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Development of Ethnomathematics-Based Discovery Learning Tools to Support Fourth-Grade Students' Mathematical Literacy

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Abstract

Mathematical literacy enables elementary school students to apply mathematical concepts, reasoning, and strategies to problems situated in meaningful contexts. However, elementary mathematics instruction remains largely procedural and rarely utilizes students' cultural environments as learning resources. This study aimed to develop ethnomathematics-based discovery learning tools and examine changes in fourth-grade students' mathematical literacy following their implementation. A research and development approach was employed using the 4D model, comprising the define, design, develop, and disseminate stages. The resulting products consisted of a lesson plan and teaching materials on plane figures—particularly squares, rectangles, and triangles—integrated with Sasak cultural contexts. The field trial involved 22 fourth-grade students at MI NW Nurul Haramain Narmada, selected through saturated sampling. Data were collected using expert validation sheets, learning implementation observations, student response questionnaires, and mathematical literacy tests. Descriptive analysis was used to assess product validity, learning implementation, and student responses, whereas differences between pretest and posttest scores were examined using the Wilcoxon signed-rank test because the data were not normally distributed. The developed learning tools achieved an average validity score of 91.50%, indicating very high validity. Learning implementation reached 96% and was categorized as very good, while student responses reached 83%, indicating a positive response. The mean mathematical literacy score increased by 29.73 points, from 41.81 on the pretest to 71.54 on the posttest, with the

Wilcoxon test revealing a statistically significant difference ($Z = -4.109$, $p < .001$). These findings provide preliminary evidence that ethnomathematics-based discovery learning tools are feasible for contextual mathematics instruction and are associated with improved mathematical literacy in the study setting. The study contributes to the development of culturally responsive mathematics learning resources; however, the findings should be interpreted cautiously because the field trial employed a single-group pretest–posttest design without a control group.

Keywords: Discovery Learning; Elementary Education; Ethnomathematics; Learning Tools; Mathematical Literacy

INTRODUCTION

Mathematical literacy is a fundamental competency that needs to be developed from the early stages of education because it involves students' ability to use mathematical concepts, procedures, facts, and reasoning to understand and solve problems in various real-life situations. Mathematical literacy does not merely emphasize obtaining correct answers; it also requires students to understand problems, select appropriate strategies, use mathematical representations, interpret results, and communicate their reasoning. Therefore, mathematics learning at the elementary level needs to provide learning experiences that enable students to use mathematics in meaningful contexts that are connected to their everyday lives (Putri Hapsari et al., 2022); Yuliana et al., 2022; Ginanjar Rahayu et al., 2025); (Larasati et al., 2025)). In the Indonesian education context, literacy and numeracy have also become important components in monitoring educational quality through the Indonesian Education Report because they reflect students' abilities to understand information, reason, solve problems, and make decisions based on available information.

The development of these competencies remains a challenge in Indonesia. The 2025 Indonesian Education Report indicates that the literacy achievement of students in general elementary schools reached 65.66%, decreasing from 71.81% in the previous year. In equivalency elementary education, literacy achievement reached 57.16%, down from 62.03%. In numeracy, the achievement of students in general elementary schools was 59.45%, decreasing from 69.58%, while the achievement in equivalency elementary education was 51.59%, decreasing from 56.70% (Badan Kebijakan Pendidikan Dasar dan Menengah, 2026). These figures indicate that strengthening literacy and numeracy remains an important priority for improving the quality of elementary education, particularly students' abilities to understand information, analyze problems, apply mathematical concepts and procedures, and use mathematical knowledge in real-life situations. This concern is also reflected in the results of the Programme for International Student Assessment (PISA) 2022. Indonesia obtained a mean mathematics score of 366 points, compared with the OECD average of 472 points, and only 18% of Indonesian students attained Level 2 or higher in mathematics, compared with 69% across OECD (OECD, 2023) Although PISA assesses 15-year-old students and therefore does not directly represent elementary school achievement, these findings highlight the importance of strengthening the foundations of mathematical literacy from earlier stages of education.

The challenge is not only related to students' mathematical performance but also to how mathematics learning is designed and implemented. Learning that is excessively oriented toward procedures and memorization may limit students' opportunities to understand mathematical concepts and apply them in different situations. A review of mathematical literacy among Indonesian elementary school students indicates the importance of learning experiences that involve problem solving and the use of mathematics in diverse contexts (Hapsari et al., 2022). Mathematics learning therefore needs to provide opportunities for students to observe phenomena, identify problems, collect information, select strategies, apply mathematical concepts, verify their solutions, and explain and interpret the results. Such learning experiences can shift mathematics instruction from procedural mastery toward the meaningful use of mathematics as a tool for understanding and solving real-life problems.

