



Ethnomathematics Learning Module for the Sasak Tribe with a Deep Learning Approach for Understanding Geometry

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Received: January 2026; Revised: February 2026; Published: April 2026

Abstract

This study aims to develop a mathematics teaching module based on the ethnomathematics of the Sasak tribe, incorporating deep learning principles to enhance students' understanding of geometry. The research was conducted at MTs Muhammadiyah Selong with the involvement of 17 seventh-grade students. The module development followed the 4D model, which includes the stages of Define, Design, Develop, and Disseminate. The Define stage focused on gathering information, setting learning objectives, determining the topics, and identifying the target audience and content through data collection from observations and interviews. The Design stage involved selecting the module design, format, and structure. The Develop stage included the creation and editing of the module, followed by expert validation for content and media, and a pilot test to assess its functionality. The Disseminate stage included distributing the validated module to the students for further implementation. The results of the module validation from both media and content experts showed that the module was highly valid, with an average score of 82.69% for content and 82% for media design. A small-scale trial with teachers and students indicated that the module was very practical, with an average score of 84% from teachers and 81% from students. The effectiveness of the module was tested using a paired sample T-test, which revealed a significant improvement in students' geometric understanding ($p < 0.05$). Furthermore, the N-gain analysis showed a moderate improvement in the students' performance. This research highlights the potential of integrating deep learning principles with local ethnomathematics in creating a meaningful, contextual, and effective learning experience for students, particularly in the understanding of geometry.

Keywords: Deep learning; Ethnomathematics; Sasak tribe; Geometry; Module development; Mathematics education

How to Cite: Saparwadi, L., Bafadal, R. E., Alpan, R. I., Alpin, R. I., Sakrim, S., & Sukarma, I. K. (2026). Ethnomathematics Learning Module for the Sasak Tribe with a Deep Learning Approach for Understanding Geometry. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 14(2), 828–842. <https://doi.org/10.33394/j-ps.v14i2.19429>



<https://doi.org/10.33394/j-ps.v14i2.19429>

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INTRODUCTION

Mathematics is a core subject that plays a crucial role in developing students' logical, critical, and systematic thinking skills (Crilly, 2026; Shaffer & Kaput, 1998). However, many students struggle to understand mathematical concepts, particularly in geometry (Emre-Akdogan & Yazgan-Sag, 2023; Mudhefi et al., 2024). The 2022 PISA results show Indonesia ranked 70th out of 81 countries with an average score of 366, while the average score of Indonesian students in geometry was only 367. This indicates that students' understanding of geometry in Indonesia is still relatively low, with many students only understanding procedural aspects without a deep conceptual understanding (OECD, 2024).

This issue is often generalized without in-depth analysis of the underlying causes. One important factor that can explain this difficulty is the lack of spatial thinking skills, which are fundamental in understanding geometry (Aliman, Sumarmi, & Marni, 2024; Avci, 2025;

Kremer et al., 2025; Maddatuang et al., 2025). Students often struggle to identify relationships between geometric shapes, visualize geometric transformations such as rotation or reflection, and connect geometric concepts with real-world applications (Awadelkarim, 2023). Spatial understanding is crucial for a deeper understanding of geometry, as emphasized by Crilly (2026), who observed that critical and creative thinking skills play a significant role in understanding mathematical concepts, including geometry.

Field observations show that mathematics education still relies on conventional approaches such as lectures and routine problem-solving exercises. These approaches fail to provide meaningful learning experiences, which in turn affect students' ability to develop their thinking skills. Fauzi, Satriawan, & Hayati (2025) and Mudhefi et al. (2024) state that conventional teaching approaches that are not contextual fail to provide opportunities for students to develop reflective and critical thinking skills needed to understand geometry. Huda et al. (2019) emphasize that more active teaching methods, such as e-learning and context-based blended learning, can improve students' understanding of mathematical concepts, as they allow students to learn independently and explore concepts in more depth. This issue can be addressed by implementing deep and meaningful learning through the study of local culture and issues relevant to students. However, the application of deep learning principles in the context of ethnomathematics is still very limited. Deep learning in education refers to a learning process that encourages deep and reflective understanding of concepts, not just memorizing procedures (Guo, 2024; Suglo, 2024). However, the pedagogical framework described in this study does not clearly explain how deep learning principles are applied to enhance mathematics learning in a cultural context. Guo (2024) and Yang et al. (2026) show that deep learning not only improves mastery of material but also the ability to link new information with existing knowledge, which is important for improving students' understanding of mathematics. A more detailed explanation of how these deep learning principles are applied within this pedagogical framework would help clarify its distinction from cultural approaches (Iffah et al., 2025; Sumaji et al., 2025; Wulandari et al., 2024).

