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THE EFFECTIVENESS OF LOCAL CULTURE-BASED MATHEMATICS LEARNING IN IMPROVING THE NUMERACY LITERACY OF STUDENTS

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Abstract

Students' numeracy literacy remains a significant challenge in higher education, particularly for prospective elementary teachers who must apply mathematical concepts in real-life contexts. This study aimed to examine the effectiveness of Gorontalo culture-based mathematics learning in enhancing numeracy literacy among fifth-semester students in the Pendidikan Guru Madrasah Ibtidaiyah program at IAIN Sultan Amai Gorontalo. A one-group pretest–posttest experimental design was employed with 38 students, using validated essay tests to measure their ability to interpret quantitative information, solve contextual problems, and apply numerical reasoning. Data were analyzed using the Wilcoxon signed-rank test and N-Gain analysis. Results indicated a significant improvement in numeracy literacy, with mean scores increasing from 38.98 in the pretest to 77.82 in the posttest ($Z = -5.374$, $p < 0.001$). The mean N-Gain score of 0.64 reflected moderate effectiveness. The integration of specific Gorontalo cultural elements, including Karawo embroidery motifs, traditional house architecture (Dulohupa and Bandayo Poboide), and musical instruments (Polopalo and Gambus), helped students relate abstract geometric concepts to familiar contexts and increased engagement. In conclusion, Gorontalo culture-based mathematics learning is an effective and innovative approach to improve numeracy literacy while fostering cultural awareness among prospective teachers. This study highlights the value of integrating ethnomathematics in higher education to strengthen both mathematical competence and appreciation of local wisdom.

Keywords: Gorontalo culture, ethnomathematics, numeracy literacy, mathematics learning, culture-based education.

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INTRODUCTION

Higher education serves as a strategic platform to prepare the next generation to navigate the challenges of today's world. One of the essential competencies required is numeracy literacy, which indicates an individual's capability to interpret, manipulate, and apply numerical and symbolic information in various practical settings (Geiger & Schmid, 2024). Numeracy literacy is not merely a calculation skill but also encompasses logical, critical, and analytical thinking abilities in solving everyday problems (Grotlüschen et al., 2020; Paunno et al., 2025).

However, the reality in several Indonesian universities, such as Universitas Putra Indonesia YPTK Padang (Devita & Rismaini, 2024), Universitas Musamus Merauke (Kaize et al., 2024), and IAIN Sultan Amai Gorontalo (Asriyati & Hulukati, 2022) shows that students' numeracy proficiency remains low. This condition is characterized by students' limited ability to interpret quantitative information, apply mathematical concepts to real-world contexts, and solve problems that require numerical reasoning. Several factors contribute to this issue, including teacher-centered instructional practices, limited integration of contextual and problem-based learning, students' low mathematical self-efficacy, and insufficient opportunities to engage in numeracy tasks across disciplines.

As a result, students often experience difficulties understanding data, making informed decisions, and developing higher-order thinking skills, which ultimately hinder their academic performance and their readiness to face complex challenges in both professional and societal contexts. This situation is further exacerbated by students' tendency, particularly those in the PGMI (Pendidikan Guru Madrasah Ibtidaiyah) program at IAIN Sultan Amai Gorontalo, to rely heavily on lecturers during the learning process. Consequently, graduates' competitiveness remains limited, and their ability to solve contextual problems in society remains weak. In fact, prospective elementary school teachers are expected to possess strong numeracy skills to foster similar competencies in their future students.

One innovative approach that can address this issue is culture-based mathematics learning, commonly referred to as ethnomathematics. Theoretically, ethnomathematics is grounded in sociocultural learning theory, which views knowledge as socially constructed through social interaction and cultural practices. From this perspective, mathematical understanding develops when learners connect formal mathematical concepts with culturally meaningful activities and authentic real-life experiences, thereby making mathematics an integral part of students' social and cultural lives (Rosa & Orey, 2011). Empirical evidence supports this view, showing that the integration of mathematics into local cultural artifacts and practices, such as those documented in the Yogyakarta context, facilitates deeper conceptual understanding by situating learning within familiar cultural environments (Sugiman et al., 2025). Furthermore, Suryaningsih & Putriyani (2022) developed a learning module integrating Betawi cultural

ethnomathematics into the teaching of plane geometry at the elementary school level, with findings indicating that the module was feasible and received positive responses from students.

