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ETHNOMATHEMATICAL PRACTICES AND THEIR INFLUENCE ON ELEMENTARY LEARNERS' NUMERICAL LITERACY: A QUASI-EXPERIMENTAL STUDY

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Abstract

This quasi-experimental study investigates the impact of ethnomathematical practices integrated into the Realistic Mathematics Education (RME) model on the numerical literacy of elementary students in Tasikmalaya, Indonesia. The research addresses the persistent issue of low numeracy skills among Indonesian students, as evidenced by national assessments and international benchmarks such as PISA. A total of 59 fifth-grade students were selected through cluster random sampling from SD Negeri Kasturi and divided into control and experimental groups. The experimental group received instruction using an RME model enriched with local cultural contexts, while the control group followed conventional methods. Data collection instruments included validated questionnaires and observation sheets, with analysis conducted through normality and homogeneity testing, followed by independent t-tests. Results indicated a statistically significant difference in post-test scores, with the experimental group outperforming the control group ($t = 2.931 > t_t = 2.771$). Observational data further revealed increased student engagement and participation in culturally contextualized learning activities. The findings suggest that integrating ethnomathematics into instruction enhances students' numerical literacy by providing relevant, engaging, and meaningful learning experiences. This study contributes to the discourse on culturally responsive pedagogy and offers practical implications for curriculum development in diverse educational settings.

Keywords: Cultural Context**,** Ethnomathematics**,** Numerical Literacy**,** Quasi-Experimental Study**,** Realistic Mathematics Education.

INTRODUCTION

Mathematics plays a central role in developing students' logical and analytical thinking from an early age. One of the most essential aspects in primary mathematics education is **numerical literacy**, which refers to the ability to understand, interpret, and effectively apply numbers in real-life situations.

However, the level of numeracy among elementary school students in Indonesia remains concerning. According to the **2023 National Assessment Report** by the Ministry of Education, Culture, Research, and Technology, more than **47% of Indonesian elementary students are categorized as having low numeracy skills**,(Kementerian Pendidikan dan kebudayaan, 2023). particularly in understanding fundamental number concepts and applying them in daily contexts. This issue is also reflected in the **2022 PISA results**, in which Indonesia ranks among the lowest in mathematics proficiency compared to other Southeast Asian countries (OECD, 2023) .

This low performance in numeracy is not merely attributed to cognitive factors but is also linked to the **lack of contextual relevance in mathematics instruction**. Traditional classroom approaches often alienate students from meaningful learning experiences, disconnecting them from their own cultural backgrounds. In this regard, **ethnomathematics** becomes a relevant pedagogical solution, as it seeks to relate abstract mathematical concepts to values, symbols, practices, and cultural traditions familiar to students. Through ethnomathematics, learners engage with mathematics in a more contextual and meaningful way, enhancing their ability to comprehend and apply numerical concepts effectively.

Several recent studies have highlighted the potential of ethnomathematics in improving students' mathematical understanding. For instance, (Febriyanti et al., 2019) reported that traditional games-based ethnomathematical approaches significantly increased student engagement and conceptual understanding in mathematics. (Iswara et al., 2022) Found that integrating local culture into mathematics teaching improved numeracy skills among students in rural areas. (Hidayati & Prahmana, 2022; Salsinha & N., 2021; Zuhri et al., 2024) observed that students exposed to culturally-based learning showed notable progress in counting and reasoning skills. Similarly, (Iswara et al., 2022; Tampubolon et al., 2023) demonstrated that contextual learning grounded in ethnomathematics enhanced the numerical literacy of lower-grade students in remote regions. Moreover, (Nurkamilah et al., 2018) concluded that such methods contribute positively to students' attitudes toward mathematics. While these studies support the positive effects of ethnomathematical practices, most have focused on **affective aspects or general engagement** rather than **directly measuring the impact on numerical literacy in a structured and experimental manner**. Furthermore, limited research has employed **quasi-experimental designs** to quantitatively evaluate the influence of ethnomathematics on students' numeracy, particularly in **Tasikmalaya**, a region rich in cultural heritage.

Given these conditions, this study addresses a relevant gap in the literature by investigating **the effect of ethnomathematical practices on students' numerical literacy using a quasi-experimental design**. Additionally, the **lack of research exploring the application of Tasikmalaya's local culture in mathematics instruction at the primary level** highlights the significance of this study in promoting culturally grounded learning strategies.

