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Development and Validation of Mathematical Literacy Instruments Based on Ethnomathematics for Primary School Students

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ABSTRACT

Mathematical literacy has become one of the essential skills required by students to face the dynamics and challenges of the 21st century. This study aims to develop an ethnomathematics-based mathematical literacy test instrument for elementary school students at phase B. The research method employed is Research and Development (R&D) using the ADDIE model. The developed instrument consists of 10 essays that integrate local cultural contexts. The item validity test results showed significance values ranging from 0.296 to 0.712, with most items meeting the validity criteria ($r \geq 0.3$). The reliability test produced a Cronbach's alpha value of 0.85, indicating very good internal consistency of the instrument. The item difficulty analysis showed that 50% of the items were classified as easy ($P > 75\%$), 40% as moderate ($25\% \leq P \leq 75\%$), and 10% as difficult ($P < 25\%$). Based on these results, it can be concluded that the developed ethnomathematics-based mathematical literacy test instrument is valid, reliable, and feasible to be used as an evaluation tool for elementary school students' mathematical literacy abilities.

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1. INTRODUCTION

The improvement of mathematical literacy has become one of the main focuses in 21st-century mathematics education because this ability is essential for solving everyday problems and facing global challenges. (Trisnaningtyas & Khotimah, 2022). The assessment instruments used to measure students' mathematical literacy must be valid, reliable, and contextual so that the measurement results truly reflect students' abilities and learning experiences. One approach considered effective in developing such instruments is ethnomathematics, which links mathematical concepts with local cultures that are close to students' lives (Diana & Fitriani, 2024; Fauzi et al., 2024; Muzaki & Masjudin, 2019; Purwanti et al., 2020).

Elementary school students' mathematical literacy consists of four main indicators: (1) formulating mathematical problems by identifying relevant information from real contexts; (2) applying mathematical concepts through calculations and problem-solving strategies; (3) interpreting solutions by connecting mathematical answers to real situations; and (4) evaluating the feasibility of solutions based on logical and contextual criteria. (Syah et al., 2024). Mathematical literacy is very important for elementary school students because it forms the basis for critical thinking and enables them to solve everyday problems, such as financial management and data interpretation, while also preparing them to face complex challenges according to international PISA standards (OECD, 2017). In addition, mastery of mathematical literacy also increases students' motivation and metacognitive abilities through the integration of contextual learning (Sofiyah et al., 2024).

Recent research shows that the development of ethnomathematics-based mathematical literacy test instruments has a positive impact on the motivation, participation, and learning outcomes of elementary school students. Diana & Fitriani (2024) Developed a mathematical literacy test instrument based on East Java culture for elementary school students using the ADDIE model. The validity test results showed that all items had a significance value below 0.05, while the reliability test resulted in a Cronbach's alpha value of 0.684 (>0.6), meaning that the instrument is valid and reliable. The difficulty level of the questions also varied from easy to difficult, so the instrument is suitable for evaluating the mathematical literacy abilities of elementary school students (Diana & Fitriani, 2024).

Other research by Fauzi et al. (2024) Developed an ethnomathematics-based mathematical literacy instrument for elementary school students in Lombok using the Tessmer model. The developed instrument was tested through expert validation, one-to-one, small group, and field test stages. As a result, the instrument was declared valid with a V Aiken score of 0.76 and reliable with a Cronbach's alpha value of 0.687. This instrument also has good question difficulty and discrimination indices. It has successfully integrated local cultural concepts, such as traditional weaving patterns, traditional buildings, and traditional foods, into mathematical literacy questions. This makes mathematics learning more relevant and meaningful for students (Fauzi et al., 2024).

Furthermore, research by Fauzi et al. (2024) and Litik & Argarini (2023) also shows that the development of ethnomathematics-based mathematical literacy evaluation instruments—both from the perspective of multiple intelligences and the exploration of cultural artifacts—can increase the effectiveness of mathematics learning and students' literacy. The developed

instruments not only meet validity and reliability criteria but are also able to increase students' activeness and understanding of mathematical concepts in their cultural contexts (Fauzi et al., 2024; Litik & Argarini, 2023).