One instructional model that is consistent with these needs is discovery learning. Discovery learning provides opportunities for students to construct knowledge through activities such as observing, identifying or formulating problems, collecting information, processing information, verifying findings, and drawing conclusions. These processes are closely related to mathematical literacy because students are required not only to obtain a final answer but also to understand a situation, determine an appropriate strategy, apply mathematical concepts, and justify their solutions. (Putri & Fakhriyana, 2023) found that discovery learning can be used to improve students' mathematical literacy. Buyung and Nirawati (2025) also reported a relationship between discovery learning and students' mathematical literacy. In addition, Sofwatun et al. (2025) showed that discovery learning integrated with GeoGebra can support mathematical literacy through learning activities that encourage students to construct concepts and connect them with real-life experiences.

Previous studies have also indicated that discovery learning can support mathematical communication, problem solving, and mathematical abilities when students are given opportunities to explore and verify their solution strategies (Dina et al., 2019).

However, the implementation of discovery learning does not automatically guarantee the development of mathematical literacy. Its effectiveness also depends on the quality of the problems, learning resources, and contexts used during the discovery process. Elementary students need learning situations that are concrete, meaningful, and closely related to their experiences so that mathematical concepts are not discovered in an overly abstract manner. In this regard, ethnomathematics offers a relevant approach because it connects mathematical concepts with cultural activities, artifacts, games, traditions, and community products. Trisnani and Utami (2021) demonstrated that ethnomathematics-based learning tools can utilize students' immediate environment as a source of mathematical learning. (Muhammad et al., 2021) also showed that cultural artifacts can help elementary students understand plane geometry concepts in a more contextual manner. Thus, ethnomathematics can serve as a bridge between students' cultural experiences and formal mathematical concepts (Nur et al., 2020); Sari et al., 2022)

Empirical support for ethnomathematics-based mathematics learning has continued to grow. A meta-analysis conducted by (Sulistyowati & Mawardi, 2023) found that ethnomathematics-based learning had a positive effect on elementary students' mathematical abilities. (Pratama & Yelken, 2024), through a meta-analysis of ethnomathematics-based learning studies, also reported evidence of its effectiveness in supporting students' mathematical literacy. In the area of learning-tool development, (Ginanjar Rahayu et al., 2025; Ristanti & Murdiyani, 2021) developed ethnomathematics-based learning tools to support mathematical literacy and reported that the resulting tools met the required feasibility criteria. (Yuliana et al., 2022) developed an ethnomathematics module integrated with realistic mathematics education to improve elementary students' mathematical literacy, while (Ginanjar Rahayu et al., 2025) developed and validated an ethnomathematics-based mathematical literacy instrument for primary school students. These findings indicate that ethnomathematics has considerable potential to be integrated into mathematics learning tools, teaching materials, instructional media, and assessment instruments.

The relevance of local cultural contexts becomes particularly important in educational environments with rich cultural resources. In Lombok, Sasak culture contains numerous objects and activities that are closely related to mathematical concepts, particularly geometry. (Fauzi et al., 2020) identified geometric concepts such as rectangles, triangles, trapezoids, circles, rhombi, kites, cones, cylinders, and pyramids in various Sasak buildings, handicrafts, arts, and traditional foods. (Fauzi & Setiawan, 2020) specifically identified geometric concepts in traditional Sasak handicrafts and highlighted their potential as contextual resources for elementary mathematics learning. (Hardiani & Putrawangsa, 2019) also found that traditional measurement practices among the Sasak community contain mathematical reasoning activities that can potentially be integrated into mathematics instruction. More recent studies have further demonstrated this potential. (Irawan et al., 2023) developed mathematics learning media incorporating Sasak ethnomathematics, while Rahmawati et al. (2024) developed a local-wisdom-based ethnomathematics module for plane geometry and reported very high validity and practicality. Broader studies have also demonstrated the increasing role of ethnomathematics in Indonesia as an approach for connecting local culture and mathematics education (Iffah et al., 2025; Sunzuma & Umbara, 2025; Kyeremeh et al., 2023).