In addition, ethnomathematics aligns closely with social constructivist theory, which emphasizes that learners actively construct knowledge through social interaction, collaboration, and engagement in meaningful learning contexts. Annisa et al. (2025) argue that learning grounded in cultural values can provide meaningful physical and social practices to support the learning process. Within this framework, ethnomathematics can function as an effective form of scaffolding in constructivist learning models, supporting learners in developing mathematical understanding through culturally grounded experiences and collaborative learning processes (Saefuloh & Halimah, 2021). Supporting this theoretical foundation, a meta-analysis conducted by Pratama & Yelken, (2024) demonstrated that ethnomathematics-based instruction is an effective approach for improving mathematical literacy, particularly in the Kalimantan region. Furthermore, an international study of data from 51 countries found that national culture significantly shapes students' mathematical achievement, underscoring the importance of culturally responsive approaches in mathematics education (Hu et al., 2018).

Gorontalo culture is characterized by a rich local wisdom, as evidenced by its mathematical patterns, structures, and symbols (Latief et al., 2023). Traditional architecture, the karawo embroidery patterns, the cultural philosophy "adat bersendikan syara', syara' bersendikan kitabullah," and traditional games are concrete examples that can be utilized in learning contexts (Husain & Walangadi, 2020). These cultural elements not only reflect Gorontalo's identity but also provide meaningful learning experiences by linking abstract mathematical concepts with students' real-life contexts.

In recent years, several studies have examined the application of Gorontalo culture in mathematics education. Pongoliu, (2025) demonstrated that ethnomathematics based on Payango architecture effectively improved elementary students' understanding of mathematical concepts. However, the study was limited to elementary-level students and focused on general conceptual understanding, without specifically addressing numeracy literacy, an essential 21st-century competency emphasized in PISA. Additionally, Kobandaha et al., (2025) utilized the mathematical patterns found in traditional karawo fabrics to explain geometric transformation concepts such as translation, reflection, dilation, and rotation. Meanwhile, Damayanti & Irfah (2025) employed the traditional Gorontalo dish ilabulo to illustrate the concept of ratio. Although these studies successfully linked Gorontalo culture with mathematical concepts, they primarily focused on exploring cultural elements rather than testing the effectiveness of culture-based learning implementation in real classroom settings, particularly in terms of students' numeracy literacy.

Despite the promising potential of ethnomathematics in improving mathematical learning outcomes, global data highlight ongoing challenges. Results from the international

PISA assessment show that Indonesian students' mathematical literacy remains below the OECD average (Retnawati et al., 2024). The weak numeracy foundation at the primary and secondary levels has a direct impact on university students' readiness to grasp advanced mathematical concepts. Therefore, strengthening numeracy literacy in higher education, especially for prospective MI/SD (Islamic Elementary School) teachers at IAIN Sultan Amai Gorontalo has become an urgent necessity.

This urgency is further emphasized by the dual responsibility of State Islamic Higher Education Institutions (PTKIN) to produce academically competent graduates while upholding cultural and religious values (Diniaty et al., 2023). Moreover, the national education policy, through the Merdeka Belajar–Kampus Merdeka (MBKM) program, emphasizes the importance of contextual and collaborative learning (Hartono et al., 2022) and locally grounded learning (Baron et al., 2022). The integration of ethnomathematics based on Gorontalo culture aligns with this vision, as it not only deepens learners' conceptual understanding of mathematics but also strengthens their cultural identity as regional youth with global competitiveness while remaining rooted in local wisdom.

Based on this background, it is evident that a gap exists between the ideal educational goals and the current realities in the field. Therefore, the purpose of this study is to examine the implementation of Gorontalo culture-based mathematics learning in improving students' numeracy literacy. The results are expected to contribute to an innovative, locally rooted learning model that can be replicated and to support the Merdeka Belajar policy in improving the quality of higher education in Gorontalo, particularly for prospective Madrasah Ibtidaiyah teachers at IAIN Sultan Amai Gorontalo.

