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Ethnomathematics-Based Learning for Enhancing Mathematical Literacy in Junior High School Students

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Article	Abstract
Keywords: Ethnomathematics-Based Learning Model; Local Culture; Mathematical Literacy; Mathematics Education Article History Received: Mei 12, 2026; Reviewed: Jun 14, 2026; Accepted: Jul 11, 2026; Published: Aug 28, 2026;	<i>Mathematical literacy remains a major challenge among Indonesian students, as reflected in national and international assessment results. This study aimed to examine the effect of an ethnomathematics-based learning model on the mathematical literacy skills of eighth-grade students at SMP Makassar Raya. A quantitative approach was employed using a pre-experimental One-Group Pretest–Posttest design. The participants consisted of 15 students selected through total sampling. Data were collected through a mathematical literacy test developed based on the PISA competencies of formulate, employ, and interpret. Descriptive and inferential statistics were used for data analysis, including the One-Sample t-test and Paired-Samples t-test. The findings revealed a substantial improvement in students' mathematical literacy, with the mean score increasing from 18.13 on the pretest to 80.53 on the posttest. The One-Sample t-test indicated that the posttest mean score significantly exceeded the Minimum Mastery Criterion ($\text{Sig.} = 0.003 < 0.05$), while the Paired-Samples t-test confirmed a significant difference between pretest and posttest scores ($\text{Sig.} = 0.000 < 0.05$). These findings indicate that ethnomathematics-based learning contributes to the improvement of students' mathematical literacy skills while promoting more meaningful mathematics learning that is relevant to cultural contexts.</i>



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INTRODUCTION

Education serves a pivotal function in enhancing the quality of human resources by fostering a wide range of competencies, including mathematical literacy. Beyond the mastery of numerical calculations, mathematical literacy involves the ability to formulate, apply, and interpret mathematical knowledge within diverse real-world

contexts (Ridzkiyah & Kiki, 2021). This competence is increasingly recognized as a fundamental skill that enables students to utilize mathematical concepts effectively when addressing problems encountered in everyday life (Nursetyani et al., 2025). Furthermore, mathematical literacy equips learners with the capacity to comprehend authentic situations, make reasoned judgments, and communicate mathematical ideas in a clear and meaningful manner (Azid et al., 2023).

Within the global discourse on mathematics education, mathematical literacy is widely recognized as a fundamental competency for the twenty-first century. Its significance has been strongly emphasized through the Programme for International Student Assessment (PISA), an international assessment framework designed to examine students' capacity to transfer and apply mathematical knowledge beyond routine classroom tasks. The Organisation for Economic Co-operation and Development (OECD) conceptualizes mathematical literacy as the ability to reason mathematically and to use mathematical concepts, procedures, and representations to formulate, apply, and interpret solutions across a variety of contextualized situations. (OECD, 2019). Despite its importance, the performance of Indonesian students in mathematical literacy remains below the global average. PISA data reveal a decline in Indonesia's mathematics score from 379 in 2018 to 366 in 2022 (OCDE, 2023; OECD, 2019). These results indicate that improving mathematical literacy continues to be a critical issue within the Indonesian education system. Consequently, there is a pressing need for learning approaches that provide meaningful experiences and connect mathematical concepts with students' real-life environments (Sulihitining & Meifiani, 2025). The persistent gap in performance suggests that many students still encounter challenges in relating mathematical knowledge to practical situations they face in their daily activities.

Similar issues have also been identified at the school level. Based on interviews with mathematics teachers at SMP Makassar Raya, students were found to experience difficulties in relating mathematical concepts to everyday life. In addition, students' participation and creativity during classroom learning remained relatively low. These conditions highlight the need for innovative learning models that can enhance student engagement while simultaneously developing mathematical literacy skills.

One alternative that can be implemented to address these issues is the ethnomathematics-based learning model, which was first introduced by Nurhusain (2025). The model consists of seven learning phases, namely Connection, Attention, Review, Analysis, Discussion, Drawing conclusion, and Evaluation, collectively abbreviated as CARADDE. This model is grounded in the ethnomathematics approach, which integrates mathematical concepts with local cultural practices, thereby making learning more contextual and meaningful (D'Ambrosio, 1985; Rosa & Orey, 2020). By integrating this approach into the learning process, students are provided with opportunities to explore mathematical concepts not only as abstract knowledge but also as practical tools embedded within everyday cultural experiences.