One potential solution is to integrate deep learning principles with cultural elements, such as those found in Sasak culture. This approach can deepen students' understanding of mathematical concepts by linking them to their cultural knowledge. Research by Widodo et al. (2025) and Hulyadi et al. (2025) shows that connecting cultural elements with deep learning strategies can improve students' critical thinking and problem-solving skills. Introducing cultural artifacts from Sasak, such as weaving patterns or traditional architectural designs, can serve as concrete representations of mathematical concepts such as symmetry, angles, and transformations. This approach not only engages students in meaningful learning but also encourages them to reflect on how their cultural knowledge interacts with mathematical principles (Muhali et al., 2025). Using Sasak cultural designs as the basis for teaching geometry requires a clear explanation of how these designs can be mapped to geometric concepts and how students are encouraged to reflect on these relationships.

Research by Salsabila et al. (2025) shows that contextualizing geometry through culture can provide a more intuitive understanding of mathematical principles, although further research is needed to determine how these concepts can be effectively organized in teaching. Ethnomathematics, as an approach that integrates cultural elements into mathematics teaching, has proven effective in helping students connect mathematical concepts with their real-life experiences (Fauzi et al., 2025; Khair, 2023; Risywandha & Dhoruri, 2024; Salsabila et al., 2025). In Lombok, particularly within the Sasak community, there is a rich cultural heritage, including weaving patterns, traditional architecture, and distinctive ornaments, which contain geometric concepts such as symmetry, flat shapes, and transformations. Hasibuan et al. (2024) affirm that local culture can be a highly relevant source of learning, as it enriches students' learning experiences and makes mathematical concepts easier to understand. Puspitorini et al. (2025) report that the implementation of deep learning in mathematics education can also deepen students' conceptual understanding. Deep learning in the context of education refers to

a process that encourages deep and reflective understanding of concepts, not just memorizing procedures (Guo, 2024; Suglo, 2024; Zhang et al., 2025).

Yang et al. (2026) show that learning that involves reflective thinking and deep understanding will be more effective in enhancing students' mathematical literacy. In this case, the deep learning approach can be used to develop teaching modules that not only present geometry material conceptually but also help students connect mathematical concepts with their cultural experiences, while encouraging them to think critically and reflectively (Guo, 2024; Hulyadi et al., 2025; Widodo et al., 2025). Puspitorini et al. (2025) state that ethnomathematics and deep learning have great potential to improve geometric understanding. However, the development of teaching modules that combine both, particularly in the context of geometry at the junior high school level, is still very limited.

Existing ethnomathematics-based learning modules from the Sasak ethnic group often only present culture as an illustration of mathematical concepts, without providing opportunities for students to build a deeper understanding through reflection and more concrete connections between local culture and mathematical concepts. Therefore, the development of ethnomathematics-based mathematics teaching modules with a deep learning approach is needed to provide students with more meaningful, contextual, and effective learning experiences. While statements regarding the importance of spatial thinking skills and deep learning in improving students' understanding of geometry are valid, this has not been convincingly proven through a critical synthesis of previous studies. Aliman, Sumarmi, and Marni (2024) show that the development of spatial thinking skills through the Earthcomm learning model can improve students' understanding of geographical concepts and other sciences. However, this study focuses more on the role of earth science in the community, not directly on its application in mathematics education.

Additionally, Avci (2025) found that cognitive flexibility can improve spatial visualization abilities and computational thinking skills in students, indicating that cognitive factors also significantly affect students' spatial abilities in geometry. Although these studies suggest a positive relationship between the enhancement of spatial skills and academic achievement in mathematics, some studies, as revealed by Fauzi et al. (2025), show that ethnomathematics-based learning, which integrates local culture, can deepen students' understanding of mathematical concepts. Khair (2023) and Risywandha & Dhoruri (2024) emphasize the importance of local cultural context in mathematics learning to improve students' mathematical literacy, although this has not been widely applied in teaching geometry. A better understanding of geometry concepts through ethnomathematics can be achieved by connecting geometry learning with local cultural elements, such as Sasak weaving patterns, which contain concepts of symmetry and geometric transformations, as explained by Salsabila et al. (2025). However, on the other hand, more in-depth research on the application of deep learning principles in the context of ethnomathematics is still limited. Guo (2024) and Yang et al. (2026) explain that deep learning encourages a more reflective and holistic understanding of concepts, not just memorizing procedures. This suggests that the development of teaching materials that integrate deep learning approaches with local cultural elements, as proposed by Widodo et al. (2025), could be a solution to deepen students' understanding of geometry.

Additionally, Kremer et al. (2025) show that deep learning-based approaches, as applied in geometry learning modules, can improve students' conceptual understanding and critical thinking skills. This approach allows students to actively engage in exploring mathematical concepts through deeper reflection and discussion, which is necessary to understand geometry more profoundly. Therefore, the development of teaching modules that integrate ethnomathematics with deep learning has the potential to enhance students' understanding of geometry. Research conducted by Puspitorini et al. (2025) also shows the great potential of deep learning and ethnomathematics in improving students' understanding of geometry, although the development of teaching modules that combine both is still limited. This underscores the importance of further developing mathematics teaching modules based on

Sasak ethnomathematics with a deep learning approach to provide students with more meaningful and contextual learning experiences, which in turn can improve their understanding of geometry concepts.