METHODS

This study employed a quantitative approach using a one-group pretest–posttest experimental design, with data collected through achievement tests and documentation. The test instrument consisted of essay-type questions designed to measure students' numeracy skills, including the ability to interpret quantitative information, apply mathematical concepts in contextual problems, and perform numerical reasoning and problem-solving tasks. The essay items were developed based on the learning objectives and indicators of numeracy competence and contextualized through culturally relevant situations, in accordance with the ethnomathematics-based learning approach implemented in this study.

Prior to data collection, the instrument underwent validation. Content validity was established through expert judgment involving mathematics education specialists, who evaluated the relevance, clarity, and alignment of each item with the intended constructs. Empirical item validity was subsequently tested using the product-moment correlation between item scores and total scores. Instrument reliability was examined using Cronbach's alpha

coefficient. The results indicated that all essay items met the validity criteria, and the reliability analysis yielded a Cronbach's alpha value of 0.80, demonstrating that the instrument was reliable and appropriate for data collection.

The study was conducted in the PGMI (Pendidikan Guru Madrasah Ibtidaiyah) program at IAIN Sultan Amai Gorontalo. The research population consisted of 58 fifth-semester students enrolled in the Advanced Mathematics 2 course during the 2023–2024 academic year. A total of 38 students were randomly selected as the sample and assigned to a single class.

Ethical approval was obtained prior to data collection, and informed consent was obtained from all participants. Participants were informed about the study objectives and procedures, assured that their participation was voluntary and would not affect their academic evaluation, and that their data would be kept confidential. The study involved no procedures that posed physical or psychological risks to participants. The authors declare that there is no conflict of interest associated with this research, and all stages of the study were conducted in accordance with applicable ethical standards.

Data analysis began with a normality check to ensure the data were suitable for further analysis. When normality assumptions were met, the differences between pre-test and post-test scores were analyzed using a paired-sample t-test. When normality was not met, the Wilcoxon signed-rank test was used as a nonparametric alternative. To evaluate the significance of these differences (Djafar et al., 2024).

Furthermore, to determine the level of effectiveness of Gorontalo culture-based learning, this study employed the N-Gain (Normalized Gain) calculation. The N-Gain analysis measures the relative improvement in students' abilities after the intervention, expressed as a percentage of the maximum possible score. In other words, N-Gain provides an overview of how much students' learning outcomes have proportionally increased after participating in the course of learning. The interpretation of N-Gain values in this study follows the criteria proposed by Hake, which categorize values as follows: $g < 0.30$ as low improvement, $0.30 \leq g < 0.70$ as moderate improvement, and $g \geq 0.70$ as high improvement (Darhim et al., 2020).

Thus, the results of the N-Gain analysis demonstrate the effectiveness of culture-based learning in enhancing students' numeracy literacy. Furthermore, students' numeracy literacy levels were categorized based on criteria adapted from Rediani (2024), with detailed categories presented in Table 1.

Table 1. Percentage Categories of Numeracy Literacy Skills

Percentage Range (%)	Category
0 – 20	Very low
21 – 40	Low
41 – 60	Medium
61 – 80	High
81 – 100	Very high

Based on Table 1, students' numeracy literacy is classified into five categories according to percentage scores. The very low (0–20%) and low (21–40%) categories indicate limited and emerging numeracy skills. The medium (41–60%) category indicates adequate ability to solve basic numerical problems. The high (61–80%) category represents good numeracy skills in applying mathematical concepts and reasoning, while the very high (81–100%) category indicates excellent numeracy literacy characterized by effective problem-solving and critical thinking in real-world contexts.