Such learning experiences enable learners to recognize the relevance of mathematics in their social and cultural environments. This perspective aligns with the findings of Febrianingsih et al. (2024), who emphasized that ethnomathematics facilitates students' understanding of mathematical concepts by connecting them with culturally rooted activities and practices.

A growing body of research has highlighted the effectiveness of ethnomathematics-based instruction in enhancing students' mathematical competencies. Evidence from previous studies indicates that incorporating cultural elements into mathematics learning can contribute positively to students' academic achievement and conceptual understanding. In particular, Tasik et al. (2023) reported that the implementation of a realistic learning model grounded in ethnomathematical principles produced a significant improvement in students' learning outcomes. Furthermore, Nurhusain et al. (2022, 2025) emphasized that ethnomathematics-based learning is highly relevant to and compatible with the Merdeka Curriculum. Nevertheless, most of these studies have primarily focused on improving general learning outcomes and have not specifically examined its effect on mathematical literacy skills within particular local cultural contexts. Moreover, studies that directly integrate local culture into mathematics instruction to assess improvements in students' mathematical literacy remain limited, particularly in the Makassar region.

Despite substantial evidence demonstrating the positive contribution of ethnomathematics to students' academic achievement, critical thinking abilities, and mathematical conceptual understanding, studies investigating its impact on mathematical literacy within the framework of a pre-experimental design remain limited, particularly when integrated with the cultural context of Makassar. The lack of empirical research in this area highlights the need for further exploration of how culturally embedded learning approaches can foster students' mathematical literacy development. To address this limitation, the current study introduces an ethnomathematics-oriented instructional approach that integrates aspects of Makassar cultural heritage into mathematics learning. By connecting mathematical concepts with students' socio-cultural environment, the intervention seeks to create a more meaningful learning experience while strengthening students' engagement with mathematical ideas.

Accordingly, this study aims to investigate the extent to which the implementation of an ethnomathematics-based learning model affects the mathematical literacy performance of eighth-grade students at SMP Makassar Raya. From a theoretical perspective, the study contributes to the expanding body of literature on ethnomathematics by offering empirical evidence concerning its role in fostering mathematical literacy within culturally grounded learning environments. From a practical standpoint, the findings may serve as a valuable resource for educators and curriculum developers in designing mathematics instruction that is context-sensitive,

culturally responsive, and supportive of deeper student understanding and participation in the learning process.

METHOD

Research Type and Approach

This study employed a quantitative approach using a pre-experimental design to examine the effect of implementing an ethnomathematics-based learning model on students' mathematical literacy skills. The study involved only one group without a comparison class; therefore, the analysis focused on changes in students' abilities before and after the treatment (Ishtiaq, 2019).

Research Design

The research adopted a One-Group Pretest–Posttest Design. This design was selected because the study involved only one class as the experimental group. In this design, participants were first administered a pretest to determine their initial level of mathematical literacy, followed by the implementation of the ethnomathematics-based learning model as the treatment, and finally a posttest to assess changes in their mathematical literacy after the intervention (Saifuddin, 2020). Through this design, students were encouraged to understand mathematical concepts by relating them to local cultural contexts and real-life situations, thereby promoting the development of mathematical literacy in a more contextual manner.

Research Site and Time

The study was conducted at SMP Makassar Raya, located at Jl. Opu Daeng Risadju No. 422, Tamparang Keke Village, Mamajang District, Makassar City, Indonesia. The study was conducted during the second semester of the 2025/2026 academic year, specifically between February and March 2026.

Population and Sample

The study involved all eighth-grade students of SMP Makassar Raya, totaling 15 participants. Because the population was relatively small and consisted of only one class, a total sampling technique was employed, allowing all members of the population to participate in the research. This sampling approach was considered the most appropriate because it allowed the entire population to be represented, while the small population size rendered the use of random sampling methods less feasible (Fadele & Rocha, 2025; Taherdoost, 2016; Zuev, 2026).

Data Collection Technique

Data collection was carried out using a mathematical literacy test administered both before and after the implementation of the ethnomathematics-based learning intervention. The pretest was employed to identify students' initial level of mathematical literacy, whereas the posttest was used to measure learning outcomes following the intervention. Instrument development was guided by the mathematical

literacy competencies emphasized in the PISA framework, specifically the abilities to formulate, employ, and interpret mathematics in various contexts (OECD, 2019). To ensure contextual relevance, these indicators were integrated with learning activities grounded in ethnomathematical perspectives. Prior to data collection, the instrument was subjected to a content validation process involving two academic experts in the fields of mathematics education and ethnomathematics, thereby ensuring the suitability, clarity, and representativeness of the test items for the objectives of the study.