METHOD

This study is a development research. The development model used is the 4D model, which consists of the Define, Design, Develop, and Disseminate stages (Pulkkinen et al., 2024; Sudarman & Ardian, 2021). The stages and procedures in this research and development are as follows:

1. **Define Stage:** This is the planning stage in the module development process. At this stage, an analysis is conducted to gather information, determine learning objectives, select themes or topics, identify the target audience (students), and outline the content to be delivered in the teaching module, including small group and individual teaching simulations. Data collection through observations and interviews is performed to analyze the needs.
2. **Design Stage:** This is the design activity stage, starting with the selection of the module design, format, and layout. The teaching module developed in this study is a mathematics module based on ethnomathematics with a deep learning approach, which will be implemented in the partner school, MTs Muhammadiyah Selong.
3. **Develop Stage:** This stage involves the development of the teaching module based on the design created in the previous stage. At this stage, the production process begins, such as creating and editing the module, and conducting quality testing by media and subject matter experts. This is done to ensure that the teaching module functions as expected. Additionally, a trial is conducted with students to assess their interaction and user experience with the module. If any problems or errors are identified, corrections will be made before the dissemination phase begins.
4. **Disseminate Stage:** This is the stage where the completed teaching module is distributed to the target users or students. In this case, it is the students of MTs Muhammadiyah Selong who are studying mathematics, specifically in grade VII. A flow diagram of the 4D development process can be seen in Figure 1.

This research was conducted at MTs Muhammadiyah Selong, with 17 seventh-grade students as the subjects. The data collection methods used included questionnaires and tests. The research instruments consisted of validation sheets for the teaching module, teacher response questionnaires, student response questionnaires, and tests to assess students' understanding of geometry. The data sources in this study included subject matter experts, media experts, as well as teachers and students from MTs Muhammadiyah Selong. Data analysis in this study was conducted through validation testing of the teaching module, practical use testing of the teaching module, and effectiveness testing of the implementation of the ethnomathematics-based mathematics teaching module with a deep learning approach to improve students' conceptual understanding of geometry (Kusmaharti & Yustitia, 2022).

Methodologically, the 4D model is compared with other development models such as ADDIE and Design-Based Research (DBR). The ADDIE model emphasizes systematic instructional design with continuous evaluation, while DBR focuses on iterative design oriented toward theory development. However, the 4D model is considered more appropriate because it provides a clearer and more structured separation of stages, making it relevant for module development that requires formal validation before implementation. Therefore, the selection of the 4D model has a clear methodological basis in the context of this development research.