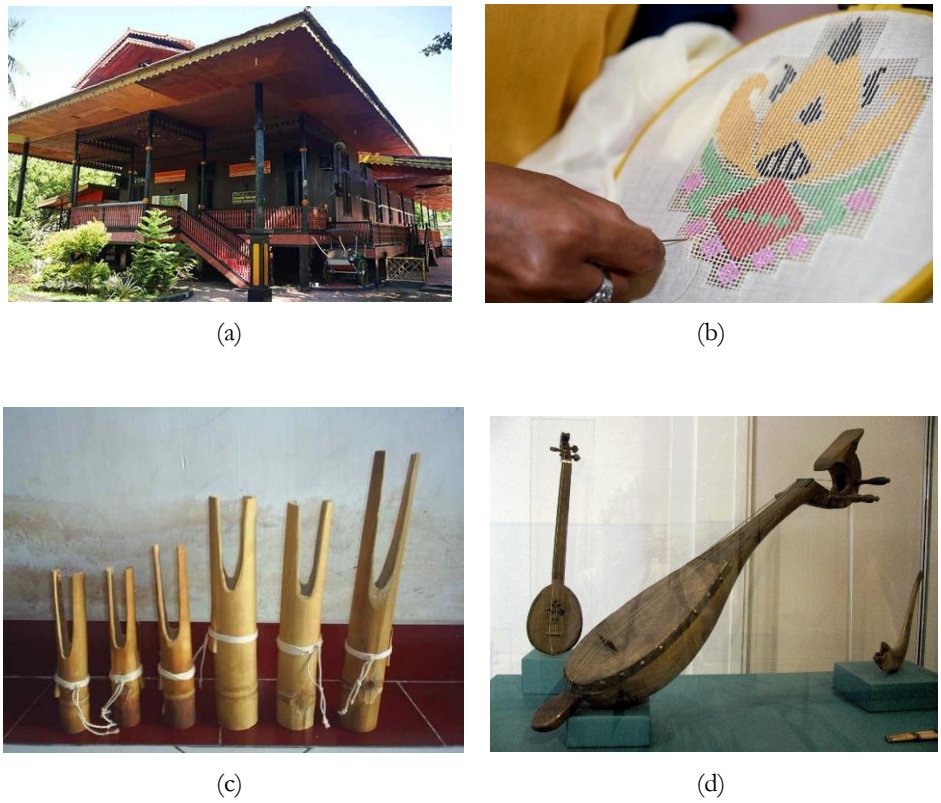
RESULT AND DISCUSSION

Data Description

This study involved 38 fifth-semester students from the PGMI (Primary School Teacher Education) study program at IAIN Sultan Amai Gorontalo, enrolled in the Advanced Mathematics 2 course. Data were collected through pretests and posttests designed to measure students' numeracy literacy skills after participating in culture-based learning in Gorontalo. The validity and reliability of the instrument were verified, with a Cronbach's Alpha value of 0.80 indicating satisfactory internal consistency.

The Advanced Mathematics 2 course primarily focuses on geometric concepts taught in elementary school. The topics covered include the introduction of two-dimensional and three-dimensional shapes, calculations of area and perimeter of plane figures, computations of volume and surface area of solid figures, and lessons on geometric transformations.

In this learning process, Gorontalo's cultural heritage was utilized as the learning context to make mathematical concepts more relatable to students' daily lives. For instance, the karawo embroidery motif was used to introduce various plane shapes and their area and perimeter calculations. Additionally, the architecture of Gorontalo traditional houses, such as Dulohupa and Bandayo Poboide, as well as traditional musical instruments like Polopalo and Gambus, served as concrete examples for understanding both two-dimensional and three-dimensional shapes and their respective measurements.



(a) (b)

(c) (d)

Figure 1. (a) Dulohupa traditional house; (b) Karawo motif; (c) Polopalo musical instrument; (d) Gambus musical instrument.

Before implementing the Gorontalo culture-based learning, an initial test (pretest) was conducted to determine the students' numeracy literacy abilities. After the implementation of the learning, a final test (posttest) was administered to measure the development of students' numeracy literacy abilities after the treatment. The pre-test and post-test results are summarized in Table 2.

Table 2. Percentage of Numeracy Literacy Ability Categories

Percent Range (%)	Pretest		Category	Posttest		Category
	Frequency	Percent		Frequency	Percent	
0 – 20	0	0%	Very low	0	0	Very low
21 – 40	20	52,63%	Low	0	0	Low
41 – 60	18	47,37%	Medium	1	2,63%	Medium
61 – 80	0	0%	High	18	47,37%	High
81 – 100	0	0%	Very high	19	50%	Very high

Based on Table 2, it can be seen that before the implementation of culture-based learning, most students' numeracy literacy skills were categorized as low (52.63%) and medium (47.37%). None of the students fell into the high or very high categories, indicating that, in general, their initial numeracy literacy skills were still relatively low. This condition underscores the pressing need for more effective learning interventions to enhance students' mastery of numeracy literacy.