Nevertheless, previous studies indicate that discovery learning, ethnomathematics, and mathematical literacy have often been investigated or developed separately. Studies on discovery learning have demonstrated its potential to support mathematical literacy, but relatively limited attention has been given to integrating Sasak culture as the primary context for the discovery process. Conversely, studies on Sasak ethnomathematics have successfully identified mathematical concepts embedded in local culture and have developed learning media and modules, but have not specifically integrated these cultural contexts into the discovery learning syntax with mathematical literacy as the targeted competency. Research integrating ethnomathematics and mathematical literacy has also emphasized the need to translate cultural contexts into systematic mathematical activities rather than using culture merely as an illustration (Umbara et al., 2023; baidillah & Khotimah, 2023); Digdayana et al., 2024). Therefore, there remains a need to develop learning tools that simultaneously integrate local cultural contexts, a discovery-oriented pedagogical process, and mathematical literacy.

This research gap provides the basis for developing ethnomathematics-based discovery learning tools in which Sasak culture serves as the primary learning context. In the present study, ethnomathematics is not used merely as a visual or cultural supplement in the teaching materials but as a source of problems and mathematical activities through which students discover mathematical concepts. Discovery learning functions as the pedagogical process that guides students through observation, problem identification, information collection and processing, verification, and conclusion drawing. Ethnomathematics functions as the contextual foundation connecting mathematical concepts with students' cultural experiences, while mathematical literacy represents the targeted competency developed through these activities. This integration is consistent with the view that ethnomathematics can bridge cultural knowledge, mathematical representation, and problem-solving activities (Sulistyawati & Radite, 2022; Sari et al., 2022; Murti, 2023).

The need for such learning tools was also identified in the initial learning conditions at MI NW Nurul Haramain Narmada, West Lombok, West Nusa Tenggara. Preliminary observations indicated that the use of contextual problems in mathematics learning was still limited, resulting in suboptimal student interaction and communication when solving mathematical problems. At the same time, the Sasak cultural environment provides various objects and activities that can be connected to geometric concepts. This condition indicates a gap between the potential of local culture as a learning resource and its systematic utilization in mathematics learning tools. Therefore, learning tools are needed that integrate local cultural contexts with an instructional model capable of actively engaging students in discovering and applying mathematical concepts.

Based on the identified problem, previous research, research gap, and instructional needs, this study aimed to: (1) develop feasible ethnomathematics-based discovery learning tools for mathematics learning; and (2) examine changes in the mathematical literacy of fourth-grade students following the implementation of the developed learning tools. The products consisted of a lesson plan and teaching materials integrating Sasak cultural contexts into plane-figure topics, particularly squares, rectangles, and triangles. The study is expected to contribute to the development of contextual mathematics learning tools while providing an alternative approach for utilizing Sasak local culture to strengthen mathematical literacy among elementary and Islamic elementary school students.

METHODS

1. Research Design

This study employed a Research and Development (R&D) approach to develop ethnomathematics-based discovery learning tools for supporting fourth-grade students' mathematical literacy. The development procedure adopted the 4D model, consisting of four stages: define, design, develop, and disseminate. The model was selected because it provides a systematic sequence ranging from needs analysis and product design to product development, validation, field testing, and dissemination.

The define stage involved preliminary analysis, learner analysis, task analysis, concept analysis, and formulation of learning objectives. The design stage involved designing a lesson plan and teaching materials by integrating discovery learning with Sasak ethnomathematical contexts. The develop stage consisted of product development, expert validation, revision, and field testing. The disseminate stage involved limited dissemination within the research context.

2. Field-Trial Design

The field trial employed a one-group pretest-posttest design. Students completed a pretest before implementation of the developed learning tools and a posttest after the learning process. The design was used to examine changes in students' mathematical literacy following implementation.

$$\mathbf{O_1 \rightarrow X \rightarrow O_2}$$

O_1 represents the mathematical literacy pretest; X represents the implementation of ethnomathematics-based discovery learning; and O_2 represents the mathematical literacy posttest.

3. Research Setting and Participants

The study was conducted at MI NW Nurul Haramain Narmada, Lembuak Village, Narmada District, West Lombok Regency, West Nusa Tenggara, Indonesia. The field trial involved 22 fourth-grade students. Saturated sampling was used because all students in the selected class participated in the field trial.

The research setting was selected because contextual problems were still limited in mathematics learning, while the Sasak cultural environment provided objects and activities that could be connected to geometric concepts.

4. Developed Products

The developed products consisted of a lesson plan and ethnomathematics-based discovery learning teaching materials focusing on polygonal plane figures, particularly squares, rectangles, and triangles.

Sasak cultural objects, including sapuk, renggi, songket motifs, ende shields, and berugak sekepat, were incorporated as concrete learning contexts. These objects were used to help students identify geometric forms, properties, and concepts through culturally familiar experiences.

Ethnomathematics served as the contextual basis of learning, while discovery learning organized the pedagogical process through observation, problem identification, information collection and processing, verification, and conclusion drawing.