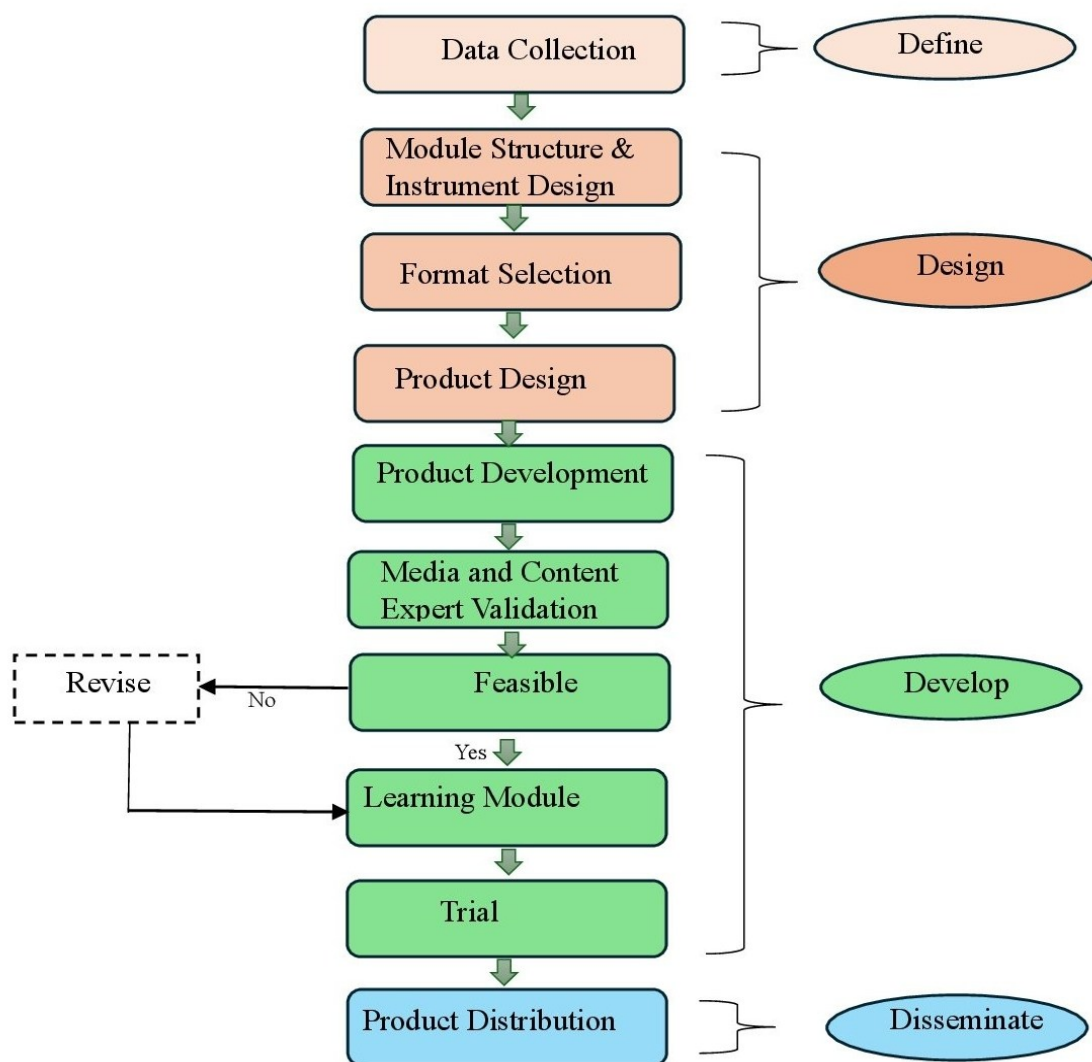


Figure 1. Shows the stages of the 4D development model.

Research Context and Subjects

The study was conducted in an Islamic junior high school with 17 seventh-grade students as subjects. This sample size is appropriate for an initial developmental study (pilot study). This research was explicitly positioned as a small-scale formative evaluation, not a generalizing effectiveness study. The goal was to obtain preliminary data on how the module functions in improving geometry understanding in a specific context. Therefore, the research findings are not generalizable to the broader population but rather serve as contextual preliminary evidence. Further research with a larger sample size and more diverse school contexts is needed to test the module's scalability and effectiveness more broadly.

Module Validation Test

The validity of the teaching module was obtained based on validation from media experts and subject matter experts (Rohmatulloh et al., 2023). The score was calculated based on the validation sheet assessed by the experts. The validation data obtained were analyzed using the following formula:

$$V = \frac{\sum \text{score of each item}}{\sum \text{maximum score}} \times 100\%$$

The results obtained were interpreted based on the criteria in Table 1.

Table 1. Validity Criteria

Percentage (%)	Criteria
$80 < V \leq 100$	Very Valid
$60 < V \leq 80$	Valid
$40 < V \leq 60$	Quite Valid
$20 < V \leq 40$	Less Valid
$0 < V \leq 20$	Not Valid

Practicality Test for Using the Teaching Module

The practicality of using the mathematics teaching module was determined based on teacher and student responses (Rohmatulloh et al., 2023). Scores were calculated based on questionnaire responses assessed by teachers and students. The practicality data obtained was analyzed using the rules

$$P = \frac{\sum \text{skor responden}}{\sum \text{skor maksimum}} \times 100\%$$

The results obtained were interpreted based on the criteria in Table 2.

Table 2. Validity Criteria

Percentage (%)	Criteria
$80 < V \leq 100$	Very Practical
$60 < V \leq 80$	Practical
$40 < V \leq 60$	Quite Practical
$20 < V \leq 40$	Not Practical
$0 < V \leq 20$	Not Practical

Effectiveness Test of the Module Usage

The effectiveness of using the ethnomathematics-based Sasak tribal mathematics teaching module with a deep learning approach to improve students' understanding of geometry was tested using the paired sample T-test. The paired sample T-test was conducted after performing a normality test, as the normality test serves as a prerequisite. After the paired sample T-test, a gain test was conducted to determine the improvement criteria, including low, medium, or high. If the results of the paired sample T-test using SPSS show a significance level (p-value) greater than 0.05, then H_0 is accepted, meaning there is no significant difference in the use of the module. However, if the significance level (p-value) is less than or equal to 0.05, it indicates a significant difference in the use of the module.

The normality test used in this study was the Kolmogorov-Smirnov normality test with the help of SPSS. If the significance of the normality test results (p-value) is greater than 0.05, then H_0 is accepted, indicating that the data follows a normal distribution. If the significance (p-value) is less than or equal to 0.05, the data does not follow a normal distribution. To determine the improvement category related to the pretest and posttest scores, the N-gain test was used. The improvement categories are low, medium, and high. The normalized gain (N-gain) is a rough measure related to the effectiveness of a treatment. One of the benefits of N-gain is that it can distinguish the impact of the treatment on learning outcomes. The N-gain can be calculated using the following formula:

$$g = \frac{\text{mark}_{post} - \text{mark}_{pre}}{\text{mark}_{max} - \text{mark}_{pre}} \times 100\%$$

The criteria for N-gain can be seen in the following Table 3.