After the implementation of Gorontalo culture-based learning, the posttest results showed a significant improvement. A total of 47.37% of students were categorized as high, and 50% as very high. Only 2.63% of students remained in the medium category, while none were in the low or very low categories. This demonstrates that culture-based learning has a substantial positive impact on enhancing students' numeracy literacy skills.

Furthermore, a comparison of students' numeracy literacy scores in the pretest and posttest is presented in Figure 2.

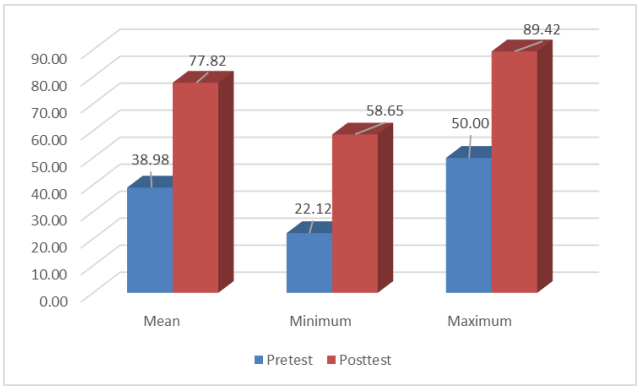


Figure 2. Students' Numeracy Literacy Scores

Based on Figure 2, students' numeracy literacy skills showed a notable improvement after the implementation of Gorontalo culture-based learning. The mean score of students during the pretest was only 38.98, which nearly doubled to 77.82 in the posttest. This indicates that culture-based learning effectively enhanced the numeracy literacy skills of PGMI students at IAIN Sultan Amai Gorontalo.

Additionally, the minimum score also showed a notable increase. During the pretest, the lowest score was 22.12, which rose to 58.65 after the treatment. This improvement demonstrates that even students with initially low abilities experienced significant progress after participating in culture-based learning. Meanwhile, the maximum score increased from 50.00 in the pretest to 89.42 in the posttest. These findings suggest that Gorontalo culture-based learning not only improved the overall average performance but also expanded the achievement range to a higher level.

Effectiveness Test Results

Normality Test

Normality was determined using the Shapiro–Wilk test to determine whether the data obtained from the sample were usually distributed. This test is particularly suitable for small samples (less than 50), as it is more sensitive in detecting deviations from normality (Suardi, 2019). The hypotheses used are as follows:

H0: The data meet the normality assumption

H1: The data do not meet the normality assumption

The significance level (α) used is 5%, with the Shapiro–Wilk statistic as the test parameter. The testing criterion is to reject H0 if p-value < α (Mellita & Lestari, 2023). The test was performed using SPSS 20, and the results are presented in Table 3.

Table 3. Results of the Normality Test Using the Shapiro–Wilk Test

	Shapiro-Wilk		
	Value	**df**	**p-value**
Pretest	0.97	38	0.29
Posttest	0.88	38	0.00

Based on Table 3, the Shapiro–Wilk value for the pretest data was 0.97 with a p-value of 0.29. Since p-value > α, we fail to reject H0, meaning the pretest data are normally distributed. Meanwhile, the Shapiro–Wilk value for the posttest data was 0.880 with a p-value of 0.00, which is less than α. This suggests that the post-test data were not normally distributed. Therefore, the significance of the pre-test and post-test score differences was evaluated employing the Wilcoxon nonparametric test.

Hypothesis Testing

The hypothesis test in the small-group trial aimed to determine whether the use of the teaching module had a significant effect on students' numeracy literacy skills. The Wilcoxon signed-rank test served as the method for analyzing paired-sample data. The corresponding hypotheses are as follows:

H0: Pre-test and post-test scores are not significantly different.

H1: Pre-test and post-test scores are significantly different

The significance level (α) used was 5%. The decision rule is to reject H0 if p-value < α. The test was conducted using SPSS 20, and the results obtained are summarized in Table 4.