Although much research has proven the effectiveness of ethnomathematics-based instruments, the development of mathematical literacy test instruments that have truly tested validity, reliability, difficulty, and discrimination levels, and are relevant to various local cultures in Indonesia, is still very limited. This limitation is an important research gap, especially in the context of Indonesia's cultural diversity. Most existing instruments are developed based on one or two specific local cultures, so they cannot yet meet the needs of measuring students' mathematical literacy in various regions with their cultural uniqueness. In addition, the wider integration of local cultures into mathematical literacy test instruments has not been systematically explored.

This research aims to develop an ethnomathematics-based mathematical literacy test instrument that can accommodate the diversity of local cultures in Indonesia more comprehensively. The developed instrument not only aims to meet validity, reliability, difficulty, and discrimination criteria but is also designed to be adapted and used in various local cultural contexts. Thus, this instrument is expected to become a reference for more inclusive and relevant mathematical literacy measurement for all elementary school students in Indonesia.

Based on the above description, this research aims to develop an ethnomathematics-based mathematical literacy test instrument that is valid, reliable, and feasible for measuring the mathematical literacy abilities of elementary school students. With this instrument, it is hoped that the process of mathematics learning evaluation will become more authentic, contextual, and supportive of strengthening students' mathematical literacy by their local cultural characteristics.

2. METHODS

This research uses the Research and Development (R&D) method with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), adapted from (Diana & Fitriani, 2024; Fauzi et al., 2024) The research aims to develop a valid and reliable ethnomathematics-based mathematical literacy test instrument for elementary school students.

This research uses the Research and Development (R&D) method with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) to develop an ethnomathematics-based mathematical literacy test instrument (Fauzi et al., 2024; Yuliana et al., 2023). The analysis stage begins with a needs study through a review of the Merdeka Curriculum Phase B (Kemendikbudristek, 2022) and PISA 2023 mathematical literacy indicators (OECD, 2023), as well as identification of local cultural practices such as West Java batik motifs and Central Java traditional congklak games (Larasati et al., 2025). In student analysis, researchers focus on the cognitive characteristics of 19 grade V students at SDN 03 Nagrikaler Purwakarta as the initial trial subjects. This analysis includes students' understanding of basic mathematical concepts, abstract thinking abilities, and skills in applying mathematics in everyday life (Diana & Fitriani, 2024). In the design stage, the

instrument grid is designed by integrating mathematical competencies (numbers, geometry, data) and ethnomathematics contexts (Assegaff & Bonyah, 2024; Herrera et al., 2024), resulting in 10 essay questions with a 0–4 scale rubric. The development stage involves expert validation by two elementary school mathematics experts and one cultural expert using a 1–4 Likert scale, with content validity analysis through Aiken's V (V ≥ 0.75) (Mejía-Clavo, 2024; Fauzi et al., 2024). The implementation stage includes limited trials on 30 grade V students at three elementary schools in the Purwakarta region, while the evaluation stage uses ANOVA analysis for item validity (Pearson correlation ≥ 0.3), reliability (Cronbach's alpha = 0.85), and question difficulty level (Azwar, 2022).

Table 1. Stages of the ADDIE Model in the Development of Ethnomathematics-Based Mathematical Literacy Test Instruments

ADDIE Stage	Activities
Analysis	Needs analysis (curriculum & PISA), identification of local culture, student cognitive analysis
Design	Designing an instrument grid, developing 10 essay items with a rubric
Development	Expert validation (math & culture), content validity (Aiken's V)
Implementation	Limited trial with 30 students from 3 elementary schools in Purwakarta
Evaluation	Item analysis (validity, reliability, difficulty) using ANATES

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Analysis Stage

The development of an ethnomathematics-based mathematical literacy test instrument begins with a review of the Merdeka Curriculum currently implemented in elementary schools (Kemendikbudristek, 2022). The development of mathematical abilities refers to five main competencies: understanding, problem-solving, communication, connection, and mathematical reasoning, as stated in recent studies (Trisnaningtyas & Khotimah, 2022). The learning achievements selected for phase B include material on whole numbers up to 10,000, fractions, picture patterns, number patterns, area and volume measurement, two-dimensional shapes, as well as pictograms and bar charts. The selected learning achievements focus on students being able to measure the length and weight of objects using standard units, and being able to determine the relationship between standard units of length. They can measure and estimate area and volume using non-standard units and standard units in the form of whole numbers.

