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Development of the Ethnomathematics-Based Mathematics Teaching Materials to Improve Conceptual Understanding of Madrasah Ibtidaiyah Students in Lombok, Indonesia

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Abstract

Mathematics learning requires real situations that students often face. Using the context around students can make mathematics learning easy for students to understand. This research aims to develop ethnomathematics-based mathematics teaching materials to improve the conceptual understanding of Madrasah Ibtidaiyah/Islamic elementary school students in Lombok, Indonesia, that are feasible and practical. This research is research and development with the development of a 4D model consisting of defining, designing, developing, and disseminating. The resulting product is ethnomathematics-based mathematics teaching materials for grade IV students of Madrasah Ibtidaiyah in Lombok, Indonesia. The results of the development of teaching materials at the level of feasibility from the validation of material experts obtained a score of 39.5 with a feasible category, cultural experts obtained a score of 19.5 with a feasible category, and media experts obtained a score of 40.8 with a very feasible category. From the results of the product trial, it is known that the resulting product falls into the practical criteria, namely from student responses obtaining an assessment of 91% with a very positive category. The implications of the research are expected to increase the mathematical conceptual understanding of madrasah ibtidaiyah students to strengthen national cultural identity.

Keywords: *ethnomathematics, sasak culture, teaching materials, madrasah ibtidaiyah students.*

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Abstrak

Pembelajaran matematika memerlukan situasi nyata yang sering dihadapi oleh siswa. Dengan menggunakan konteks yang ada di sekitar siswa, membuat pembelajaran matematika mudah dipahami oleh siswa. Penelitian ini bertujuan untuk mengembangkan bahan ajar matematika berbasis etnomatematika untuk meningkatkan pemahaman konsep siswa Madrasah Ibtidaiyah di Lombok, Indonesia yang layak dan praktis. Penelitian ini merupakan penelitian dan pengembangan dengan pengembangan model 4D, terdiri atas *define* (pendefinisian), *design* (perancangan), *develop* (pengembangan), dan *disseminate* (penyebaran). Produk yang dihasilkan adalah bahan ajar matematika berbasis etnomatematika untuk siswa kelas IV Madrasah Ibtidaiyah di Lombok, Indonesia. Hasil pengembangan bahan ajar pada tingkat kelayakan dari validasi ahli materi diperoleh skor 39,5 dengan kategori layak, dari ahli budaya diperoleh skor 19,5 dengan kategori layak, dan dari ahli media diperoleh skor 40,8 dengan kategori sangat layak. Dari hasil uji coba produk diketahui bahwa produk yang dihasilkan masuk dalam kriteria praktis, yaitu dari respon siswa memperoleh penilaian 91% dengan kategori sangat posititf. Implikasi penelitian ini diharapkan dapat meningkatkan pemahaman konsep matematika siswa madrasah ibtidaiyah, sehingga memperkuat jati diri budaya bangsa.

Kata kunci: *etnomatematika, budaya sasak, bahan ajar, siswa madrasah ibtidaiyah.*

INTRODUCTION

Currently, Indonesia is working on improving and empowering the welfare of the community through its program, namely the Sustainable Development Goals (SDGs). One of the focuses of the SDGs program is the field of Education, namely by improving the quality of Education to achieve sustainable development. Through the SDGs, it is hoped that the community will be able to overcome the challenges of the world of education and produce a superior, creative, innovative, and critical generation (Ilma et al., 2024).

Education and culture are inseparable parts. Cultural development and preservation is part of the educational process. Education and culture play a very important role in the development of national values and influence the development of character based on noble cultural values (Harahap & Mujib, 2022).

In Indonesia, cultural diversity is a wealth in itself that needs to be appreciated and integrated into the education system. One area that has a rich cultural diversity is the island of Lombok, which is inhabited by the Sasak tribe who maintain their cultural heritage. Education is an important means of understanding the younger generation about this diversity, and mathematics as part of the educational curriculum has great potential to be integrated with local culture. Research Fauzi and Gazali (2022) shows that the character of the Sasak community's customary housing based on sikut awak uses a mathematical model in its calculations so that it can be used in mathematics learning.