5. Data Sources and Expert Validation

Data were obtained from expert assessments and field-trial results. Expert assessment data concerned the validity of the developed learning tools, while field-trial data included learning implementation, learning outcomes, teacher observations, and student responses.

The validation process involved experts in three areas: (1) mathematics content; (2) instructional design; and (3) instructional practice/learning. The source document does not explicitly state the number of individuals serving as validators; therefore, no numerical number of validators is reported here.

6. Research Instruments

The instruments consisted of: (1) lesson-plan validation sheet; (2) teaching-material validation sheet; (3) mathematical literacy test validation sheet; (4) student-response questionnaire validation sheet; (5) learning implementation observation sheet; (6) student-response questionnaire; and (7) mathematical literacy test.

The mathematical literacy test was used to obtain students' scores before and after implementation. The test instrument was validated by experts based on the correspondence between the test items and their intended measurement objectives and the appropriateness of language use. Items were classified as valid or invalid by the validators.

7. Data Collection

Data collection employed four main techniques: expert validation, observation, questionnaire, and testing. The learning tools and validation sheets were submitted to experts for assessment and revision recommendations. Classroom observations were conducted using an implementation observation sheet completed by a partner teacher. The student-response questionnaire was administered after learning. The mathematical literacy test was administered as a pretest before implementation and a posttest after implementation.

8. Data Analysis

Product validity was analyzed by calculating the average score for each indicator and aspect and then determining the overall average. The result was compared with the predetermined validity criteria, and revisions were made when necessary. The validation results were 91.67% for teaching materials from the content expert, 93.00% from the design expert, and 90.00% for the lesson plan from the learning expert. The overall average validity was 91.50%, categorized as very valid. Learning implementation was analyzed using P = $P = \frac{\Sigma A}{\Sigma N} \times 100\%$ where P represents the implementation percentage, ΣA represents the number of observed aspects, and ΣN represents the total number of observed aspects. The criteria were 75–100% very good, 50–74% good, 25–49% poor, and 0–24% not implemented. The implementation result was 96%, categorized as very good.

Student responses were analyzed based on the proportion of students providing positive responses. A response rate above 50% was considered positive. The overall student response was 83%, categorized as positive. Mathematical literacy was analyzed using pretest and posttest scores. The mean pretest score was 41.81 (SD = 12.22), while the mean posttest score was 71.54 (SD = 12.71), representing an increase of 29.73 points.

Normality testing produced significance values of 0.000 for the pretest and 0.002 for the posttest. Because the data did not meet the normality assumption, the Wilcoxon Signed-Rank Test was used. The test produced $Z = -4.109$, $p < .001$, indicating a statistically significant difference between students' mathematical literacy scores before and after implementation.

Because the study used a single group without a control group, the observed change is interpreted as within-group change following implementation rather than causal evidence equivalent to a controlled experiment.

RESULTS

1. Development of the Learning Tools

The learning tools were developed using the 4D model, consisting of the define, design, develop, and disseminate stages. At the define stage, the analysis indicated that polygonal plane-figure materials were appropriate for development through the integration of ethnomathematical contexts and the discovery learning syntax. At the design stage, a lesson plan and teaching materials were designed by incorporating Sasak cultural objects as concrete contexts for mathematics learning. The cultural objects included sapuk, renggi, songket motifs, ende shields, and berugak sekepat. At the develop stage, the products were validated by experts and revised based on their recommendations before field testing.

The final products consisted of a lesson plan and ethnomathematics-based discovery learning teaching materials for polygonal plane figures, particularly squares, rectangles, and triangles. The Sasak cultural objects were incorporated as concrete contexts to help students connect mathematical concepts with cultural experiences familiar to them.

2. Validation Results of the Learning Tools

The developed learning tools were validated before field implementation. The validation results are presented in Table 1.

Table 1. Validation Results of the Learning Tools

Validated Component	Percentage	Category
Teaching materials – content expert	91.67%	Very valid
Teaching materials – design expert	93.00%	Very valid
Lesson plan – learning expert	90.00%	Very valid
Average	91.50%	Very valid

As shown in Table 1, the teaching materials obtained 91.67% from the content expert and 93.00% from the design expert. The lesson plan obtained 90.00% from the learning expert. Overall, the average validity score was 91.50%, categorized as very valid. All components obtained scores above 90%, indicating that the products were sufficiently valid to proceed to field testing after revisions based on the validators' recommendations.

3. Learning Implementation and Student Responses

The field trial indicated that the developed learning tools could be implemented effectively in classroom instruction. The learning implementation and student-response results are presented in Table 2.