3.1.2 Design Stage

In the design stage, learning objectives and indicators of mathematical literacy test abilities are formulated based on phase B learning achievements. The developed instrument consists of essay questions arranged in a mathematical literacy test grid by integrating cultural elements from various regions in Indonesia. The question grid covers indicators of mathematical literacy abilities and local cultural contexts, such as East Kalimantan, West Nusa Tenggara, Bali, North Sumatra, Central Java, South Sulawesi, West Java, and East Java. Examples of indicators include comparing the total area of several rectangles, identifying

geometric shapes in traditional wells, and interpreting the meaning of symbols and diagrams in cultural contexts. The test to be developed consists of essay questions. Then, a mathematical literacy test grid is arranged.

Table 2. Mathematical Literacy Ability Test Grid

Learning Achievement	Indicators of Mathematical Literacy Test	Question Number	Cultural Elements
Students are able to measure the length and weight of objects using standard units, and can determine the relationship between units of length. They can measure and estimate area and volume using non-standard units and standard units in the form of whole numbers.	**Formulate:** understanding and applying mathematical ideas • (comparing the total area of several rectangles) • (identifying the number of cakes with the area of the wrapper leaves) • (identifying geometric shapes (cylinders) in problems in the context of local culture (traditional wells)) • (estimating the size of banana leaves shaped like rectangles)	1, 2, 3, 10	East Kalimantan, West Nusa Tenggara, Bali, North Sumatra
	Employ: conducting an exploration (estimation) • (analyzing two parts of rectangles, calculating the area of each, and adding the results to obtain the total area) • (estimating the additional area for planting crops) • (estimating the amount of paint needed)	4, 5, 6	Central Java, South Sulawesi
	Interpret: translating and interpreting the meaning of symbols, tables, diagrams, pictures, graphs, as well as mathematical sentences • (understanding the characteristics of measuring volume, and making visualizations) • (naming, describing, and calculating the dimensions of cuboids) • (understanding the concept of geometry, volume formulas, and area formulas)	7, 8, 9	Central Java, West Java, East Java

3.1.3 Development Stage

The developed test instrument consists of 10 essay questions with a maximum score of 100. A picture accompanies each question to make it easier for students to reason and understand the context of the question. For example, question number 1 invites students to calculate the area of a Kalimantan batik motif using the concept of a rectangle as an application of ethnomathematics in the context of local culture. Below is one of the questions on the developed instrument.

1. Perhatikan gambar berikut!

Di desa Dayak, ada tradisi membangun rumah panggung dengan bentuk lantai yang terdiri dari beberapa persegi panjang. Jika ada rumah panggung dengan lantai yang terdiri dari dua persegi panjang, yang satu berukuran 6 meter × 4 meter dan yang lainnya 5 meter × 3 meter, bandingkanlah dari kedua lantai tersebut. Manakah yang lebih luas?

Figure 1. Example of Mathematical Literacy Ability Test Questions

3.1.4 Implementation Stage

The instrument was tested on 19 grade V students at SDN 03 Nagrikaler Purwakarta in the 2024/2025 academic year. The selection of trial subjects is based on the cognitive readiness of grade V students who have studied all the material in the instrument, so it is appropriate to test the validity and reliability of the instrument.