Culture has a significant influence on how individuals understand and approach mathematical concepts. One of the innovations in mathematics education in elementary schools is by providing culture-based mathematics teaching materials. Mathematics learning by involving elements or concepts of regional culture is called ethnomathematics (Nugraha et al., 2020). The trend of publication of ethnomathematical research in Indonesia has increased more than in previous years, with the highest number reached in 2021 (Turmuzi et al., 2023).

Research related to mathematics in Lombok culture has been carried out by several researchers such as Supiyati et al. (2019) which states that there is a sensitivity to the use of numbers practiced by the ancestors of Sasak since ancient times in making measurements using their anthropometric skills (ethnomathematics).

School mathematics is closely related to the culture in which mathematics is taught because mathematics cannot be separated from the historical context, social context, and worldview of students (Gwekwerere, 2016). Elementary school mathematics learning includes concepts about geometry. Ethnomathematics helps understanding concepts through cultural knowledge, so ethnomathematics must recognize that cultural factors are as important as mathematical factors (Trinick et al., 2017). If elementary school teachers understand this, then the need to make them aware of integrating ethnomathematics into mathematics teaching (Umbara, 2024).

Ethnomathematics-based teaching materials in elementary schools can be interpreted as special materials prepared by teachers when carrying out mathematics learning process activities and associated with culture, either in the form or habits that are often encountered by students in the classroom (Muhammad & Novitasari, 2019). Development research related to ethnomathematics in teaching materials has been carried out by several researchers, for example (Sutarto et al., 2022). The application of ethnomathematics to culture in mathematics education can be achieved through the use of teaching materials which are one of the learning resources. Research Lidinillah et al. (2022) stated that there are various kinds of studies on the integration of ethnomathematics into the curriculum.

However, in the development of mathematics teaching materials in elementary schools, there is often a lack of local cultural involvement. It is difficult to find in mathematics textbooks in Indonesia that place the cultural context as a starting point (Prahmana et al., 2021). Research by Aswasulasikin et al. (2020) that the local culture of Sasak tends to be marginalized and some are even extinct and unknown to the next generation. Culture local Sasak almost extinct due to student elementary schools in the district East Lombok is not knows or understand it. The teaching materials that will be developed in this study are related to geometry material (Sunzuma & Maharaj, 2020). recommend that teachers find ways to use cultural examples that accommodate all learners from different cultural backgrounds. Therefore, this research aims to fill this gap by developing ethnomathematics teaching materials that integrate Sasak culture in mathematics learning in elementary schools in Lombok.

The development of this teaching material is expected to increase students' understanding of mathematics to strengthen cultural identity. By understanding cultural and religious contexts, mathematics learning can become more relevant, engaging, and applicable to students' daily lives. Based on the above thoughts, the researcher is interested in conducting research related to the development of ethnomathematics-based mathematics teaching materials for students of Madrasah Ibtidaiyah in Lombok. The approach in developing this teaching material is not only based on the aspect of transferring mathematical knowledge, but also includes character building and appreciation of local culture, namely the culture of the Lombok community among students. This study also utilizes participatory methods by involving teachers, students, and local community leaders, so that the teaching materials produced have high relevance to the needs of students at Madrasah Ibtidaiyah. Thus, this

study presents a unique contribution both in developing a locally-based teaching material and in creating contextual and meaningful learning experiences for students.

METHODS

The method used in this study is research and development with the development of a 4D model consisting of 4 main stages, namely Define (definition), design (planning), develop (development), and disseminate (spread) (Thiagarajan et al., 1974). Phase Define Researchers analyze things that are needed in the learning process and collect information related to the product ethnomathematics-based mathematics teaching materials for Madrasah Ibtidaiyah students by integrating Sasak culture in Lombok. Phase design in the form of determining the design to be made includes selecting materials, making the initial design, and preparing the manufacturing budget ethnomathematics-based mathematics teaching materials for Madrasah Ibtidaiyah//Islamic elementary school (MI) students by integrating Sasak culture in Lombok. At the develop produce ethnomathematics-based mathematics teaching materials for Madrasah Ibtidaiyah students by integrating Sasak culture in Lombok. At this stage, the product is tested for feasibility by validators or experts and tested for practicality through student responses as users. Validators include media experts, content/material experts, and cultural experts. Finally in the stage disseminate is the dissemination of ethnomathematics-based mathematics teaching materials for Madrasah Ibtidaiyah students by integrating Sasak culture in Lombok that has been produced after revising the suggestions from validators at the development stage.

