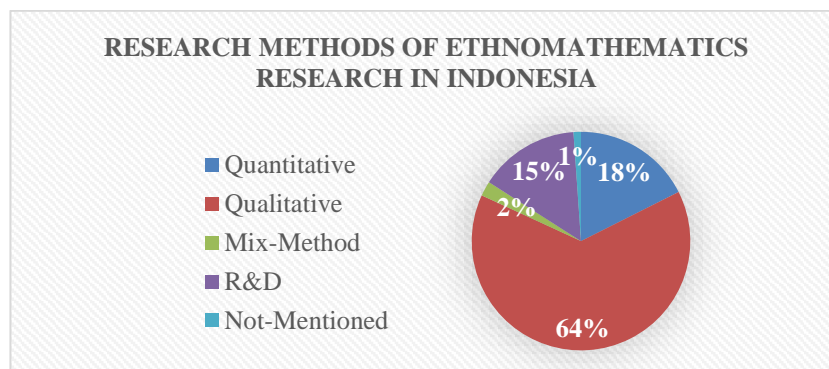
flowchart of the selection process as a source of article review in accordance with the PRISMA Protocol for Systematic Review in Figure 1.

## FINDINGS

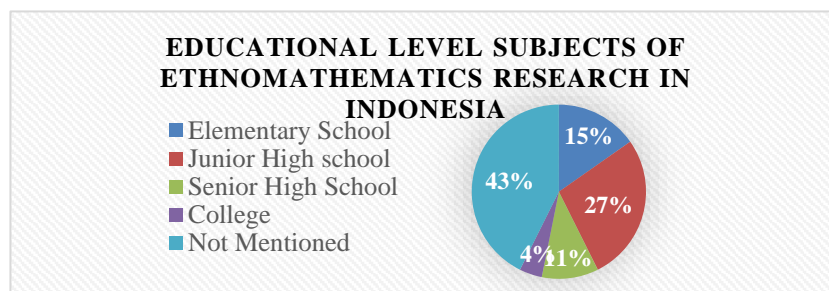
### RQ1: What is the number and growth of ethnomatematics research publications in Indonesia in a given period?

The analysis's findings indicate that there was one article in 2016, five in 2017, sixteen in 2018, forty-two in 2019, forty-three in 2020, forty-one in 2021, fifteen in 2022, fourteen in 2023, and five in 2024. The development of ethnomatematics in Indonesia started in 2016, and the most significant number of investigations took place in 2020, according to the analysis's findings. The trend of research on ethnomatematics from year to year is shown in Figure 2.

From the Figure 2, it can be seen that the study of ethnomatematics in Indonesia increased rapidly in 2019 and decreased in 2022. This is in line with the findings of Deda, et al. (2024) based



**Figure 3.** Percentage of the number of ethnomathematics research methodologies in Indonesia in 2016-2024



**Figure 4.** Percentage of ethnomathematics research in Indonesia at the education level in 2016-2024

on data from Google Scholar and Scopus, global ethnomathematics research increased in 2019 and decreased in 2022. The increase in ethnomathematics research in Indonesia in 2019 is also shown in the research of Turmuzi, et al (2023) based on data obtained from SINTA in the period 2016 – 2021.

#### **RQ2: What are the research methodologies used in ethnomathematics research in Indonesia?**

In ethnomathematics research in Indonesia, qualitative research methodologies, quantitative, mixed methods, and R&D are used. As shown in Figure 3, the number of quantitative research documents was 32 (18%), qualitative 117 documents (64%), Mix-Method as many as four documents (2%), RnD as many as 27 documents (15%), and Not-Mentioned as many as two documents (1%). It can be seen that qualitative research methods are widely used in ethnomathematics research. This is in line with the research of Turmuzi, et al (2023) based on data obtained from SINTA, qualitative methods are the most widely used methods to investigate ethnomathematics in Indonesia.

This type of research is superior and consistent with some previous analyses because it is relatively new in learning (Sharma, 2013), which has continued to experience improvement in many institutions over the past few decades (Mohajan, 2018). Sharma (2013) reports that one advantage of this method is that it can record a detailed picture of the attitudes of participants in small groups.