Table 3. Improvement Criteria

N-gain (g)	Percentage Criteria
$g < 0,3$	Low
$0,3 \leq g < 0,7$	Medium
$0,7 \leq g \leq 1$	High

RESULTS AND DISCUSSION

The learning process at MTs Muhammadiyah Selong is still teacher-centered, which makes students passive. The approach used by the teacher has not involved learning resources that connect the material with the local wisdom of the surrounding community. In addition, the use of student worksheets is still limited. Students' understanding of geometry is also still low.

The researcher then conducted observations around the school environment, specifically at Muhammadiyah Boarding School Selong and community activities in East Lombok, where most of the people use materials from the Sasak tribe's batik culture. The results of the learning observations became the basis for forming the background problem and the observations in the East Lombok community environment as supporting material for developing a mathematics teaching module on similarity concepts based on Sasak ethnomathematics.

The researcher designed the development of a mathematics teaching module on the topic of angle relationships and similarity, based on Sasak ethnomathematics with a deep learning approach, to improve the understanding of students at MTs Muhammadiyah Selong. The steps for designing the mathematics teaching module include setting the module flow, starting with establishing learning objectives, designing scenarios, designing teaching materials based on Sasak ethnomathematics with a deep learning approach, and evaluating learning in terms of students' geometric understanding. The deep learning approach used in the teaching module refers to the principles of connected, conceptual understanding, and reflective learning. Connected refers to linking the material with other contexts and real-life experiences, such as students applying various Sasak cultural elements to geometric concepts. Conceptual understanding means strengthening deep understanding through the meaning of concepts, not just memorization. The concept understanding in this study is about angle relationships and the concept of similarity. Reflective refers to encouraging self-evaluation and reflection on the students' thinking processes.

The process of designing the mathematics teaching module includes the developed title: "Mathematics Teaching Module Based on Sasak Ethnomathematics with a Deep Learning Approach," which can be seen in Figure 1.

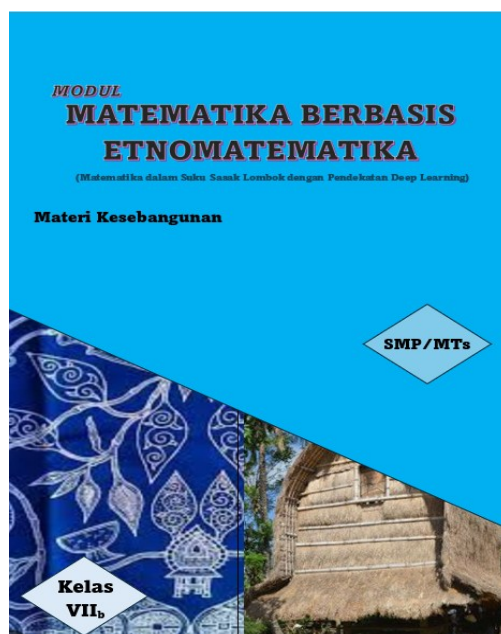


Figure 1. Cover of the Mathematics Teaching Module

This teaching module book is also equipped with instructions for using the mathematics teaching module which can make it easier for readers and the learning objectives to be achieved; Mathematics material that has the characteristics of local cultural elements of the Sasak tribe as contextual problems and questions related to the ability to understand geometry are the characteristics of the development of this teaching module.

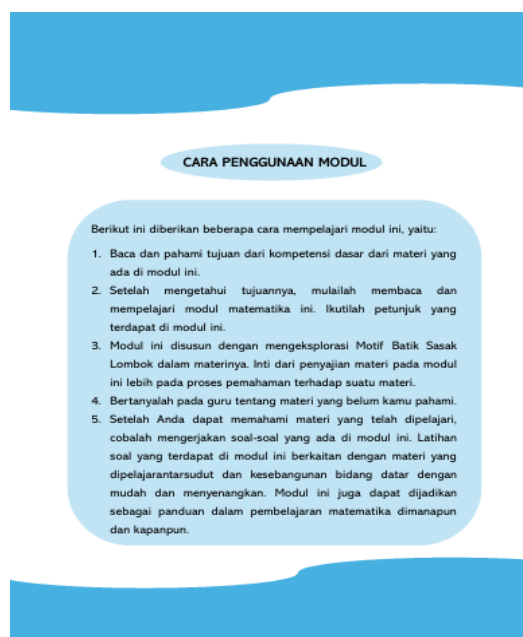


Figure 2. Instructions for Use and Learning Objectives in the Teaching Module

Figure 2 represents the presentation of module user instructions and learning objectives in the mathematics teaching module. Including learning objectives in the module is a crucial step in ensuring that the learning process runs smoothly, effectively, and benefits all parties involved. This, of course, can direct the learning focus on what needs to be learned within a predetermined timeframe effectively and efficiently. Furthermore, students can measure their level of understanding of the material being studied.