Grade IV students of MI Nurul Islam Sekarbela Mataram for the 2023/2024 school year. The stages of developing ethnomathematics-based mathematics teaching materials for Madrasah Ibtidaiyah students by integrating the Sasak culture in Lombok include (1) the observation stage and the collection of initial information data, (2) the planning stage, (3) the preparation stage of teaching materials, (4) the expert validation test stage, (5) the product revision stage, and (6) the dissemination and implementation stage.

The data collection technique in this study was carried out by distributing questionnaires. The dissemination of the questionnaire aims to obtain data that is used to test the feasibility and practicality of ethnomathematics-based mathematics teaching materials for Madrasah Ibtidaiyah students by integrating the Sasak culture in Lombok. The dissemination of the eligibility questionnaire was aimed at three validators: media members, content/material experts, and cultural experts. Meanwhile, the distribution of the practicality questionnaire is aimed at fourth grade students of MI Nurul Islam Sekarbela Mataram for the 2023/2024 school year. The assessment aspects for media experts are goal, appropriateness, practicality and flexibility, and target grouping. The assessment aspects for material experts are goal, appropriateness, technical quality, and practicality and flexibility. The assessment aspects for cultural experts are the suitability of the content of the teaching materials with Lombok culture. The assessment aspects for student responses are goal, appropriateness, technical quality, practicality, innovation, and proactiveness.

Data obtained from experts and students used the Likert scale as a reference for the preparation of the questionnaire with the Likert scale criteria used with five intervals, as follows.

Table 1. Scaling Rules

Score	Information
5	Excellent
4	Good
3	Enough
2	Less
1	Very Less

After the data is given, the score is then determined to determine the level of feasibility (from expert validation) and the level of practicality (from student responses). Eligibility criteria are used to see how large the level of feasibility of the teaching materials produced. The eligibility criteria are interpreted with the ideal assessment criteria with the following formula:

Table 2. Ideal Assessment Criteria

No.	Score Range	Category
1.	$X > M_i + 1{,}8\ Sb_i$	Excellent
2.	$M_i + 0{,}6\ Sb_i < X \leq M_i + 1{,}8\ SB_i$	Good
3.	$M_i - 0{,}6\ Sb_i < X \leq M_i + 0{,}8\ SB_i$	Enough
4.	$M_i - 1{,}8\ Sb_i < X \leq M_i - 0{,}6\ SB_i$	Less
5.	$X \leq M_i - 1{,}8\ Sb_i$	Very Less

Information:
X : Actual score (empirical)
Mi : Mean ideal
SBi : Ideal Standard Deviation
The percentage value of feasibility and practicality is calculated by the formula:

$$Presentase\ kelayakan\ = \frac{\sum skor\ yang\ hasil\ observasi}{\sum skor\ maksimal} \times 100\%$$

The feasibility percentage value is then interpreted as a practicality criterion. The criteria for validation are used to see how much level of practicality the teaching materials produced. Practicality criteria are interpreted according to (Riduwan & Sunarto, 2013) with the following formula:

Table 3. Practicality Interpretation Criteria

No.	Rating Nilai	Category
1.	81% - 100%	Very Practical
2.	61% - 80%	Practical
3.	41% - 60%	Enough
4.	21% - 40%	Practical
5.	0% - 20%	Very Practical

RESULTS AND DISCUSSION

The result of this research and development is ethnomathematics-based mathematics teaching materials for students of Madrasah Ibtidaiyah in Lombok. The following is an explanation of the development process that has been carried out:

1. Define

   The purpose at the define stage is to adjust the development conditions where each media has a different needs analysis and aims to determine the product to be used. Determination of the products used through needs analysis. The needs analysis at this stage goes through four main steps, namely:

   a. Front-End Analysis

      The first step taken is to conduct an initial analysis to find out the basis of the problem being researched. Before determining the product developed, the researcher conducts a literature study to analyze the needs. Literature studies include studies on ethnomathematics, Lombok culture, and grade IV flat building materials. Ethnomathematical approach used in teaching materials (Trisnawati, 2022). There are several mathematical concepts related to the ethnomathematics of the local wisdom of Sasak Culture (Turmuzi, et al., 2022).