#### **RQ3: Where is the distribution of regions in Indonesia that apply ethnomathematics the most in a certain period?**

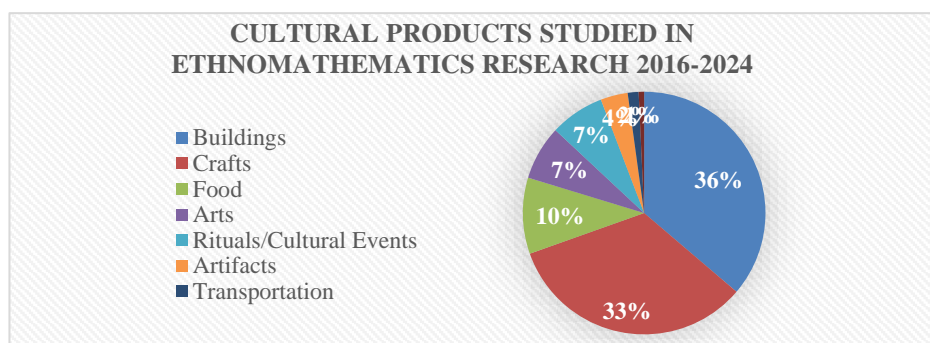
The distribution of regions in Indonesia that apply ethnomathematics the most is West Java Province, with 24 documents, followed by Central Java Province, with 23 documents, and Bengkulu, with 16 documents as shown in Table 1.

#### **RQ4: How many publications of ethnomathematics research in Indonesia at various levels of education in a certain period?**

Based on Figure 4, it is known that the target content of elementary school reaches 15% (n=29), junior high school 27% (n=52), senior high school 11% (n=20), and college 4% (n=8). Meanwhile, 43% (n=81) of the studies did not mention the targeted education level.

**Table 1**  
Distribution of regions in Indonesia in ethnomathematics research in Indonesia in 2016-2024

No	Regency	N
1	West Java	24
2	Central Java	23
3	Bengkulu	16
4	Special Region of Yogyakarta	13
5	East Java	13
6	Bali	9
7	Nanggroe Aceh Darussalam	8
8	South Sumatra	7
9	West Nusa Tenggara	7
10	North Sumatra	6
11	Lampung	5
12	South Sulawesi	5
13	Riau Islands	4
14	West Sumatera	3
15	Banten	3
16	East Nusa Tenggara	2
17	Southeast Sulawesi	2
18	West Papua	2
19	Riau	1
20	South Kalimantan	1
21	Central Kalimantan	1
22	North Sulawesi	1
23	Maluku	1
24	Nusa Tenggara (NTT and NTB)	1
25	Java Island	2
26	Central Java Border DIY	1
27	Not Mentioned	21
<b>Total documents</b>		<b>182</b>



**Figure 5.** Percentage of Cultural Products Studied in Ethnomathematics Research 2016-2024

The results of the analysis show that ethnomathematics research is most often conducted at the junior high school level, which is in line with Turmuzi, et al (2023), which shows that the subjects of ethnomathematics research articles in Indonesia at the learning unit level are primarily in junior high schools.

#### **RQ5: What are the many types of cultural products studied in ethnomathematics learning in Indonesia?**

Based on Figure 5, the cultural products studied in ethnomathematics research include buildings, traditional crafts, arts, traditional rituals/cultural events, food, artifacts, clothing, and transportation. The most studied cultural products are buildings, with a percentage of 36% (n=50).



**Table 2**  
Learning Media Integrated with Ethnomathematics

Authors	Research Focuses
(Lestari et al., <a href="#">2018</a> )	An application that can identify Balinese batik with ethnomathematics elements on it using the backpropagation method
(Rudyanto et al., <a href="#">2018</a> )	Multimedia flash with an ethnomathematics background contains the context of mathematics in Indonesian culture.
(Irawan et al., <a href="#">2019</a> )	Math-based multimedia learning using Java
(Nugroho et al., <a href="#">2019</a> )	Learning media in the form of PPBY videos (YouTube-based ethnomathematics learning tools)
(Sudirman et al., <a href="#">2020</a> )	Ethnomathematics-based Augmented Reality mobile learning
(Fadilah et al., <a href="#">2021</a> )	Interactive media, namely Lectora Inspire, is ethnomathematics-based with the orientation of HOMTS (High Order Mathematic Thinking Skills) and learning by doing.
(Muzaki et al., <a href="#">2022</a> )	Sasak ethnomathematics-based E-Module
(Fitiradhy et al., <a href="#">2023</a> )	Character Education-Based Character Education-Based Ethnomathematics Puppet android application
(Richardo et al., <a href="#">2023</a> )	Android-based Augmented Reality learning media
(Ramadhani et al., <a href="#">2023</a> )	Ethno-flipped classroom model
(Ilma & Usodo, <a href="#">2024</a> )	Ethnomathematics-based interactive multimedia

The rate of other cultural products studied includes traditional crafts of 33% (n=46), traditional food of 10% (n=14), arts of 7% (n=10), traditional rituals/cultural events of 7% (n=10), artifacts of 4% (n=5), transportation of 1% (n=2), traditional clothing of 1% (n=1).