Table 2. Learning Implementation and Student Responses

Aspect	Result	Category
Learning implementation	96%	Very good
Student responses	83%	Positive

The learning implementation reached 96%, which was categorized as very good. Overall, student responses reached 83%, indicating a positive response to the developed learning tools.

At the indicator level, the highest responses were observed for making learning more enjoyable, ease of understanding the material, and student activity, each reaching 100%. The response for students' willingness to express their opinions reached 63%, while the indicators of material exploration and hypothesis verification each reached 72%.

4. Mathematical Literacy Results

The field trial involved 22 fourth-grade students. Mathematical literacy was measured through a pretest administered before implementation of the learning tools and a posttest administered after the learning process.

Table 3. Descriptive Statistics of Mathematical Literacy Scores

Measurement	N	Mean	SD
Pretest	22	41.81	12.22
Posttest	22	71.54	12.71

As presented in Table 3, the mean mathematical literacy score increased from 41.81 on the pretest to 71.54 on the posttest, representing an increase of 29.73 points following implementation of the developed learning tools.

5. Normality and Wilcoxon Test Results

Before testing the difference between the two measurements, the pretest and posttest data were examined for normality. The significance values were 0.000 for the pretest and 0.002 for the posttest. Both values were below 0.05, indicating that the data did not meet the normality assumption. Therefore, the Wilcoxon Signed-Rank Test was used to examine the difference between the paired scores.

Table 4. Wilcoxon Signed-Rank Test Results

Statistic	Value
N	22
Z	−4.109
Sig. (2-tailed)	< .001
Decision	Significant difference

The Wilcoxon test produced $Z = -4.109$, $p < .001$, indicating a statistically significant difference between students' mathematical literacy scores before and after implementation of the developed learning tools.

These findings indicate a within-group change in mathematical literacy among the students who participated in the ethnomathematics-based discovery learning. However, because the field trial employed a one-group pretest-posttest design, the result should be interpreted as evidence of change within the group rather than definitive causal evidence that the improvement was solely caused by the developed learning tools.

DISCUSSION

1. Feasibility of the Ethnomathematics-Based Discovery Learning Tools

The findings showed that the developed ethnomathematics-based *discovery learning* tools obtained an average validity score of **91.50%**, categorized as **very valid**. This result indicates that the lesson plan and teaching materials met the required feasibility criteria for fourth-grade mathematics learning. The high validation score suggests that the developed tools were appropriate in terms of content, instructional design, and learning implementation. The development process through the *define, design,* and *develop* stages enabled the learning tools to be designed according to students' needs, learning objectives, content characteristics, and the cultural context incorporated into the learning materials.

This finding supports Ristanti and Murdiyani (2021), who developed ethnomathematics-based learning tools to support students' mathematical literacy. It is also consistent with the meta-analysis conducted by Sulistyowati and Mawardi (2023), which reported the effectiveness of ethnomathematics-based learning for elementary students' mathematical abilities. Therefore, the high validity score in the present study not only indicates the technical feasibility of the product but also supports the use of ethnomathematics as a contextual approach in mathematics instruction.

The Sasak cultural context represents a major characteristic of the developed learning tools. The incorporation of sapuk, renggi, songket motifs, ende shields, and berugak sekepat provides concrete representations of geometric concepts. This approach is consistent with Fauzi et al. (2020), who identified various elements of Sasak culture as potential mathematics learning resources for elementary schools. Fauzi and Setiawan (2020) likewise demonstrated that traditional Sasak crafts contain geometric concepts that can be integrated into mathematics learning. Thus, the present study extends the use of Sasak cultural contexts from cultural exploration into an integrated component of *discovery learning* oriented toward mathematical literacy.

2. Learning Implementation and Student Responses

The learning implementation reached 96%, categorized as very good, while student responses reached 83%, categorized as positive. These results indicate that the developed learning tools were not only theoretically valid but also applicable in an actual classroom setting. The high implementation score indicates that the instructional procedures designed in the learning tools could be implemented consistently during the learning process. The observation instrument was specifically used to assess learning implementation, while the student-response questionnaire was administered after the learning activities.

The positive student responses also suggest that culturally familiar contexts can contribute to meaningful mathematics learning experiences. The highest response scores were obtained for making learning more enjoyable, ease of understanding the material, and student activity, each reaching 100%. Meanwhile, students' willingness to express their opinions reached 63%, while material exploration and hypothesis verification each reached 72%. This pattern suggests that the cultural context supported student engagement, although aspects related to expressing ideas and conducting verification could still be strengthened.