   b. Student Analysis (Learner Analysis)

      The character of students is important to know because the success of the learning process depends on the needs of the students (Pudji Hartono & Bagus Riyandiarto, 2021). The student's analysis was used to explore his knowledge of Lombok culture and the student's geometry ability. This analysis uses a method of analyzing student needs by conducting interviews with fourth grade students of MI Nurul Islam Sekarbela Mataram for the 2023/2024 school year and making observations during mathematics learning activities in the classroom. Based on the interview, the results were obtained that students had difficulty in calculating and understanding the elements of flat buildings, so that their understanding of the concept of the area and circumference of flat buildings was less developed. In addition, students do not know much about Lombok culture. Seeing these conditions, mathematics teaching materials based on Sasak Cultural ethnomathematics were developed.

   c. Concept Analysis

      Conceptual analysis is a step that aims to apply the principles or concepts used in the development of materials as a tool, especially to achieve basic competencies and core learning in the research carried out (Lestari, 2018). At this stage of analysis, it is carried out by identifying, designing, and compiling mathematics teaching materials based on Sasak Culture ethnomathematics.

   d. Specifying Instructionalobjectives

      The analysis of the formulation of learning objectives is a limitation of the design of mathematics teaching materials based on Sasak Cultural ethnomathematics. The materials developed are the properties, circumference, area of Rectangles and Triangles and the application of the concept in daily life. Learning mathematics in elementary school using cultural wealth can make the learning process more meaningful (Mauluah & Putra, 2021; Mauluah & Marsigit, 2019).

2. Design

The next stage is design, at this stage the researcher begins to design the design of mathematics teaching materials based on Sasak Culture ethnomathematics. The stages that will be carried out by the researcher are as follows:

a. Product Planning

1) Formulating Teaching Materials

At the stage of formulating teaching materials, researchers write the material in *Microsoft word*. The material developed was 4 activities, namely:

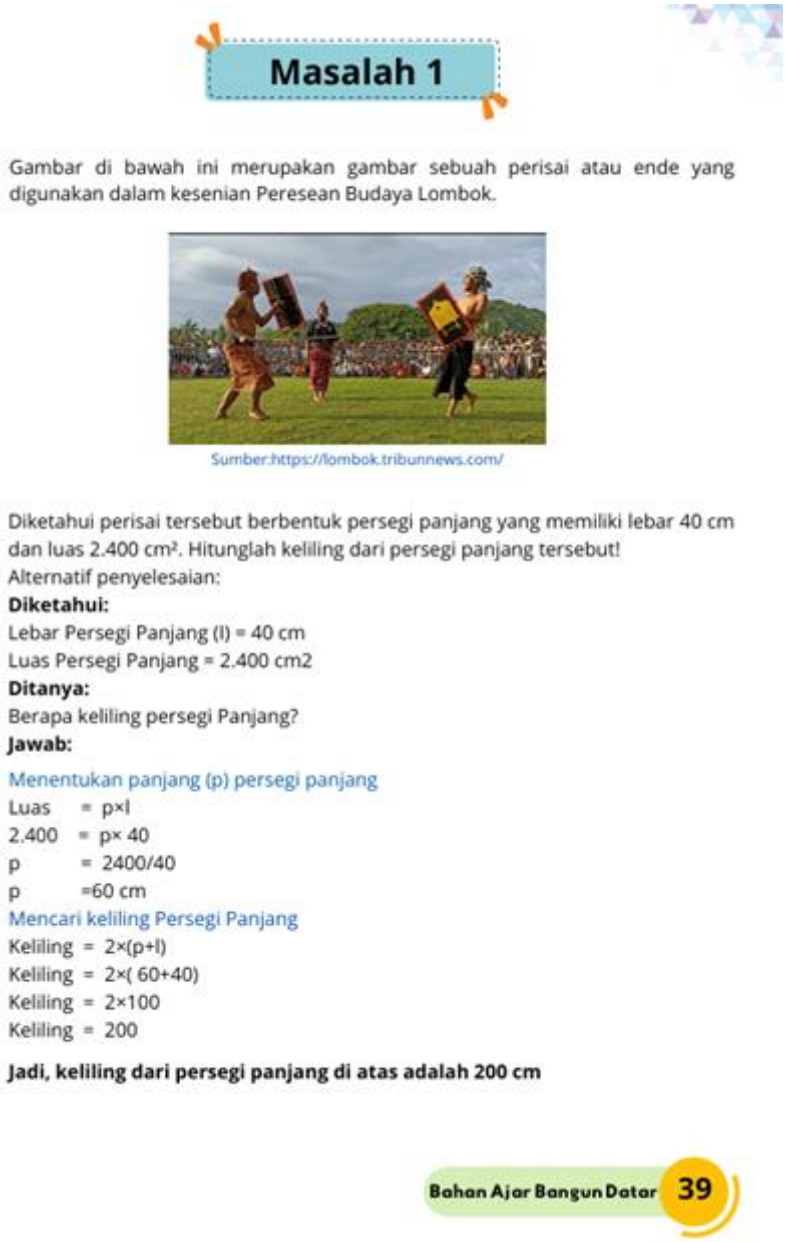
- Activity 1: identify the properties of quadrilaterals and triangles
- Activity 2: Determine the circumference of the rectangle and triangle.
- Activity 3: determine the area of a quadrilateral and a triangle
- Activity 4: application of the concept of circumference and area of squares and triangles with ethnomathematical nuances of Lombok culture.