Data Analysis Technique

The analytical procedures adopted in this study comprised both descriptive and inferential statistical approaches. Descriptive statistics were utilized to summarize the level of students' mathematical literacy before and after exposure to the ethnomathematics-based learning intervention. The analysis incorporated measures of central tendency and dispersion, including the mean, median, mode, variance, standard deviation, minimum score, and maximum score derived from the pretest and posttest results. To address the research objectives and verify the proposed hypotheses, inferential analyses were subsequently undertaken. These analyses focused on examining the extent to which the instructional intervention contributed to improvements in mathematical literacy outcomes. Specifically, a One-Sample t-test was employed to determine whether the mean posttest score exceeded the Minimum Mastery Criterion (MMC). In addition, a Paired-Samples t-test was conducted to compare students' performance before and after the intervention, thereby establishing whether the increase in mathematical literacy achievement was statistically significant. (Zuev, 2026).

RESULTS AND DISCUSSION

This section is the most important section of your article. The analysis or results of the research should be clear and concise. The results should summarize (scientific) findings rather than providing data in great detail. Please highlight differences between your results or findings and the previous publications by other researchers.

Research Results

The results of this study are presented to address the research objective of examining the effect of an ethnomathematics-based learning model on the mathematical literacy skills of eighth-grade students at SMP Makassar Raya. The data were analyzed through two stages, namely descriptive and inferential analyses, using the pretest and posttest results.

a. Descriptive analysis of mathematical literacy skills

The descriptive analysis revealed that students' mathematical literacy skills were initially at a relatively low level prior to the intervention. After the implementation of the ethnomathematics-based learning model, an improvement in students' mathematical literacy was observed, as reflected in the higher posttest mean score compared to the pretest mean score. A summary of the descriptive statistics for

students' mathematical literacy skills is presented in Table 1.

Table 1. Descriptive Statistics of Students' Mathematical Literacy Skills

Statistics	Pretest	Posttest
Sample size	15	15
Ideal score	100	100
Mean	18,13	80,53
Median	17	81
Mode	10	75
Standard deviation	9,102	5,975
Variance	82,838	35,695
Maximum	35	90
Minimum	5	71
Range	30	19
Achieved mastery	0	14 (93,33%)
Did not achieve mastery	15 (100%)	1 (6,67%)

The data presented in Table 1 indicate that the pretest results reflected not only a generally low level of mathematical literacy among students but also considerable variation in performance across individuals. This finding highlights the need for more adaptive and contextual learning strategies to improve students' mathematical literacy comprehensively. In contrast, the posttest results show that students achieved not only a high level of performance but also a relatively homogeneous distribution of scores. In other words, the results demonstrate not only a high mean score but also a strong level of consistency across students. This condition suggests that the implemented learning process contributed to an overall improvement in students' mathematical literacy skills, with a learning mastery rate of 93.33%. The increase in posttest scores further indicates positive changes in students' mathematical literacy skills following their participation in ethnomathematics-based learning.

b. Normality test

A normality test was conducted using the Shapiro–Wilk test because the sample size was fewer than 50 participants. The results are presented in Table 3.

Table 2. Results of the Shapiro–Wilk Normality Test

	Shapiro-Wilk		
	Statistic	df	Sig.
Pre_Test	,954	15	,591
Post_Test	,919	15	,189

The normality test results showed that the significance values for both the pretest and posttest exceeded 0.05, indicating that the data met the assumption of normal distribution. Consequently, parametric statistical procedures were considered appropriate and were applied in the subsequent analyses.

- c. Posttest compared with the minimum mastery criterion

Table 3. One-Sample t-Test

Test Value = 75						
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Posttest	3.587	14	.003	5.533	2.22	8.84

The One-Sample t-test analysis indicated that the average posttest score was significantly above the Minimum Mastery Criterion (MMC = 75), as reflected by the test results ($t = 3.587$; $p = 0.003 < 0.05$). This result suggests that, following the implementation of the ethnomathematics-based learning model, students not only demonstrated improved mathematical literacy skills but also achieved performance levels that exceeded the established mastery benchmark.