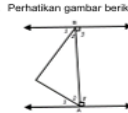
Figure 3. Presentation of Ethnomathematics-Based Case Studies of the Sasak Tribe

Based on Figure 3, students are presented with case study problems commonly encountered in Sasak batik, integrated with the application of the concepts of angle relationships and similarity. The material is presented based on problems integrated with geometric activities in Sasak batik. Through this learning module, students can learn about geometry in Sasak batik paintings by examining them from various perspectives, such as the concept of angles, relationships between angles, and the similarity of planes and triangles. Furthermore, students can learn about comparing the main structure of a building or object with a sketch or miniature of that object's structure.

Pemfaktoran:
 Jawaban untuk no 1, 2, 3, 4 sesuai dengan paparan di atas.
 [5] Jika besar $\angle A_1 = 70^\circ$, maka Berdasarkan gambar, $\angle DBE$ berpenyiku dengan $\angle CBE$, sehingga
 $\angle A_1 + \angle A_2 = 180^\circ$ (berdasarkan sudut berpelurus)
 $\angle A_1 = 180^\circ - \angle A_2 = 180^\circ - 70^\circ = 110^\circ$
 Berdasarkan sudut sehadap, maka dengan $\angle B_1$, maka $\angle A_1 = \angle B_1 = 110^\circ$ dan $\angle A_2 = \angle B_2 = 70^\circ$
 Berdasarkan sudut dalam berseberangan, maka $\angle B_1 = \angle A_2 = 110^\circ$ dan $\angle B_2 = \angle A_1 = 70^\circ$
 Berdasarkan sudut luar berseberangan, maka $\angle A_1 = \angle B_2 = 110^\circ$ dan $\angle A_2 = \angle B_1 = 70^\circ$
 Jadi, besar $\angle A_1, \angle A_2, \angle B_1, \angle B_2$ adalah 110° , dan besar $\angle A_2, \angle A_1, \angle B_2, \angle B_1$ adalah 70° .

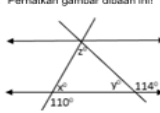
Ayo Kita Menalar

1. Perhatikan gambar berikut!



Tentukan nilai $\angle B_1, \angle B_2$, dan $\angle B_3$ jika $\angle A_1 = \angle B_1, \angle A_2 = \angle B_2$, dan $\angle A_3 = 60^\circ$.

2. Perhatikan gambar di bawah ini!



Tentukan nilai $x^\circ + y^\circ + z^\circ$ pada gambar di atas!

Figure 4. Presentation of Geometry Comprehension Questions

Figure 4 represents an evaluation question that hones geometric comprehension skills in determining angle sizes through relationships between angles. Through the Sasak ethnomathematics-based mathematics teaching module, students can learn about the concept of angles, the relationships between angles in lines and planes, and the concept of similarity through Sasak Lombok batik.

The mathematics teaching module validation questionnaire was assessed by two expert validation experts: a material expert and a media expert. The material validation assessment of the mathematics teaching module was reviewed from three aspects: language appropriateness, content appropriateness, and presentation appropriateness. The results of the material expert validation assessment are shown in Table 3.

Table 4. Material Expert Validation Results

Indicator	Average Score	Percentage
Content	3,3	82,5
Language	3,25	81,25
Presentation	3,38	84,38
Average	3,31	82,69

Berdasarkan Tabel 3 diperoleh hasil penilaian validasi ahli materi mendapatkan rata-rata skor sebesar 3,31. Hal ini setara dengan persentase 82,69% yang berarti modul ajar matematika berbasis etnomatematika mempunyai kriteria sangat valid.

The media expert validation assessment evaluated several aspects, including screen design, user-friendliness, consistency, and graphics. The results of the media expert validation assessment are shown in Table 5.

Table 5. Media Expert Validation Results

Indicator	Average Score	Percentage
Appearance	3,2	80
Design	3,2	80
Usability	3,4	85
Consistency	3,4	85
Graphics	3,2	80
Average	3,3	82

Based on Table 4, the results of the media expert validation assessment obtained an average score of 3.3. This equates to 82%, indicating that the ethnomathematics-based mathematics teaching module of the Sasak tribe meets the criteria for highly valid. Therefore, it can be concluded that the ethnomathematics-based mathematics teaching module meets the criteria for high validity.

The researchers conducted a small-scale trial of the validated mathematics teaching module to determine its practicality. This practicality test involved teachers and students. The results of teacher and student responses to the use of the ethnomathematics-based mathematics teaching module are presented in Table 5.