These findings are consistent with the principles of discovery learning, which position students as active participants in constructing mathematical understanding. (Putri & Fakhriyana, 2023) reported that the application of discovery learning and inquiry learning was associated with improvements in students' mathematical literacy. Dina et al. (2019) also reported that discovery learning can support students' mathematical communication and disposition. Thus, integrating discovery learning with ethnomathematical contexts provides a relevant pedagogical basis for promoting student activity during mathematics learning.

3. Improvement in Mathematical Literacy

The results showed that the mean mathematical literacy score increased from 41.81 on the pretest to 71.54 on the posttest, representing a difference of 29.73 points. The Wilcoxon test produced $Z = -4.109$ and $p < .001$, indicating a statistically significant difference between the pretest and posttest scores. This finding provides initial empirical evidence of a positive within-group change in mathematical literacy after students participated in learning using the developed tools.

The improvement can be understood in relation to the characteristics of learning that combine discovery processes with culturally meaningful contexts. Mathematical literacy requires more than computational proficiency; it involves the ability to use mathematics to understand and solve problems situated in particular contexts. The OECD framework emphasizes formulating, employing, and interpreting mathematics across different contexts as important components of mathematical literacy(OECD, 2023). In the present study, Sasak cultural contexts provided concrete situations through which students could connect geometric concepts with familiar objects and experiences.

This finding is also consistent with (Yuliana et al., 2022), who developed an ethnomathematics module integrated with realistic mathematics education to improve elementary students' mathematical literacy. Furthermore, (Pratama & Yelken, 2024), through a meta-analysis, reported the effectiveness of ethnomathematics-based learning in improving students' mathematical literacy. The present findings therefore strengthen the emerging evidence that cultural contexts can provide an alternative means of making mathematics learning more meaningful and oriented toward the application of mathematics in real-life situations.

4. Contribution of Integrating Discovery Learning and Ethnomathematics

The main contribution of this study lies in the integration of two components, namely discovery learning as the pedagogical approach and Sasak ethnomathematics as the learning context. Ethnomathematics provides contexts that are close to students' experiences, while discovery learning provides a learning sequence that encourages students to observe, identify problems, collect and process information, verify findings, and draw conclusions. This combination provides opportunities for students to construct mathematical understanding through a discovery process rather than merely receiving mathematical concepts directly.

This finding is relevant to previous research on contextual learning using ethnomathematics, which has demonstrated its potential to support problem-solving abilities. (Nur et al., 2020), for example, found that contextual learning with ethnomathematics can enhance problem-solving based on students' levels of thinking.

(Muhammad et al., 2021) also demonstrated that cultural artifacts can be used to support elementary students' understanding of two-dimensional geometric concepts.

Therefore, the present study does not merely position culture as an additional illustration in teaching materials but uses it as a mathematical context that supports the process of concept discovery. This represents an important distinction from mathematics instruction that relies predominantly on abstract examples or contexts distant from students' everyday experiences.

5. Theoretical and Practical Implications

Theoretically, the findings support the view that mathematics learning integrating cultural contexts and discovery activities can provide more contextualized learning experiences. The integration brings together three important elements: cultural context, discovery processes, and mathematical literacy. This finding is consistent with the development of ethnomathematics research, which increasingly positions culture as an integral component of mathematics education rather than merely as an object of cultural study.

Practically, the developed lesson plan and teaching materials may provide an alternative resource for elementary and Islamic elementary school teachers, particularly in geometry learning. Teachers can utilize cultural objects available in students' surroundings as starting points for developing mathematical problems. In the Sasak context, cultural artifacts, crafts, patterns, buildings, and traditional activities provide potential contexts for connecting mathematics with students' everyday experiences. Previous studies on Sasak culture have also identified geometric concepts that can be utilized in elementary mathematics learning.

6. Limitations of the Study

Although the findings indicate a statistically significant change, they should be interpreted in light of several limitations. First, the field trial involved only 22 students from one class, so generalization to schools and students with different characteristics should be made cautiously. Second, the study employed a one-group pretest-posttest design without a control group; therefore, the observed increase cannot be attributed exclusively to the developed learning tools. Third, discovery learning requires sufficient time and scaffolding to ensure that all students can participate meaningfully in the discovery process. Fourth, mathematical literacy develops through continuous practice, meaning that changes observed during a single instructional period cannot represent long-term development.

Accordingly, the findings are more appropriately regarded as initial evidence regarding the feasibility and potential application of the developed learning tools, rather than definitive causal evidence of effectiveness. Future research should involve larger samples, multiple schools, comparison or control groups, and broader cultural and mathematical contexts.