#### **RQ6: What types of media are used in ethnomathematics learning in Indonesia?**

The use of media in ethnomathematics learning is very diverse. In this study, the learning media used were two types: conventional learning media and digital learning media.

Conventional learning media used in ethnomathematics research in Indonesia are teaching materials for student worksheets (Hirzi & Gazali, [2020](#); Husna et al., [2021](#); Mulyadin, [2019](#); Roza et al., [2020](#); Sari & Araiku, [2020](#); Setiawan et al., [2021](#); Suherman et al., [2021](#); Supriadi et al., [2019](#); Supriadi & Arisetyawan, [2020](#); Vitoria & Monawati, [2020](#); Widada, Herawaty, et al., [2019](#); Zaenuri et al., [2020](#)), module teaching materials (Kusumaningsih et al., [2020](#); Lena et al., [2019](#); Widada, Nugroho, et al., [2019](#)), student books (Risdiyanti & Prahmana, [2021](#); Widada, Nugroho, et al., [2019](#)), student project sheets (Setiawan et al., [2019](#)), and props (traditional snake and ladder game)(Utami et al., [2019](#)). In addition, there is one article that is not mentioned and does not see what type of teaching materials are used, namely research conducted by Hariastuti et al. (Hariastuti et al., [2024](#)).

Learning activities that use technology as a learning tool, such as the internet and various digital devices (mobile phones, laptops, computers, and others), are called digital learning media. In ethnomathematics research, some digital learning media are integrated with ethnomathematics, and some are not integrated with ethnomathematics (only as a tool). The digital learning media that are integrated with ethnomathematics as shown in [Table 2](#).

As for digital learning media that are not integrated with ethnomathematics, which only serve as aids in ethnomathematics learning are GeoGebra (Busrah & Pathuddin, n.d.; Nursyahidah & Albab, [2021](#); Wawan et al., [2023](#)), QR-Code (Rahayu et al., [2018](#)), google classroom (Budi Utami et al., [2019](#)), website (Ambarwati et al., [2020](#)), LMS Moodle (Andy Rudhito et al., [2020](#)), LCD projector (Roza et al., [2020](#)), drone (Widada et al., [2020](#)), and WhatsApp (Zahrona & Chaniago, [2021](#)). GeoGebra learning media is a digital learning media that is not integrated with ethnomathematics and is most widely used as an ethnomathematics learning aid.

In addition, there is also research by Mumpuni and Marsigit ([2022](#)) and Suryawan, et al. ([2023](#)) which uses digital learning media, but it is not mentioned and it is not clear whether it is integrated with ethnomathematics or not.

## DISCUSSION

Ethnomathematics research in Indonesia has begun to decline since 2020, while the results of the 2022 PISA assessment show that the mathematical literacy of Indonesian students has also decreased (OECD, 2022b). This highlights the need for continuous efforts to improve students' mathematical competencies to compete globally. The ethnomathematics approach can potentially improve students' mathematical literacy, especially in the context-based component of mathematical literacy assessment. Given Indonesia's rich culture, enhancing and conducting more ethnomathematics research is essential to increase student involvement and understanding related to mathematical literacy and preserve Indonesia's cultural heritage.

The qualitative approach is widely used in ethnomathematics research because of the characteristics of ethnomathematics itself. Ethnomathematics focuses on the practices and understanding of mathematics that are influenced by the cultural background of a particular society. Qualitative methods allow researchers to explore and understand the meanings behind mathematical practices in specific cultural contexts. However, efforts are needed to develop a more comprehensive approach so that the research results can be optimally utilised in improving mathematical literacy and artistic preservation. In this case, we can use other research methods, namely quantitative, mixed-method, and RnD.

As a country with the most ethnic, cultural, and linguistic backgrounds globally, Indonesia has great potential for developing ethnomathematics studies. Based on the results of the 2010 census of the Central Statistics Agency (Lidinillah et al., 2022), there are 1,340 ethnic groups in Indonesia, which are grouped into 31 ethnic groups. The Javanese dominate and occupy the first place, which is around 40.22% of the total population, followed by the Sundanese tribe around 15.5%, and the third and fourth are the Batak tribe (3.58%) and the Sulawesi tribe (3.22%). However, the analysis results in this study show that the distribution of ethnomathematics research is the most in the Sundanese in West Java province. Therefore, it is hoped that further research related to ethnomathematics in the Javanese tribes can be conducted across Central Java, East Java, and DI Yogyakarta. We can explore ethnomathematics in cultural products other than buildings, namely traditional crafts, food, art, traditional cultural rituals/events, artifacts, transportation, and clothing.