Table 4. Hypothesis Test Outcomes Assessed with the Wilcoxon Test

Pretest	Posttest	Nilai Z	p-value
38,98	77,82	-5,374	0,000

Table 4 shows that in the large-group trial, there was an improvement in students' numeracy literacy skills. This is evident from the posttest score, which increased by 38.84 points compared to the pretest score. Moreover, as shown in Table 4, the Z-test yielded a value of -5.374 with a corresponding p-value of 0.000. Because the p-value is less than the 0.05 significance threshold, the null hypothesis is rejected, supporting the alternative hypothesis. Therefore, it can be concluded that in the large-group trial, the use of the teaching module had a significant effect on the numeracy literacy skills of students at IAIN Sultan Amai Gorontalo.

N-Gain Test

To evaluate the impact of a teaching intervention, it is not sufficient to examine only pre-test to post-test score improvements; the proportional improvement in learners' abilities relative to the maximum possible score should also be considered. One of the most widely used methods for this purpose is the N-Gain (Normalized Gain) analysis. The N-Gain test provides an overview of the extent to which learning achievement improves following the intervention, accounting for learners' initial performance before treatment. The N-Gain test findings, as analyzed using SPSS 20, are presented in Table 5.

Table 5. Outcomes of the N-Gain Analysis

	Mean	Standard Deviation
N-Gain Score	0,64	0,15
N-Gain percentage	64	14,55

Based on Table 5, the N-Gain analysis indicates a mean N-Gain score of 0.64 (SD = 0.15). When expressed as a percentage, this equals 64%, with a standard deviation of 14.55%. Referring to Hake's (1999) interpretation criteria, an N-Gain value of 0.64 falls within the medium category ($0.30 \leq g < 0.70$). This indicates that the implementation of Gorontalo-based cultural learning in this study was moderately effective in improving students' numeracy literacy skills. The relatively small standard deviation also suggests that the improvement in students' abilities was pretty consistent across participants.

Further analysis of the N-Gain score distribution revealed that 57.89% of students achieved medium N-Gain scores, while 42.11% reached the high N-Gain category. No students were classified in the low N-Gain category, indicating that all participants experienced at least a

moderate level of learning gain. This distribution demonstrates that the learning intervention consistently led to positive improvements and reinforces the effectiveness of ethnomathematics-based learning in enhancing students' numeracy literacy.

Discussion

The research findings confirm that the practice of Gorontalo culture-based learning in the Advanced Mathematics 2 course significantly enhanced students' numeracy literacy. Based on the pretest results, most students were in the low (52.63%) or medium (47.37%) categories, with none scoring in the high or very high categories. After the treatment, the distribution shifted markedly, with 47.37% of students reaching the high category and 50% reaching the very high category, whereas only 2.63% remained in the medium category. No students remained in the low or very low categories. This change indicates that culture-based learning not only improved average performance but also raised the achievement levels of lower-performing students.

The mean score analysis further reinforces this result. The pretest mean score of 38.98 nearly doubled to 77.82 on the posttest. The minimum score increased from 22.12 to 58.65, while the maximum score rose from 50.00 to 89.42. This indicates that students with both low and high initial abilities experienced meaningful improvements. Thus, Gorontalo culture-based learning successfully equalized learning outcomes while pushing overall academic achievement to a higher level.

The effectiveness of the treatment is also evident in the N-Gain result. The mean N-Gain score of 0.64 (64%) is categorized as moderate with a standard deviation of 0.15, indicating that the learning approach was reasonably practical and produced relatively uniform improvement among participants. This aligns with Hake' s interpretation that $0.30 \leq g < 0.70$ represents a medium level of improvement (Darhim et al., 2020).

This finding is consistent with Pratama & Yelken, (2024), who found that integrating ethnomathematics into learning has a notable supportive effect on students' mathematical literacy development. Cultural contexts make learning more meaningful and relatable to everyday life, thereby motivating students to engage deeply with numeracy concepts. Similarly, Linuhung et al., (2025) reported an N-Gain of approximately 61%, also within the medium category, in their study on ethnomathematics-based numeracy development. In line with these findings, Aini et al., (2025) integrated a STEAM and ethnomathematics-based approach using local cultural contexts, which also demonstrated a significant improvement in students' numeracy literacy through a pretest-posttest design. Their study highlights the relevance of integrating cultural and value-based learning in mathematics to foster both academic competence and character development.