2) Design of mathematics teaching materials based on ethnomathematics of Sasak Culture

In the design of mathematics teaching materials based on ethnomathematics of Sasak Culture using *the Canva* application.

Figure 1. Teaching Materials Design

The math problems given in learning should be related to the context of daily life (Murtafiah et al., 2022). The following is the design of the presentation of mathematical problems.



Masalah 1

Gambar di bawah ini merupakan gambar sebuah perisai atau ende yang digunakan dalam kesenian Peresean Budaya Lombok.

Sumber:https://lombok.tribunnews.com/

Diketahui perisai tersebut berbentuk persegi panjang yang memiliki lebar 40 cm dan luas 2.400 cm². Hitunglah keliling dari persegi panjang tersebut!
Alternatif penyelesaian:
Diketahui:
Lebar Persegi Panjang (l) = 40 cm
Luas Persegi Panjang = 2.400 cm2
Ditanya:
Berapa keliling persegi Panjang?
Jawab:
Menentukan panjang (p) persegi panjang
Luas = p×l
2.400 = p× 40
p = 2400/40
p =60 cm
Mencari keliling Persegi Panjang
Keliling = 2×(p+l)
Keliling = 2×(60+40)
Keliling = 2×100
Keliling = 200

Jadi, keliling dari persegi panjang di atas adalah 200 cm

Bahan Ajar Bangun Datar 39

Figure 2. Problem Presentation Design

b. Instrument preparation

The preparation of research instruments is carried out by compiling a questionnaire. The questionnaire is in the form of several statement columns by filling in a Checklist (√) mark for each statement. This research instrument consists of four types of questionnaires, where three types of questionnaires will be validated by experts including media experts, content/material experts, cultural experts, and one response questionnaire for students.

The validation questionnaire for material experts contains 11 statements consisting of 4 aspects of evaluation, namely purpose, accuracy, technical quality, and practicality and flexibility. The validation questionnaire for media experts contains 12 statements consisting of 4 indicators, namely goal, appropriateness, practicality and flexibility, and target grouping. The validation questionnaire for cultural experts contains 6 statements with the indicator of content quality. The student response

questionnaire contains 10 questions consisting of 6 indicators, namely purpose, appropriateness, technical quality, practicality, innovation, and proactiveness.

3. Development

The development stage or can be called tahaap development aims to produce media that has gone through the advice and validation of experts so that the media can be declared feasible and can be tested at the next stage (Fidinna and Istiqomah, 2022). After the creation of the design of mathematics teaching materials based on ethnomathematics of Sasak Culture, it was continued with the expert validation stage by material expert validators, media expert validators, and cultural expert validators. This stage is carried out to determine the level of feasibility of the media being developed.

a. Material Expert Validation Results

The validation of material experts is validated by two material expert validators, namely Mathematics Education lecturers of IAIN Kudus. The average result of the overall assessment of the subject matter expert obtained a score of 39.5, so the validation in terms of material, the design of mathematics teaching materials based on ethnomathematics of Sasak Culture based on the Sukarjo conversion table is included in the "Feasible" category.