Table 6. Module Usage Response

Respondents	Average Score	Percentage
Teacher	3,36	84
Students	3,24	81

Table 5 shows the results of the teacher response questionnaire assessment regarding the use of the mathematics teaching module. The average score was 3.36, equivalent to 84%, yielding the criteria for "Very Practical to Use," based on the aspects of content, presentation, ease of use, in-depth learning, and module benefits. The assessment of product practicality through a student questionnaire yielded an average score of 3.24, equivalent to 81%, yielding the criteria for "Very Practical to Use," based on the aspects of interest, ease of understanding, in-depth learning, culture, and module benefits. Both assessments, the teacher questionnaire and the student questionnaire, indicate that the ethnomathematics-based mathematics teaching module meets the criteria for "Very Practical to Use." The geometry understanding test instrument was administered to students at MTs Muhammadiyah Selong. Pretest and posttest data were analyzed using SPSS. A brief discussion of descriptive statistics is provided in the table below.

Table 4. Data Normality Test

Tes	Mean	Std. Deviation	Kolmogorov-Smirnov Z	Sig.
Pre Test	58,05	9,44	0.839	0.483
Post Test	71,29	9,48	0.663	0.772

Table 4 shows that the Kolmogorov-Smirnov test has a significance level of 0.483 for the pretest and 0.772 for the posttest. Therefore, since the significance level (p-value) is greater than 0.05, both pretest and posttest data are normally distributed. Therefore, both tests indicate a normal distribution of the pretest and posttest data.

After the data was determined to have a normal distribution, a paired sample t-test was conducted to assess the effectiveness of the module on student understanding. The following are the results of the paired sample t-test.

Table 5. Paired Sample T-test Pretest and Posttest

Description	Std. Dev	t	Sig	Information
Pretest Posttest	4,116	-13,258	0.000	H ₀ rejected

Based on Table 5, the significance level (p-value) is less than or equal to 0.05. This indicates that the use of the Sasak ethnomathematics-based mathematics teaching module with a deep learning approach is effective in improving students' understanding of geometry concepts. The improvement in students' understanding of geometry can be observed through the N-gain test.

The N-gain is necessary to measure the improvement in students' understanding of geometry concepts before and after learning in this study related to the use of the module. Based on the N-gain test using pretest and posttest scores, the average pretest score was 58.05, and the average posttest score was 71.29. The ideal score in the assessment is 100, so based on

the N-Gain calculation, the score obtained is 0.315. Based on the N-Gain calculation, it is found that the improvement in students' mathematics learning outcomes using the Sasak ethnomathematics-based teaching module with a deep learning approach is 0.315. According to the N-Gain score criteria, the improvement in student learning outcomes in the control group falls into the medium category ($0.3 \leq g < 0.7$).

The Sasak ethnomathematics-based mathematics teaching module with a deep learning approach that has been developed meets the criteria of validity, practicality, and effectiveness in improving students' understanding of geometry. This is due to several important aspects, such as the connection between Sasak ethnomathematics and geometric understanding, the implementation of the teaching module in the learning process, the relevance of local cultural contexts in mathematics learning, and the relationship between the teaching module and students' geometric abilities.

DISCUSSION

This study examined the development of a mathematics teaching module based on Sasak ethnomathematics, with a deep learning approach, to enhance students' understanding of geometry. The results indicate that the module has proven to be valid, practical, and effective in achieving the intended outcomes. The following points delve into a more detailed discussion of the findings, aligned with the relevant references.

The Link Between Sasak Ethnomathematics and Geometry Understanding

The connection between Sasak ethnomathematics and geometry understanding is significant. Ethnomathematics, especially in the context of Sasak batik, is rich in geometric concepts, such as shapes, patterns, and mathematical order. Research by Fauzi et al. (2025) and Khair (2023) supports the idea that local cultural artifacts, such as batik, are inherently mathematical and provide a valuable resource for teaching geometry. The motifs in Sasak batik involve various geometric shapes, including triangles, squares, rhombuses, and circles. They also exhibit geometric transformations like translation, reflection, and rotation. Risywandha & Dhoruri (2024) argue that the application of ethnomathematics in education helps students relate abstract mathematical concepts to real-world cultural experiences, enhancing conceptual understanding.

In this study, Sasak batik was used as a medium to help students identify geometric elements such as symmetry, transformations, and proportions, making the abstract concepts more tangible and relatable. This method aligns with the findings of Salsabila et al. (2025), who found that using local cultural elements in mathematics lessons allows students to connect theoretical knowledge with their everyday lives, thus improving understanding.