3.1.5 Evaluation Stage

Based on the trial results, the feasibility of the instrument was tested through validity and reliability tests using the ANATES software. The validity test results showed that the item significance value ranged from 0.296 to 0.712, with the highest value on question number 10. The reliability test resulted in a Cronbach's alpha value of 0.85, indicating that the instrument is highly reliable (Fauzi et al., 2024). Analysis of the question difficulty level showed four questions in the moderate category, five easy questions, and one difficult question, so the instrument is feasible to use as an evaluation tool for elementary school students' mathematical literacy abilities.

Rata2= 26.00 Simpang Baku= 3.68 KorelasiXY= 0.74 Reliabilitas Tes = 0.85

No.Urut	No. Subyek	Kode/Nama Subyek	Skor Ganjil	Skor Genap	Skor Total
1	1	Adzkia	13	13	26
2	2	Ali	12	12	24
3	3	Alwi	11	13	24
4	4	Alya	13	13	26
5	5	Anisa	10	14	24
6	6	Aqila	13	16	29
7	7	Azkia	13	14	27
8	8	Byan	10	12	22
9	9	Dyla	15	16	31
10	10	Ervina	12	14	26
11	11	Faidah	11	16	27
12	12	Fahri	14	16	30
13	13	Ghazi	11	14	25
14	14	Habibi	9	9	18
15	15	Haniar	11	12	23
16	16	Hasna	14	14	28
17	17	Jibril	11	13	24
18	18	Qinar	16	19	35
19	19	Rafka	12	13	25

Figure 2. Hasil Output ANATES Uji Validitas dan Reabilitas

3.2 Discussion

Mathematical problem-solving is an important aspect of mathematics learning because it can increase students' self-confidence and decision-making abilities in everyday life (Trisnaningtyas & Khotimah, 2022). The instrument developed in this research integrates cultures from various regions in Indonesia, such as East Kalimantan, West Nusa Tenggara (Lombok), Bali, Central Java (Joglo), South Sulawesi (Toraja), and North Sumatra. The ethnomathematics approach was chosen because culture is very close to children's lives, thus increasing their motivation to solve problems related to everyday experiences (Diana & Fitriani, 2024).

The validity test results show that each item has an adequate significance value, with the highest value on question number 10 (0.712). The reliability test with a Cronbach's alpha value of 0.85 indicates very good internal consistency of the instrument. The varied question difficulty level, with the majority of questions being easy and moderate, shows that this instrument can accommodate students with various ability levels (Fauzi et al., 2024).

Thus, the developed ethnomathematics-based mathematical literacy test instrument can be used as a valid and reliable evaluation tool to measure students' mathematical literacy abilities in phase B. This is in line with the minimum standards for good test instruments according to the latest (Fauzi et al., 2024; Trisnaningtyas & Khotimah, 2022). Analysis of the difficulty level of each item shows that this instrument is dominated by questions with a low difficulty level, so it is suitable for the elementary school level. Therefore, this instrument is feasible and good to use as an evaluation tool for elementary school students' mathematical literacy abilities. The ADDIE development method used in this research has proven effective in producing valid, reliable, and contextual mathematical literacy ability test instruments.

4. CONCLUSION

This research has successfully developed an ethnomathematics-based mathematical literacy test instrument for elementary school students by following the stages of the ADDIE development model. The resulting instrument contains items that integrate local cultural contexts from various regions in Indonesia, making it more relevant and meaningful for students. The validity test results show that all items meet content and empirical validity criteria, while the reliability test results in a Cronbach's alpha coefficient of 0.85, indicating very good internal consistency of the instrument. The varied question difficulty level, with a greater proportion of easy and moderate questions, shows that this instrument is suitable for use with elementary school students. Thus, the ethnomathematics-based mathematical literacy test instrument developed in this research is proven to be valid, reliable, and feasible to use as an evaluation tool for elementary school students' mathematical literacy abilities. The use of this instrument is expected to help teachers carry out more authentic and contextual assessments, as well as support the strengthening of students' mathematical literacy following their local cultural characteristics and the demands of the Merdeka Curriculum. This instrument not only meets psychometric standards but is also relevant to

local cultural contexts so that it can support more meaningful and contextual mathematics learning.