- d. Comparison of students' mathematical literacy scores in the pretest and posttest

Table 4. Paired-Samples t-Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-62,400	8,990	2,321	-67,379	-57,421	-26,881	14	,000

The Paired-Samples t-test results revealed a statistically significant difference between students' scores before and after the intervention, with a significance value of 0.000, which was below the 0.05 criterion. The mean difference of -62.400 indicates a substantial improvement in students' performance, as reflected by the considerably higher posttest scores compared to the pretest scores. These results indicate that the ethnomathematics-based learning model effectively enhanced students' mathematical literacy skills and generated significant improvements from both statistical and educational perspectives.

- e. Summary of findings

The analysis yielded several key findings. First, students' mathematical literacy skills before the intervention were still below the Minimum Mastery Criterion (MMC). Second, a substantial improvement in mathematical literacy was observed following the implementation of the ethnomathematics-based learning model, as indicated by the increase in average scores and a learning mastery rate of 93.33%. Third, the results demonstrated that the ethnomathematics-based learning model positively influenced the development of students' mathematical literacy skills. Finally, the instructional process incorporated local cultural contexts as learning resources to support students' understanding of mathematical concepts.

Discussion

The findings of this study indicate that the ethnomathematics-based learning model was effective in improving the mathematical literacy skills of eighth-grade students at SMP Makassar Raya. The improvement was evident not only in the higher posttest scores compared with the pretest scores but also in the inferential statistical results,

which indicated a significant effect at the 95% confidence level.

a. Analysis of initial ability: indications of low mathematical literacy

The relatively low average score obtained prior to the intervention ($M = 18.13$) indicates that students had not yet adequately developed the fundamental dimensions of mathematical literacy, namely the abilities to formulate, employ, and interpret mathematical concepts. This result suggests that the instructional practices previously experienced by students were still insufficient in fostering higher-order thinking skills and in promoting the application of mathematics to contextual problem-solving situations.

These findings align with the broader perspective of mathematical literacy, which extends beyond procedural proficiency and encompasses the capacity to comprehend, interpret, and utilize mathematical knowledge effectively in diverse real-life contexts (Ridzkiyah & Kiki, 2021). The limited level of students' initial mathematical literacy also reflects trends reported in international assessments, particularly PISA, where Indonesian students have consistently performed below the global benchmark in mathematics literacy (OCDE, 2023; OECD, 2019). In addition, Nursetyani et al. (2025) highlighted that mathematical literacy constitutes a crucial educational outcome because it equips learners with the ability to apply mathematical understanding to authentic situations encountered in everyday life. Consequently, strengthening mathematical literacy should remain a central objective within mathematics education to better prepare students for the challenges of contemporary society.

These results are supported by Amidi et al. (2025) who found that students' low mathematical literacy is influenced by their limited ability to connect mathematics with everyday contexts and by low levels of learning independence. Their study demonstrated that mathematics instruction that is abstract and detached from students' cultural experiences contributes to difficulties in understanding and interpreting contextual problems. Similarly, Sulihitining & Meifiani (2025) argued that low mathematical literacy remains a major challenge in mathematics education because students are not sufficiently accustomed to dealing with contextual problems that require integrated reasoning, application, and interpretation skills. Likewise, Hidayat & Linda (2023) explained that mathematics is often presented in schools as a culturally neutral discipline, making it difficult for students to recognize its relevance to everyday life. As a result, students tend to exhibit low mathematical reasoning skills and limited engagement in the learning process.

b. Improving mathematical literacy: the role of cultural context in learning

Students' mathematical literacy showed substantial improvement following the implementation of the ethnomathematics-based learning model. This progress was indicated by an average posttest score of 80.53 and a learning mastery rate reaching 93.33%. These findings imply that incorporating local cultural contexts into mathematics instruction can enhance students' understanding and create more meaningful learning experiences.

The observed improvement may be explained by the fundamental nature of ethnomathematics, which links mathematical concepts to students' daily lives and cultural experiences. By connecting learning materials with familiar contexts, students are better able to comprehend mathematical ideas and recognize their relevance in real-world situations. Through the incorporation of Makassar cultural contexts into classroom activities, mathematical concepts became more accessible and relevant to students. As a result, learners were better able to construct understanding because the instructional content was closely connected to the cultural values, practices, and social environments with which they were already familiar. These findings are consistent with the perspectives of D'Ambrosio (1985) and Rosa & Orey (2020), who argued that ethnomathematics serves as a bridge between formal mathematics and cultural practices, thereby making learning more meaningful and contextual. Sarwoedi et al. (2018) also emphasized that cultural activities such as measuring, counting, pattern-making, and other traditional practices represent concrete manifestations of mathematical concepts that can strengthen students' understanding.