b. Results of Cultural Expert Validation

The validation of cultural experts is carried out by two cultural expert validators. The average result of the overall assessment of cultural experts was obtained with a score of 19.5, so the validation of cultural experts, the design of mathematics teaching materials based on ethnomathematics of Sasak Culture based on the Sukarjo conversion table is included in the "Feasible" category.

c. Media Expert Validation Results

The validation of media experts was validated by two media expert validators, namely lecturers of Madrasah Ibtidaiyah Teacher Education, IAIN Kudus. The average result of the overall assessment of material experts obtained a score of 40.8, so the validation from media experts, the design of mathematics teaching materials based on Sasak Cultural ethnomathematics based on the Sukarjo conversion table is included in the "Very Feasible" category.

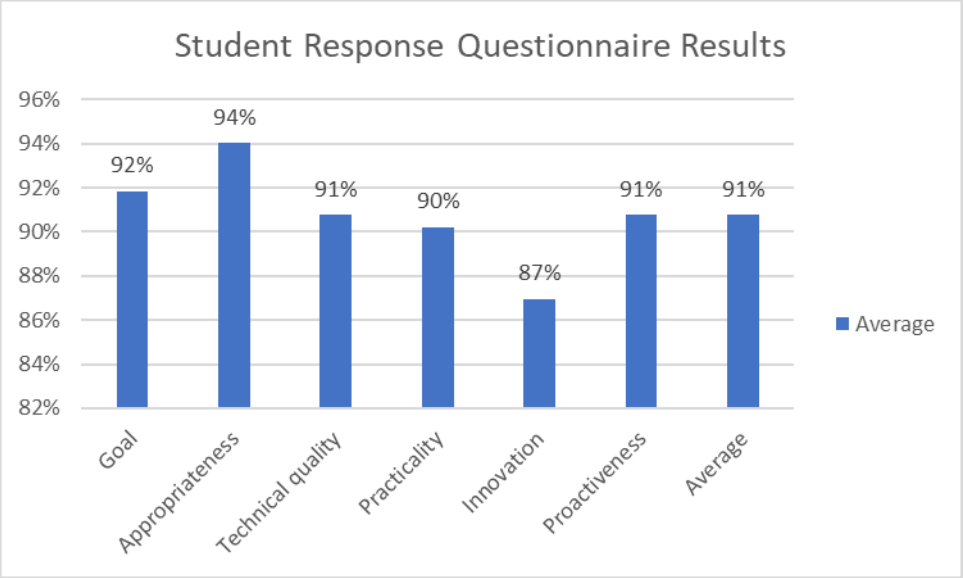
d. Limited Scale Field Trial

The product trial was carried out after the design of Sasak Culture's ethnomathematics-based mathematics teaching materials received validation from material expert validators, cultural expert validators, and media validators who had received criticism and suggestions from experts so that they came to the conclusion that the media was worthy of testing. This trial was carried out on a limited scale, namely 5 grade IV students of MI Nurul Islam Sekarbela Mataram for the 2023/2024 school year which was taken using *a simple sampling method*. Based on the data that has been obtained, it can be concluded that the response of students on a limited scale to ethnomathematics-based mathematics teaching materials of Sasak Culture was positively responded to with an average percentage of 89% obtained in the very positive category.

4. Dissemination

After the development stage is completed, proceed to the deployment stage (*Disseminaiton)* which is the last stage of the research (Lestari, 2018). This research was only carried out with limited dissemination, namely by disseminating mathematics teaching materials based on Sasak Culture ethnomathematics.

Furthermore, it measures the practicality of using mathematics teaching materials based on Sasak Cultural ethnomathematics. The aspect explored in measuring this practicality is the same as the student response questionnaire used during the limited-scale trial. The following are the results of the student response questionnaire:



Graph 1. Recap of Student Response Questionnaire Results

Based on the results of the student response questionnaire, there are 6 indicators that are assessed. The results of the assessment showed that several indicators had the same average percentage. The highest value lies in the Appropriateness indicator getting an average percentage of 94%. In last place is the Innovation indicator which gets an average percentage of 87%. Based on the data that has been obtained, it can be concluded that the response of students to the Sasak Culture ethnomathematics-based mathematics teaching materials was positively responded to with an average percentage of 91% obtained in the very positive category.