Although this study demonstrates a significant improvement in students' numeracy literacy, the level of effectiveness remains within the medium category, indicating room for further enhancement. As learning tools or instructional media, cultural objects should be carefully selected based on their relevance to mathematical concepts, familiarity to learners, and potential to represent abstract ideas in concrete forms. The planning stage should involve mapping cultural artifacts or practices to specific learning objectives, determining how they will be integrated into learning activities, and designing tasks that encourage exploration, discussion, and reflection. During implementation, cultural objects can serve as contextual problem sources, manipulatives, or discussion prompts to support active learning and collaborative inquiry.

The use of cultural objects as learning aids offers several advantages in mathematics education. Culturally grounded materials enhance students' engagement and motivation by connecting mathematical concepts to their lived experiences, making learning more meaningful and accessible. They also facilitate conceptual understanding by bridging abstract mathematical ideas with concrete representations found in cultural practices. Furthermore, ethnomathematics-based learning supports the development of higher-order thinking skills, problem-solving abilities, and numeracy literacy by encouraging students to analyze, interpret, and apply mathematics within authentic cultural contexts. These advantages align with findings from previous studies, which emphasize that the effectiveness of ethnomathematics-integrated instruction is influenced by instructional design, learner characteristics, and the depth of cultural integration (Pratama & Yelken, 2024; Mauladaniyati et al., 2025; Putri et al., 2024).

From a practical perspective, the findings of this study suggest that Gorontalo-based mathematics instruction can be systematically applied as an alternative teaching strategy for geometry courses in higher education, particularly in teacher education programs. In practice, lecturers can begin by identifying local cultural elements that contain implicit geometric concepts, such as Karawo motifs, traditional house structures, or other regional artifacts. These cultural objects can then be mapped to specific learning objectives, for example, using Karawo embroidery patterns to introduce geometric transformations such as reflection, translation, rotation, and dilation, as demonstrated by Kobandaha et al., (2025). Learning activities may be designed as contextual problem-solving tasks, group discussions, and exploratory assignments that encourage students to analyze mathematical structures embedded in cultural artifacts.

Similarly, traditional house architecture can be utilized to teach concepts of shape, space, measurement, and arithmetic by guiding students to observe, model, and mathematically represent architectural elements, as reported by Cesaria et al., (2025). The use of reliefs and traditional architectural ornaments has also been shown to support students' understanding of geometry and symmetry, which are often challenging when taught through abstract explanations alone Khasanah et al., (2022). Through these instructional steps, ethnomathematics-based

learning not only enhances students' conceptual understanding and numeracy literacy but also promotes active learning, collaboration, and cultural awareness. This approach is particularly valuable for prospective teachers, as it equips them with practical strategies to integrate local culture into mathematics instruction in their future classrooms.

Despite these contributions, several limitations of this study should be acknowledged. First, the research employed a one-group pretest–posttest design without a control group, which limits the ability to attribute learning gains solely to the intervention. Second, the sample size was relatively small and drawn from a single study program at one institution, which may restrict the generalizability of the findings. Third, the duration of the intervention was limited, and the cultural materials used were confined to specific Gorontalo contexts. Future studies are therefore recommended to involve larger and more diverse samples, include comparison groups, extend the implementation period, and explore a wider range of cultural artifacts to further examine the effectiveness of ethnomathematics-based learning.

CONCLUSION

This study concludes that integrating Gorontalo cultural elements into mathematics learning significantly enhances students' numeracy literacy. This is evidenced by the shift in performance categories, from predominantly low and medium levels before treatment to mostly high and very high levels afterwards. The mean student score nearly doubled, from 38.98 (pretest) to 77.82 (posttest), and the Wilcoxon test confirmed a significant improvement from pretest to posttest. Moreover, the N-Gain measurement of 0.64 (medium) signifies that the learning model was moderately successful in enhancing students' numeracy literacy. In practice, combining local cultural elements, for example, Karawo motifs, traditional Gorontalo architecture (Dulohupa and Bandayo Poboide), and traditional musical instruments (Polopalo and Gambus), has proven to help students grasp abstract geometric concepts in real-life contexts. Beyond strengthening conceptual understanding, this approach also enhances efforts to preserve Gorontalo culture and fosters educators who are deeply rooted in local values while remaining globally competitive.

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