Dynamics of the Mathematics Teaching Module in the Learning Process

The deep learning approach integrated into the Sasak ethnomathematics module fosters an active, contextual, and reflective learning process. This module encourages students to actively engage with the material by analyzing and discussing geometric elements found in Sasak batik. Guo (2024) emphasizes that deep learning focuses on meaningful understanding and conceptual clarity, moving beyond rote memorization. By using the batik motifs as a starting point for discussions, students were able to understand concepts like angle relationships, symmetry, and geometric transformations in a more engaging and meaningful context.

Through a series of structured activities, students were guided to build their understanding of geometry by exploring the concepts in depth, fostering critical thinking and problem-solving skills. This approach is aligned with Yang et al. (2026), who argue that deep learning helps students connect new information with prior knowledge, improving their ability to think critically and creatively. Moreover, the module's evaluation method also emphasized not just the final answers but the thinking processes, allowing students to reflect on their learning journey.

Relevance of Local Cultural Context in Mathematics Learning

The integration of local cultural context in mathematics learning is crucial for making abstract mathematical concepts more accessible. By connecting geometry with the students' cultural heritage, this study reinforces Puspitorini et al. (2025)'s argument that culturally relevant content increases student motivation and engagement. As seen in the case of Sasak batik, students were able to apply mathematical concepts to their local environment, making learning more contextual and meaningful. This aligns with Mudhefi et al. (2024)'s observation that integrating cultural contexts in learning helps students see mathematics as part of their everyday lives, not just as abstract concepts.

Furthermore, Crilly (2026) notes that the relevance of local culture in education fosters deeper conceptual understanding, as students are encouraged to observe, analyze, and reflect on cultural practices through a mathematical lens. This not only strengthens their mathematical understanding but also promotes the development of critical thinking and problem-solving skills. Additionally, incorporating cultural elements makes the learning process more inclusive by acknowledging and respecting students' diverse cultural backgrounds.

Relationship Between the Teaching Module and Geometry Skills

The relationship between the teaching module and students' geometry skills is evident in the positive outcomes observed in this study. The module provided a systematic guide for students, with clearly defined objectives, structured material, and contextual examples. Kremer et al. (2025) highlighted that a well-designed teaching module with progressive exercises helps students build a deeper understanding of geometric concepts over time.

This study's findings align with Salsabila et al. (2025), who assert that the use of ethnomathematics in teaching improves students' ability to visualize geometric shapes and understand their properties. The use of visualizations and representations, such as the patterns in Sasak batik, reinforced students' spatial thinking, a critical skill in geometry. Avci (2025) further emphasizes that fostering spatial reasoning is vital for developing geometric skills, and this study's approach helped students develop these skills by relating geometry to their cultural context.

CONCLUSIONS

Based on the findings, the developed mathematics teaching module based on Sasak ethnomathematics with a deep learning approach is effective in enhancing students' understanding of geometry. The module has met the criteria of validity, practicality, and effectiveness, as evidenced by expert assessments and positive feedback from both teachers and students. The deep learning approach, combined with culturally relevant content, has proven to be a valuable strategy for improving students' conceptual understanding and problem-solving skills. Key conclusions are:

1. The module developed based on Sasak ethnomathematics with a deep learning approach is highly valid, as indicated by expert validation in content and design.
2. The module is highly practical, with positive responses from both teachers and students.
3. The use of the module effectively improves students' understanding of geometry, as shown by significant improvement in pretest and posttest results.

RECOMMENDATION

Further research should focus on the development of e-modules based on Sasak ethnomathematics with a deep learning approach to provide easier and more direct access for students, thereby enhancing their understanding of geometry concepts. The integration of local culture in mathematics learning can be expanded to other regions to make mathematics education more inclusive and culturally relevant.

ACKNOWLEDGMENT

The authors express his highest appreciation and gratitude to the Higher Education Research and Development Council of Muhammadiyah Central Board for the financial support provided through the RisetMu Batch IX

program for the 2025 Fiscal Year with contract number 0259.484/I.3/D/2025. The author also expresses his gratitude to the lecturers, fellow researchers, and ITS Kes Muhammadiyah Selong who have provided academic direction, constructive input, and facility support during the research process. In addition, appreciation is given to the Principal of MTs., Mrs. Nurul Ulfa, S.Pd. as the mathematics teacher, the students and the school, namely MTs. Muhammadiyah Boarding School Selong who have participated in the trial of the learning module.

FUNDING INFORMATION

This research is supported by the Higher Education Research and Development Council of PP Muhammadiyah through the Applied Research scheme of the RisetMu Batch IX program for the 2025 Fiscal Year with contract number 0259.484/I.3/D/2025

AUTHOR CONTRIBUTIONS STATEMENT

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Rahman Ihdanil Alpin	✓	✓					✓		✓			✓		
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I Ketut Sukarma				✓			✓	✓						

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest regarding the publication of this paper.

ETHICAL APPROVAL

The research involving human participants was conducted in accordance with relevant institutional and national research ethics guidelines and in line with the principles of the Declaration of Helsinki.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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