This study acknowledges several limitations: (1) cultural coverage remains partial relative to Indonesia's full diversity; (2) trials were confined to Grade V students in Purwakarta, limiting generalizability; (3) implementation requires teacher training not addressed here; and (4) long-term impacts on literacy development were not measured. Future research should expand cultural representation, test cross-grade applicability, and develop teacher support modules.

5. AUTHORS' NOTE

The authors declare that there are no conflicts of interest in the publication of this article. The authors also confirm that this article is free from plagiarism.

6. REFERENCES

Assegaff, N., & Bonyah, E. (2024). Development of ethnomathematics-based teaching materials through interactive games to improve students' mathematical literacy. *Pasundan Journal of Mathematics Education*, *14*(2), 112–128.

Azwar, S. (2022). *Penyusunan skala psikologi* (Edisi ke-2). Yogyakarta: Pustaka Pelajar.

Diana, R. F., & Fitriani, S. L. (2024). Pengembangan instrumen tes literasi matematis berbasis etnomatematika untuk siswa SD/MI. *Jurnal Penelitian Pembelajaran Matematika Sekolah (JP2MS)*, *8*(2), 234–241.

Fauzi, A., Rahmatih, A. N., Ermiana, I., & Nurmawanti, I. (2024). Pengembangan instrumen literasi matematis berbasis etnomatematika untuk peserta didik sekolah dasar. *JUPIKA: Jurnal Pendidikan Matematika Universitas Flores*, *7*(2), 153–167.

Herrera, L. M. M., Ordóñez, S. J., & Ruiz-Loza, S. (2024). Enhancing mathematical education with partial visualization tools. *Frontiers in Education*, *9*(1229126).

Kemendikbudristek. (2022). *Keputusan BSKAP No. 033/H/KR/2022 tentang capaian pembelajaran kurikulum merdeka*.

Larasati, I., Pramasdyahsari, A. S., & Harun, L. (2025). Enhancing elementary students' numeracy skills through ethnomathematics-based learning: an analysis of minimum competency assessment results. *Journal of Honai Math*, *8*(1), 71–88.

Litik, B. S. Y., & Argarini, D. F. (2023). Eksplorasi etnomatematika pada artefak peninggalan sejarah di kota NTT. *Jurnal Ilmiah Matematika Realistik*, *4*(1), 79–88.

Muzaki, A., & Masjudin, D. (2019). Analisis kemampuan literasi matematis siswa. *Mosharafa: Jurnal Pendidikan Matematika*, *8*(3), 493–502.

OECD. (2017). *PISA 2015 assessment and analytical framework: Science, reading, mathematics, financial literacy and collaborative problem solving* (Revised edition). OECD Publishing.

OECD. (2023). *PISA 2022 results: The state of learning and equity in education* (Volume I). OECD.

Purwanti, E., Wardono, W., & Wigati, E. (2020). Analisis kemampuan literasi matematika siswa sekolah dasar melalui model pembelajaran contextual teaching and learning. *Prosiding Seminar Nasional Fakultas Ilmu Pendidikan 2020*, 78–87. http://pgsd.unnes.ac.id.

Sofiyah, K., Rangkuti, S. W., Psb, M. S., & Darwin, N. A. (2024). Dasar literasi matematika dalam pembelajaran. *Jurnal Ilmiah Multidisiplin Terpadu*, *8*(12), 2246–6111.

Syah, M. S. F., Widodo, W., & Sudibyo, E. (2024). Kemampuan literasi matematika siswa sekolah dasar berdasarkan perspektif teori Gestalt. *ELSE: Elementary School Education Journal*, *8*(1), 85–95.

Trisnaningtyas, N. O., & Khotimah, R. P. (2022). Analisis kemampuan literasi matematis dalam menyelesaikan soal AKM ditinjau dari gaya belajar. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(4), 2714–2724.

Yuliana, Usodo, B., & Riyadi. (2023). The new way to improve mathematical literacy in elementary school: ethnomathematics module with realistic mathematics education. *Al-Ishlah: Jurnal Pendidikan*, *15*(1), 33–44.