This study specifically aims to: (1) **identify the effectiveness of ethnomathematical practices in enhancing students' numerical literacy**, and (2) **empirically examine the influence of local-culture-based approaches on elementary learners' numeracy performance**, with the research site being **SD Negeri in Tasikmalaya, Indonesia**. The main focus of this research lies in students' **ability to apply numerical reasoning in real-life and culturally relevant contexts**, including understanding, computation, and logic-based problem solving.

The expected contributions of this study are both theoretical and practical. Theoretically, it will enrich the literature on culturally integrated mathematics education and provide a model for developing numeracy grounded in local wisdom. Practically, the results can serve as a guide for elementary school teachers in designing mathematics instruction that is relevant to students' daily lives and cultural identities. Furthermore, the outcomes may support educational policymakers and local governments in promoting a curriculum that embraces **contextual and culturally responsive mathematics learning**, particularly in Tasikmalaya and other culturally diverse regions

RESEARCH METHOD

This study employed a **quantitative approach** with a **quasi-experimental design**. This approach was chosen to measure the effect of implementing a **Realistic Mathematics Education (RME) model integrated with ethnomathematics** on the **numerical literacy** of elementary students in a setting where full individual randomization was not feasible, but **group-level randomization** was possible.

The population of this study consisted of all fifth-grade students at **SD Negeri Kasturi, Cikijing Sub-district, Majalengka Regency**, during the 2024/2025 academic year. The sampling technique used was **cluster random sampling**, which involves selecting intact classroom groups randomly. Based on this technique, two fifth-grade classes were selected as the sample: **Class V (Local 1) as the control group**, and **Class V (Local 2) as the experimental group**. The total number of students involved in the study was **59**, consisting of **39 female and 20 male students**.

The study adopted a **non-equivalent control group design**, a form of quasi-experiment. In this design, both groups were administered a pre-test and post-test; however, the instructional strategies differed. The experimental group received instruction using the **RME model based on ethnomathematical principles**, while the control group was taught using **conventional teaching methods** typically used by classroom teachers.

Data were collected using two main instruments: **questionnaires** and **observation sheets**. The questionnaire was used to measure students' levels of numerical literacy, whereas the observation sheets were designed to assess students' engagement and learning activities during the instructional process. All research instruments underwent **content validation** by subject-matter experts in mathematics education and assessment. Following validation, a **pilot test** was conducted on a class with similar characteristics to the research sample. The pilot test was carried out to ensure the **reliability** of the instruments and to analyze the **item difficulty index** and **discriminating power**. Reliability was measured using **Cronbach's Alpha coefficient**, while the analysis of difficulty level and discriminating index was applied to evaluate the quality of each questionnaire item related to numeracy.

Data analysis was conducted in two main stages. First, to examine the **effect of the ethnomathematics-based RME model on students' numerical literacy**, a **simple linear regression analysis** was used. This analysis aimed to determine the significant influence of the instructional model (independent variable) on students' numeracy outcomes (dependent variable). Second, to determine **the difference in numerical literacy between the students taught using the conventional method and those taught using the ethnomathematics-based RME model**, an **independent samples t-test** was employed. Prior to hypothesis testing, **normality and homogeneity tests** were conducted to ensure that the data met the assumptions required for parametric analysis. All data processing and statistical analyses were conducted using appropriate statistical software to ensure precision and validity of the results.

RESULT AND DISCUSSION

In this experimental study, the learning process was carried out over five sessions. Four sessions were allocated for instructional activities, and one session was dedicated to the post-test. The test instrument initially consisted of 12 items, which were first trialed on sixth-grade students at SD Negeri Kasturi Cikijing, Majalengka Regency. As a result of the trial, five items were selected to be used in the post-test.

The implementation of the Realistic Mathematics Education (RME) model integrated with ethnomathematics was assessed through student activities during the learning process, using observation as the evaluation method. Observations were conducted directly during the treatment phase in the experimental class. These observations took place over the course of four sessions, in line with the delivery of the treatment. The results of the student

activity observation sheet during the RME-based learning integrated with ethnomathematics are presented in Table 1 below :

Table 1. observations result

Learning process	Average score of the meeting			
	1	2	3	4
1	2,89	3,11	3,39	3,71
2	3,04	3,25	3,68	3,93
3	2,93	3,11	3,54	4,00
4	2,86	3,04	3,32	3,61
5	2,82	3,14	3,32	3,61
Average	2,91	3,13	3,45	3,77
Percentage	72,68%	78,21%	86,25%	94,29%