The development of ethnomathematics teaching materials in Lombok aims to integrate local culture into mathematics learning, especially in flat building materials. Flat buildings are part of geometry materials in mathematics. Research Hendriyanto et al. (2021) identifying, describing and analyzing the geometric thinking skills of students in the field of analytical geometry on ethnomathematics-based circle and ellipse material content based on the characteristics of van Hiele's geometric thinking skills. In research Sunzuma and Maharaj (2022), teachers' views on geometry are classified according to the cultural, social, and practical dimensions of ethnomathematics. Ethnomatematics on geometric materials is widely carried out by several researchers, for example Richardo et al. (2023) development of android-based AR learning media with the context of Yogyakarta ethnomathematics. Research Zuliana et al. (2023) there is a relationship between Javanese architecture and

ornaments of Indonesian Traditional Mosques with geometric patterns (cuboids, cylinders), symmetrical patterns, and geometric transformations (rotation) which are used as learning resources and starting points for the mathematics learning process. Students can identify and describe the form of transformation of the Sam Poo Kong building (Aisyah et al., 2021).

School education is important to focus on appreciating local culture, which strengthens ethnic relations in the quest for equality and builds artistic-cultural salvation (Silva et al., 2022). The ethnomathematical approach is expected to improve students' understanding of mathematical concepts while appreciating their cultural heritage. Ethnomathematics as a culturally responsive teaching strategy will reveal new dynamics in socio-cultural deficit thinking (Meeran & Van Wyk, 2022). The development process involves the study of literature that examines Lombok culture, especially related to the form of buildings, tools, and motifs that are often used in daily life. Collaboration with Cultural Experts is needed to ensure the accuracy and relevance of the content developed. Preparing a learning module that contains information about flat buildings taken from Lombok cultural elements, such as the shape of traditional houses and batik motifs.

After development, teaching materials were tested in several schools in Lombok. Feedback from students showed that students had a higher interest in learning mathematics when the material was presented with a familiar cultural context, students more easily understood the concept of flat building when it was associated with objects and motifs they saw daily, and practical activity encouraged students to more actively participate and work together in groups. Several studies show the role of ethnomathematics in learning. In line with research Harahap and Nasution (2024), students' responses to ethnomathematics teaching materials with a contextual approach to improve students' mathematical communication skills showed that they received a positive response of 86.2%. The ethnomathematics-based curriculum helps students demonstrate a consistent mathematical process as they reason, solve problems, communicate ideas, and choose appropriate representations through the development of everyday mathematical practices (Rosa & Orey, 2021). Mathematical problem solving abilities can develop at a higher level by using contextual learning and ethnomathematics (Nur et al., 2020). There is an increase in the mathematical skills of prospective elementary school teachers in mathematics learning through the application of a hybrid learning model based on ethnomathematics with a cybergogy approach (Fendrik et al., 2024).

The development of ethnomathematics teaching materials with a focus on the flat building of Lombok culture has shown positive results. The integration of local cultures not only enriches the learning experience of students but also provides relevant context for understanding mathematical concepts. In line with research Albanese and Perales (2020), ethnomathematics learning becomes more interesting and meaningful for students. Realistic mathematics learning with an ethnomathematical approach can be a vehicle for students to simplify the concept of function to be more meaningful (Herawaty et al., 2020). It is hoped that this teaching material can be applied more widely and become a model in the development of a culture-based curriculum in Indonesia.

CONCLUSION

The results of the research and development show that the ethnomathematics-based mathematics teaching materials of Sasak culture for students of Madrasah Ibtidaiyah in Lombok have achieved a good level of feasibility with a feasible category, as validated by experts. The implementation of these teaching materials in the learning process also shows a high level of practicality, proving that these teaching materials support student involvement in understanding mathematical concepts through the context of local culture. By integrating elements of Sasak culture, such as traditions, arts, and daily life patterns, these teaching materials not only become a means of learning mathematics that is more contextual and meaningful, but also contribute to preserving local wisdom. Therefore, the development of these teaching materials is expected to be a relevant and useful model for achieving educational goals based on local culture, especially in the Madrasah Ibtidaiyah environment.

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