CONCLUSION

This study developed ethnomathematics-based discovery learning tools for teaching polygonal plane figures to fourth-grade students at an Islamic elementary school. The development followed the 4D model, consisting of the define, design, develop, and disseminate stages. The developed products consisted of a lesson plan and teaching materials integrating Sasak cultural contexts, including sapuk, renggi, songket motifs, ende shields, and berugak sekepat, into mathematics learning. The validation results showed an average score of 91.50%, categorized as very valid. The learning implementation reached 96%, categorized as very good, while students' responses reached 83%, indicating a positive response to the developed learning tools.

The implementation of the developed learning tools was associated with a change in students' mathematical literacy performance. The mean score increased from 41.81 on the pretest to 71.54 on the posttest, representing an increase of 29.73 points. The Wilcoxon Signed-Rank Test yielded $Z = -4.109$, $p < .001$, indicating a statistically significant difference between students' mathematical literacy scores before and after the learning intervention. These findings suggest that ethnomathematics-based discovery learning tools have potential as a contextual mathematics learning alternative for supporting students' mathematical literacy.

However, the findings should be interpreted proportionally because the field trial involved only 22 students from one class and employed a one-group pretest-posttest design without a control group. Therefore, the observed increase cannot be considered definitive causal evidence that the developed learning tools alone caused the improvement. Future studies should involve larger samples and multiple schools and employ experimental or quasi-experimental designs with comparison groups to obtain stronger evidence of effectiveness. Further development may also expand the use of local cultural contexts across different mathematics topics and educational levels

REFERENCES

Digdayana, I. U., Prahmana, R. C. I., & Pepkolaj, L. (2024). Integrating the traditional game of Bola Bekel into mathematics education: A culturally relevant context for teaching LCM and GCD. *JRAMathEdu (Journal of Research and Advances in Mathematics Education), 9*(3), 164–175. https://doi.org/10.23917/jramathedu.v9i3.10687

Dina, Z. H., Ikhsan, M., & Hajidin, H. (2019). The improvement of communication and mathematical disposition abilities through discovery learning model in junior high school. *JRAMathEdu (Journal of Research and Advances in Mathematics Education), 4*(1), 11–22. https://doi.org/10.23917/jramathedu.v4i1.6824

Fauzi, A., Rahmatih, A. N., Sobri, M., Radiusman, R., & Widodo, A. (2020). Etnomatematika: Eksplorasi Budaya Sasak sebagai Sumber Belajar Matematika Sekolah Dasar. *JRPM (Jurnal Review Pembelajaran Matematika), 5*(1), 1–13. https://doi.org/10.15642/jrpm.2020.5.1.1-13

Fauzi, A., & Setiawan, H. (2020). Etnomatematika: Konsep Geometri pada Kerajinan Tradisional Sasak dalam Pembelajaran Matematika di Sekolah Dasar. *Didaktis: Jurnal Pendidikan dan Ilmu Pengetahuan, 20*(2), 118–128. https://doi.org/10.30651/didaktis.v20i2.4690

Ginanjar Rahayu, T., Nurussama, A., Eka Putri, H., Zahra Saskia, A., Intan Safitri, M., Wahyuni, R., & Rahmawati, T. (2025). Development and validation of mathematical literacy instruments based on ethnomathematics for primary school students. *Metodik Didaktik: Jurnal Pendidikan Ke-SD-an, 21*(1), 11–19. https://doi.org/10.17509/md.v21i1.85839

Hardiani, N., & Putrawangsa, S. (2019). Etnomatematika: Tradisi Pengukuran Masyarakat Suku Sasak dan Potensi Pengintegrasiannya dalam Pembelajaran Matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 8*(1), 159–174. https://doi.org/10.24127/ajpm.v8i1.1814

Iffah, R. D. L., Subanti, S., Usodo, B., & Nurhasanah, F. (2025). Systematic literature review: Ethnomathematics research in Indonesia. *JRAMathEdu (Journal of Research and Advances in Mathematics Education), 10*(1), 28–40. https://doi.org/10.23917/jramathedu.v10i1.5621

Irawan, A., Septiani, N. W. P., & Wulan, R. (2023). Analisis Etnomatematika Suku Sasak dalam Pengembangan Media Pembelajaran Matematika. *Sebatik, 27*(1), 16–21. https://doi.org/10.46984/sebatik.v27i1.2095

Kyeremeh, P., Awuah, F. K., & Dorwu, E. (2023). Integration of ethnomathematics in teaching geometry: A systematic review and bibliometric report. *Journal of Urban Mathematics Education, 16*(2), 68–89. https://doi.org/10.21423/JUME-V16I2A519