Based on Table 1, it can be observed that the implementation of the Realistic Mathematics Education (RME) model integrated with ethnomathematics showed a consistent increase in percentage at each meeting. This improvement was attributed to the teacher's ongoing efforts to refine and enhance teaching strategies throughout each session. The RME-based learning model that incorporates ethnomathematical elements follows five distinct phases. In the first phase, students are presented with contextual problems to help them conceptualize three-dimensional geometric shapes by connecting them with local cultural elements (understanding the problem). In the second phase, students are encouraged to investigate the given problem while observing the teacher's explanation, particularly how the content is related to culture (explaining the problem). During the third phase, the teacher guides students in solving the problem by linking it to relevant cultural practices (solving the problem). In the fourth phase, one student is asked to present their solution to the class, followed by a group discussion comparing responses and encouraging peer feedback (comparing and discussing answers). Finally, in the fifth phase, the teacher provides a conclusion by summarizing the lesson and emphasizing its cultural relevance (drawing conclusions).

The execution of this instructional approach in the experimental class was found to be highly effective, as reflected in the final observation during the fourth meeting, which showed a high percentage of 94.29%. Students in the experimental class demonstrated a high level of enthusiasm, largely due to the inclusion of ethnomathematical elements and engaging games throughout the learning process. This stands in contrast to the control class, which applied a conventional teaching model. In the control group, several students tended to disengage and play on their own while the teacher was delivering the lesson. Moreover, student participation remained relatively low in that setting, as the learning process was still predominantly teacher-centered. Next,to determine the difference inability improvement between control classes, testing continues

using parametric statistics (t-test), by determining the hypothesis to be tested, presented in Table 2**.**

Table2. Hypothesis details

Research Hypothesis	Statistical Hypothesis
• H_0 **(Null Hypothesis):** *There is no significant difference in numeracy literacy skills between students who receive conventional learning and those who receive learning through the Realistic Mathematics Education (RME) model based on ethnomathematics.*	$H0:\mu1=\mu2$
• H_a **(Alternative Hypothesis):** *There is a significant difference in numeracy literacy skills between students who receive conventional learning and those who receive learning through the Realistic Mathematics Education (RME) model based on ethnomathematics.*	$H\alpha:\mu1>\mu2$

Before testing the hypothesis, the researcher first carried out prerequisite tests, namely the normality test and homogeneity test (Zakiah et al., 2020; Zuhri et al., 2024). the output results for normality test can be seen in table 3.

Table3. Shapiro–WilkTest

	Statistic	Df	Sig
PreTestExperiment	0.961	29	0.225
PostTestEksperimen	0.962	29	0.300
PreTestControl	0.97	29	0.202
PostTestControl	0.99	29	0.284

Based on Table 3 calculations using the Shapiro-Wilk test in the table above, it can be concluded all of data is normal distribution, next that results of homogeneity test calculations for both the experimental class and the control class searched using SPSS are presented in Table 4.

Table4. Summary of Homogenity Test Result

Class	Varians	Fcount	Ftable	Information	Conculation
Experiment	0.093	2.995	3.38519	Fcount<Ftable	Homogen
Control	0.159				

From Table 4, the Fcount< Ftablevalue is obtained with a significance level of α=0.05 so it can be concluded that the data for the two samples are homogeneous. So the t test can be continued because it meets

both conditions, namely that the data is normally distributed and homogeneous. Asummary of the t- test results can be seen in table 5.

Table 5. Summary of t-test Result

Statistical Hypothesis	Tcount	Ttable	Information
$H0$:$\mu1$=$\mu2$	2.931	2.771	Hareceived

From Table 5 it is known thatthe tcountis 2,931 and the table is 2.771, namely tcount>ttable. Thus, the hypothesis is accepted, which means that the average increase in the mathematical literacy skills of students taught using the PjBL learning model is greater than the average increase in the mathematical literacy skills of students taught using the regular learning model.

The results of the independent t-test hypothesis testing indicate a significant difference in numerical literacy outcomes between students taught using conventional methods and those engaged with the **Realistic Mathematics Education (RME)** model based on ethnomathematics. This is evidenced by the value of **tcount = 2.931**, which exceeds **ttable = 2.771**, implying that the null hypothesis is rejected and the alternative hypothesis is accepted. Thus, there is a statistically significant difference in students' post-test scores between the experimental and control groups. The average post-test score of the experimental group was **63.45**, which was considerably higher than that of the control group, which was **42.48**.