Based on the results of the analysis, ethnomathematics research is most often at the junior high school education level. Junior high school students are at the stage of cognitive development of concrete operations and formal operations (Mauliya, 2019). Therefore, at this stage, students have an easier time understanding mathematical concepts related to the cultural context they are familiar with. Ethnomathematics can bridge students' understanding between formal mathematics and the practice of mathematics in their culture. The mathematics curriculum at the junior high school level also has space to integrate aspects of local culture. Junior high school mathematics materials such as geometry, measurement, and patterns can be related to mathematical practices in the community's culture. However, it is hoped that this ethnomathematics research can expand its reach to other levels of education (elementary, high school, tertiary) to better understand the potential for cultural integration in mathematics learning.

In ethnomathematics learning, we can take advantage of learning media (Pulungan & Rakhmawati, 2022). In the findings Muhammad, et al. (Muhammad et al., 2023), learning media has been the third most used in ethnomathematics research in mathematics learning in Indonesia from 2017 to 2022. There are two essential roles of learning media in the learning process: 1) Media as a teaching aid, 2) Media as a learning resource (Pulungan & Rakhmawati, 2022). Using media while learning can foster interest and motivation, and can also improve the quality of education, and facilitate the delivery of information (Baiduri et al., 2019). Learning media has been proven to improve learning outcomes and student learning achievement (Safitri & Koeswanti, 2021). In addition to motivating and increasing students' interest in learning, the benefits of learning media also facilitate the delivery of material, create a fun learning atmosphere, shorten learning time, improve learning quality, have a more flexible learning process, and increase student learning experience (Hapsari & Fahmi, 2021).

One of the learning media that we can use is digital learning media. Like learning media, digital learning media also aims to facilitate teaching and learning activities. Therefore, using digital



learning media is expected to improve the quality of the learning process and outcomes (Batubara, 2021). According to Kaiful Umam, digital media can present learning materials contextually, excitingly, and interactively through audio and visuals (Fatimah, 2021). The benefits of digital learning media include increasing students' interest in learning, clarifying information, eliminating space and time limitations, and fostering student learning independence (Octalia et al., 2021). This media will make the learning process more fun and not dull. It will become the right choice for innovative teachers and help students solve the ambiguity and complexity of the material. Through digital learning media, students can also create a more profound understanding than just learning from words or pictures because the press can display images and sounds (audiovisual), increasing learning activities in the classroom, and learning will be more meaningful.

## CONCLUSION

Based on the results of the analysis, it can be concluded that a) the development of ethnomathematics in Indonesia began in 2016, with the most significant number of studies occurring in 2020 and increasing rapidly in 2019 and decreasing in 2022; b) the type of research methodology that is widely carried out is qualitative research as much as 64%; c) the distribution of the most ethnomathematics research was found in West Java province as many as 24 documents; d) ethnomathematics research is most at the junior high school education level; e) the most studied cultural products are buildings; f) The learning media used in ethnomathematics research consists of two types, namely conventional learning media and digital learning media, with some digital learning media integrated with ethnomathematics and some not integrated with ethnomathematics (only as a tool).

Meanwhile, we can use the ethnomathematics approach to improve students' mathematical literacy. The research methods can use more comprehensive methods such as quantitative methods, mix-methods, and R&D. Indonesia has great potential for the development of ethnomathematics studies because of its cultural richness, especially in the Javanese tribe, so that we can take advantage of the cultural richness of the Javanese tribe in Central Java, East Java, and DI Yogyakarta as a source of ethnomathematics learning that is still under-researched. Cultural products that can be studied besides buildings include traditional crafts, food, arts, and traditional rituals/cultural events. In addition, it is hoped that this ethnomathematics research can expand its reach to other levels of education besides junior high schools (elementary, high school, and university) and utilise digital learning media in ethnomathematics learning.

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## AUTHOR'S DECLARATION

### Authors' contributions

All authors contributed to the conception and design of the study. RDLI, SS: main idea, conceptualization, and writing of the manuscript, BU: data analysis, review and validation, FN: collecting data and reporting.

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### Availability of data and materials

All data are available from the authors.

**Competing interests**

The authors declare that the publishing of this paper does not involve any conflicts of interest. This work has never been published or offered for publication elsewhere, and it is completely original.

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