Larasati, I., Pramasdyahsari, A. S., & Harun, L. (2025). Enhancing elementary student's numeracy skills through ethnomathematics-based learning: An analysis of minimum competency assessment results. *Journal of Honai Math, 8*(1), 71–88. https://doi.org/10.30862/jhm.v8i1.861

Muhammad, A. F. N., Marsigit, M., & Soeharto, S. (2021). Learning the concept of two-dimensional figure through Borobudur artifacts for lower graders of elementary school mathematics. *Ethnomathematics Journal, 2*(2), 43–50. https://doi.org/10.21831/ej.v2i2.39885

Murti, R. C. (2023). Culturally responsive teaching to support meaningful learning in mathematics primary school: A content analysis in student's textbook. *Jurnal Prima Edukasia, 11*(2), 294–302. https://doi.org/10.21831/jpe.v11i2.63239

Nur, A. S., Waluya, S. B., Rochmad, R., & Wardono, W. (2020). Contextual learning with ethnomathematics in enhancing the problem solving based on thinking levels. *JRAMathEdu (Journal of Research and Advances in Mathematics Education), 5*(3), 331–344. https://doi.org/10.23917/jramathedu.v5i3.11679

OECD. (2023). *PISA 2022 results (Volume I and II)—Country notes: Indonesia.* https://www.oecd.org/en/publications/pisa-2022-results-volume-i-and-ii-country-notes_ed6fbcc5-en/indonesia_c2e1ae0e-en.html

Pratama, R. A., & Yelken, T. Y. (2024). Effectiveness of ethnomathematics-based learning on students' mathematical literacy: A meta-analysis study. *Discover Education, 3*(1), Article 202. https://doi.org/10.1007/s44217-024-00309-1

Putri Hapsari, I., Victor Didik Saputro, T., & Damas Sadewo, Y. (2022). Mathematical literacy profile of elementary school students in Indonesia: A scoping review. *Journal of Educational Learning and Innovation (ELIa), 2*(2), 279–295. https://doi.org/10.46229/elia.v2i2.513

Putri, Y. I., & Fakhriyana, D. (2023). Application of discovery learning and inquiry learning model in improving students' mathematical literacy skills. *Jurnal Pendidikan Matematika (Kudus), 6*(2), 145–156. https://doi.org/10.21043/jpmk.v6i2.22001

Ristanti, A. M., & Murdiyani, N. M. (2021). Development of ethnomathematics-based learning tools to achieve mathematical literacy skills of junior high school students. *Ethnomathematics Journal, 2*(2), 80–91. https://doi.org/10.21831/ej.v2i2.43302

Sari, A. K., Budiarto, M. T., & Ekawati, R. (2022). Ethnomathematics study: Cultural values and geometric concepts in the traditional "tanean-lanjang" house in Madura-Indonesia. *JRAMathEdu (Journal of Research and Advances in Mathematics Education), 7*(1), 46–54. https://doi.org/10.23917/jramathedu.v7i1.15660

Sulistyawati, E., & Radite, R. (2022). Ethnomathematics study of bamboo woven model in Yogyakarta based on Liki design matrix and TTS integration in mathematics learning. *JRAMathEdu (Journal of Research and Advances in Mathematics Education), 7*(4), 237–252. https://doi.org/10.23917/jramathedu.v7i4.18170

Sulistyowati, E., & Mawardi, D. N. (2023). The effectiveness of ethnomatematics-based learning on mathematics ability of elementary school students: A meta-analysis study. *Al-Bidayah: Jurnal Pendidikan Dasar Islam, 15*(1), 1–26. https://doi.org/10.14421/albidayah.v15i1.879

Sunzuma, G., & Umbara, U. (2025). Ethnomathematics-based technology in Indonesia: A systematic review. *Asian Journal for Mathematics Education, 4*(1), 129–153. https://doi.org/10.1177/27527263241305812

Ubaidillah, M. F. M., & Khotimah, R. P. (2023). Development of student's worksheet based Bas-basan traditional game in rectangular and triangle. *JRAMathEdu (Journal of Research and Advances in Mathematics Education), 8*(3), 190–198. https://doi.org/10.23917/jramathedu.v8i3.5119

Yuliana, Y., Usodo, B., & Riyadi, R. (2023). The new way improve mathematical literacy in elementary school: Ethnomathematics module with realistic mathematics education. *AL-ISHLAH: Jurnal Pendidikan, 15*(1), 33–44. https://doi.org/10.35445/alishlah.v15i1.2591