Further evidence of the effectiveness of the ethnomathematics-based learning model was obtained from the inferential statistical analysis. The One-Sample t-test results showed that the mean posttest score was significantly higher than the predetermined Minimum Mastery Criterion, with a significance value of 0.003, which was below the 0.05 level. Likewise, the Paired-Samples t-test revealed a significant difference between students' pretest and posttest scores, as indicated by a significance value of 0.000. These findings demonstrate that the improvement in students' performance was statistically significant and unlikely to have occurred by chance.

Moreover, the findings indicate that the ethnomathematics-based learning model positively influenced not only students' overall learning achievement but also their mathematical literacy skills. The integration of cultural contexts into mathematics instruction appears to have provided meaningful learning experiences that supported students' ability to understand and apply mathematical concepts more effectively. By engaging students in learning experiences that integrate mathematical concepts with culturally meaningful contexts, the model appears to have strengthened their ability to understand, apply, and interpret mathematics in ways that are relevant to real-world situations. Moreover, the observed improvement is not merely statistically significant but also pedagogically meaningful, as students not only improved their scores but also exceeded the established mastery criterion.

The findings of this study are consistent with previous research demonstrating that ethnomathematics-based learning contributes positively to students' mathematics achievement, critical thinking skills, mathematical reasoning, self-confidence, and mathematical literacy (Amidi et al., 2025; Batiibwe, 2024; W. Hidayat et al., 2025; Lola et al., 2026; Tasik et al., 2023). Similarly, Mumu et al. (2026) reported that mathematics learning grounded in local cultural contexts contributes positively to students' engagement, problem-solving abilities, and mathematical literacy in a variety of educational settings. Their study emphasized that the incorporation of cultural

elements into mathematics education enhances the relevance and accessibility of mathematical concepts, as learning experiences become closely aligned with students' social and cultural backgrounds.

Further support is provided by the work of Asare (2026) who found that ethnomathematics-oriented instruction promotes more positive learning attitudes, increases classroom participation, and strengthens students' capacity to relate mathematical concepts to cultural activities encountered in everyday life. Students who are able to identify mathematical ideas within familiar cultural practices tend to demonstrate greater confidence and a higher level of involvement in the learning process. In a similar vein, Payadnya et al. (2024) concluded that embedding cultural contexts into mathematics instruction fosters stronger student engagement and encourages learners to view mathematics as a meaningful component of daily life rather than as a purely abstract discipline detached from real-world experiences.

c. Contextual learning and the development of 21st-century skills

The effectiveness of the ethnomathematics-based learning model observed in this study indicates that its benefits may extend beyond the enhancement of mathematical literacy alone. The model also has the potential to foster competencies that are essential for success in the twenty-first century. As a fundamental educational outcome, mathematical literacy involves a range of complex cognitive processes, including mathematical reasoning, critical analysis of information, the selection of appropriate problem-solving strategies, and the interpretation of results within meaningful contexts (OECD, 2019; Ridzkiyah & Kiki, 2021). These competencies are closely associated with the skills required to address challenges in contemporary society.

Accordingly, the significant improvement in students' mathematical literacy skills observed in this study indicates the potential development of higher-order thinking skills (HOTS). Through learning activities that encourage students to engage with contextual problems that are relevant to their cultural backgrounds, students are provided with opportunities to evaluate information, construct logical arguments, and apply mathematical knowledge in authentic situations. Such learning experiences support the development of advanced cognitive abilities, which are increasingly recognized as essential components of effective mathematics education. This finding is consistent with Hidayat et al. (2025), who reported that the integration of ethnomodelling into mathematics instruction significantly enhances students' mathematical critical thinking skills. Through exploration, analysis, and problem-solving activities grounded in cultural contexts, students are encouraged to develop deeper conceptual understanding while strengthening their mathematical argumentation skills. Similar conclusions were drawn by Hendriana et al. (2022), who found that ethnomathematics-based learning contributes simultaneously to the development of mathematical hard skills and soft skills.