This difference reflects the positive impact of the RME model incorporating ethnomathematical elements on students' numerical literacy. The approach emphasizes real-life contexts, allowing students to develop their numeracy skills through meaningful problem-solving. The integration of culturally relevant materials made the learning process more engaging, contextual, and enjoyable, thereby increasing students' motivation and active participation in class.

Observation data regarding the implementation of the RME-based learning model support these findings. All instructional stages, as described by **Wahyudi (2020)**—*understanding contextual problems, explaining the context, solving problems, comparing and discussing solutions, and concluding*—were successfully applied during the lessons. While the first meeting faced technical challenges, particularly with the preparation of ethnomathematical media for projection, the instructional stages were still properly executed despite time constraints.

By the second session, improvements were evident in classroom time management, and students began to ask questions and express their opinions more actively. The third meeting saw even more interaction between students and the teacher, especially when guiding students through contextual problem-solving. In the fourth session, student engagement further increased during group discussions and presentations.

Quantitative observation results also showed a consistent rise in implementation quality across meetings. In the first session, the implementation score reached **72.68%**,

categorized as *good*. This rose to **78.21**% in the second meeting, **86.25**% in the third, and finally **94.29**% in the fourth, which was categorized as *very good*. These improvements suggest that the RME model based on ethnomathematics was implemented effectively and supported the development of students' numerical literacy skills.

Field observations also revealed students' high enthusiasm when solving ethnomathematical problems. The use of culturally embedded tasks created a joyful learning atmosphere and fostered active engagement. In the experimental group, students were more involved in learning activities—asking questions, sharing ideas, and solving mathematical problems. These findings are consistent with the study by (Azmi et al., 2018; Nursyahidah et al., 2018; Revina & Leung, 2019; Risdiyanti et al., 2019) who stated that students engaged in RME-based instruction tend to be more active and capable of solving contextual problems using real objects in their own ways, making the learning experience both meaningful and enjoyable. Moreover, students demonstrated confidence in presenting their work

In contrast, the control group, which was taught through conventional methods, showed lower student involvement. Some students were observed to be disengaged, preferring to play while the teacher explained the material. The teacher-centered nature of conventional instruction limited student interaction and reduced learning effectiveness, particularly in fostering numeracy skills.

The students' performance in the post-test was also influenced by the frequency and quality of practice provided during the learning process. Students in the experimental group, who regularly practiced solving contextual problems, appeared more confident and capable when completing post-test tasks. On the other hand, many students in the control group struggled to complete the test effectively, suggesting that traditional instruction did not adequately prepare them for complex problem-solving.

These findings are in line with previous research. (Fauzi & Lu'luilmaknun, 2019; Febriyanti et al., 2018, 2019; Iswara et al., 2022; Maulida, 2020; Saribu et al., 2018)reported that the implementation of the RME model based on ethnomathematics was more effective than conventional approaches and positively impacted students' mathematical literacy. Similarly, a study conducted by (Tampubolon et al., 2023)also confirmed that students taught through RME demonstrated higher levels of numerical literacy compared to those in conventional settings. These consistent findings reinforce the conclusion that the **RME model integrated with ethnomathematics significantly enhances elementary students' numerical literacy**.

CONCLUSION

This study provides empirical evidence supporting the integration of ethnomathematical practices into mathematics instruction through the Realistic Mathematics Education (RME) model as an effective strategy to enhance numerical literacy among elementary learners. The findings indicate a statistically significant improvement in students' numeracy skills when learning is contextualized through culturally relevant content. Quantitative analysis, supported by observation data, demonstrates that the experimental group outperformed the control group in post-test scores, reflecting the pedagogical value of embedding local cultural elements into mathematical instruction.

The consistent increase in student engagement and performance across instructional sessions further underscores the potential of culturally responsive approaches to foster deeper mathematical understanding. Ethnomathematics not only bridges the gap between abstract mathematical concepts and students' lived experiences but also promotes active learning, motivation, and critical thinking. These results suggest that incorporating local cultural contexts into mathematics curricula can be an impactful

approach to addressing low numeracy levels, particularly in culturally rich regions such as Tasikmalaya. It is recommended that educators and curriculum developers consider adopting ethnomathematics-based RME models to create meaningful learning experiences that are both contextually relevant and pedagogically sound. From a theoretical standpoint, this study contributes to the growing body of literature advocating for culturally grounded mathematics education. Practically, it offers actionable insights for teachers and policymakers aiming to improve numeracy outcomes through localized, inclusive teaching strategies. Future research is encouraged to explore the long-term impacts of such models across diverse educational settings and cultural groups.

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