In addition, the core dimensions of mathematical literacy—namely formulate, employ, and interpret—require learners to demonstrate competencies that extend beyond procedural proficiency. Students are expected to identify and structure

problems mathematically, select and apply relevant concepts and strategies, and critically evaluate the validity of solutions within specific contexts (OECD, 2019). Such abilities represent fundamental aspects of effective problem-solving and informed decision-making, both of which are widely recognized as essential competencies in twenty-first-century education (Nursetyani et al., 2025).

From a pedagogical standpoint, these findings indicate that the ethnomathematics-based learning model offers considerable potential as an instructional alternative for mathematics education. By situating mathematical learning within meaningful cultural contexts, the model not only facilitates conceptual understanding but also encourages the simultaneous development of critical thinking, mathematical reasoning, and problem-solving abilities. Consequently, ethnomathematics-based instruction can support a more holistic learning process that equips students with the cognitive skills necessary to address complex challenges both within and beyond the classroom. This conclusion is supported by Batiibwe (2025), who emphasized the significant potential of ethnomathematics as a pedagogical approach for promoting conceptual understanding, problem-solving abilities, and meaningful connections between mathematics and students' cultural experiences. Consequently, the implementation of this model is relevant not only for improving academic achievement but also for preparing students to face increasingly complex social, cultural, and technological challenges in the future (Hidayat et al., 2023).

d. Relevance of ethnopedagogy in the Society 5.0 Era

The findings of this study are also relevant to educational developments in the Society 5.0 era, which emphasizes contextual, human-centered, and culturally responsive learning. Hidayat et al. (2023) argued that ethnopedagogical approaches are highly relevant to contemporary educational challenges because they integrate technology, culture, and future-oriented competencies. In addition, Batiibwe (2025) noted that ethnomathematics programs offer considerable opportunities for enhancing conceptual understanding, problem-solving skills, and cultural values, although their implementation continues to face challenges related to the availability of cultural learning resources and teachers' pedagogical readiness. Within this context, ethnomathematics-based learning not only preserves local cultural values but also helps students develop adaptive, creative, and problem-solving abilities required in modern society. The integration of local culture into classroom instruction also serves as a means of cultural preservation while strengthening local identity amid technological advancement and globalization.

This study contributes theoretically by strengthening the body of knowledge supporting ethnomathematics as an effective instructional approach for improving mathematical literacy through local cultural contexts. Furthermore, it extends the application of ethnomathematics within the context of Makassar culture as a meaningful and contextual learning resource. Practically, the findings may serve as a reference for teachers in designing more innovative, contextual, and culturally responsive mathematics instruction aligned with the principles of the Merdeka Curriculum.

The study has several limitations. The relatively small sample size and the use of a pre-experimental design without a control group limit the generalizability of the findings. In addition, the study was conducted over a relatively short period and focused on a single local cultural context.

CONCLUSION

This study investigated the impact of an ethnomathematics-based learning model on the mathematical literacy skills of eighth-grade students at SMP Makassar Raya. The results indicated that the implementation of the model significantly improved students' mathematical literacy. This improvement was reflected in the increase from pretest to posttest mean scores, the high percentage of students achieving learning mastery, and the statistical analyses showing significant differences between students' performance before and after the intervention. The findings suggest that the incorporation of local cultural contexts into mathematics learning enables students to better understand, apply, and interpret mathematical concepts in relation to their everyday experiences. These results support the notion that ethnomathematics is an effective approach for enhancing mathematical literacy through contextualized and meaningful learning. In addition, ethnomathematics-based instruction may contribute to the development of critical thinking, mathematical reasoning, and problem-solving abilities, which are recognized as important competencies for the 21st-century. Based on these findings, mathematics teachers are encouraged to incorporate local cultural elements into instructional practices to strengthen students' mathematical literacy. Schools may also facilitate the development of ethnomathematics-oriented learning materials that provide more relevant and contextual learning experiences. Furthermore, the results of this study may serve as a useful reference for future research on ethnomathematics in different educational and cultural contexts.

Despite these positive outcomes, several limitations should be acknowledged. The study was limited to a single school and one cultural setting, which may affect the broader applicability of the findings. Moreover, the investigation focused only on short-term effects and on mathematical literacy as the primary outcome. Future studies are recommended to involve larger and more diverse samples and to examine the influence of ethnomathematics-based learning on other educational outcomes, including critical thinking, problem-solving skills, and the long-term sustainability of learning achievements.

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