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ETHNOMATHEMATICS MODULE BASED ON RME (REALISTIC MATHEMATICS EDUCATION) ON STUDENTS' NUMERATION AND CRITICAL REASONING

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Abstract

Numeracy skills are among those that need to be developed in the 21st century, so they are often a topic in educational research. Furthermore, the character of critical reasoning is a frequently discussed topic because it is part of the Pancasila student profile dimension. However, based on the results of the 2024 education report card in Melawi Regency, numeracy skills and critical reasoning character are still low. Therefore, efforts are needed to improve students' numeracy skills and critical reasoning character through the use of RME (Realistic Mathematics Education)-based ethnomathematics modules. The purpose of this study was to determine the effectiveness of the RME-based ethnomathematics module of the Dayak Muntak tribe in improving students' numeracy skills and critical reasoning character. This research used an experimental design with a pretest-posttest control group. The subjects of this study were 56 students from the control class and 57 from the experimental class. This research instrument used numeracy test questions and a critical reasoning character questionnaire. The results of the study indicate that implementing the RME-based ethnomathematics module had a significant and effective impact on students' numeracy and critical reasoning skills. This is evident from the results of the Mann-Whitney U-test, which demonstrated a treatment effect, and the N-Gain test, which indicated the level of improvement in numeracy and critical reasoning skills.

Keywords: ethnomathematics module; RME (realistic mathematics education); numeracy skills; critical reasoning character; critical reasoning.

Abstrak

Kemampuan numerasi merupakan satu diantara kemampuan yang perlu dikambangkan pada abad XXI, sehingga sering menjadi topik dalam penelitian pendidikan. Selain itu, topik yang sering dibahas adalah karakter bernalar kritis karena merupakan bagian dari dimensi profil pelajar Pancasila. Namun, berdasarkan hasil rapor pendidikan tahun 2024 di Kabupaten Melawi kemampuan numerasi dan karakter bernalar kiritis masih rendah. Oleh karena itu, perlu upaya untuk meningkatkan kemampuan numerasi dan karakter bernalar kritis siswa melalui penggunaan modul etnomatematika berbasis RME (Realistic Mathematics Education). Tujuan penelitian ini adalah mengetahui efektivitas modul etnomatematika suku Dayak Muntak berbasis RME untuk meningkatkan kemampuan numerasi dan karakter bernalar kritis siswa. Metode penelitian ini menggunakan metode eksperimen dengan desain pretest-posttest control group. Subjek penelitian ini terdiri dari 56 siswa dari kelas kontrol dan 57 siswa dari kelas eksperimen. Instrumen penelitian ini menggunakan soal tes numerasi dan angket karakter bernalar kritis. Hasil penelitian menunjukkan bahwa penerapan modul etnomatematika berbasis RME memberikan pengaruh yang signifikan serta efektif dalam meningkatkan kemampuan numerasi dan karakter bernalar kritis peserta didik. Hal tersebut terlihat dari hasil uji U-Mann Whitney yang menunjukkan adanya pengaruh perlakuan, serta uji N-Gain yang mengindikasikan tingkat efektivitas peningkatan kemampuan numerasi dan karakter bernalar kritis.

***Kata kunci**: modul etnomatematika; RME (realistic mathematics education); kemampuan numerasi; karakter bernalar kritis; penalaran kritis*

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INTRODUCTION

One of the skills that needs to be developed in the 21st century is numeracy. Numeracy is the ability to use numbers and mathematical symbols, along with knowledge, to solve everyday problems (Anderha & Maskar, 2021). Furthermore, numeracy encompasses the development of critical thinking skills, enabling students to evaluate, analyze, and make decisions based on their knowledge (Elisa & Saputro, 2024). Numeracy is a skill that students should prioritize because it is closely related to the problems we face (Mala & Setyaningsih, 2023). Furthermore, numeracy is closely related to critical reasoning (Pratiwi et al., 2023).

Critical reasoning is a student's ability to analyze problems specifically and systematically, accurately distinguish problems, and identify information to plan solution strategies (Sutarni et al., 2024). Therefore, critical reasoning is essential for students to solve problems effectively (Faradillah & Humaira, 2021; Sutarni et al., 2024). Students who are frequently confronted with real-life problems can be motivated to think, thereby improving their critical thinking (Rahmawati et al., 2023).

The 2024 education report in Melawi Regency shows that junior high school students' numeracy skills are below the minimum competency level, while their critical reasoning skills require greater attention and improvement. This condition is influenced by classroom learning practices that do not fully encourage meaningful learning, low levels of teacher reflection on learning, and limited application of innovative learning practices. Therefore, efforts are needed to improve students' numeracy skills and critical reasoning skills. One such effort is the development of an RME-based ethnomathematics module. Combining ethnomathematics with the RME approach offers hope for improving student learning in new ways (Alghiffari et al., 2024). The RME-based ethno-mathematics module is a mathematics teaching material integrated with the culture of the Muntak Dayak Tribe and contains RME steps. The RME approach focuses on interactions with the surrounding environment and starts from real situations relevant to students (Angreni, 2021; Setyaningsih et al., 2021). Learning that uses real contexts or situations can make learning more meaningful for students (Muna et al., 2023). Therefore, this approach is highly relevant for designing teaching modules that connect theory with real-world contexts (Baharuddin et al., 2025). The steps of RME are understanding contextual problems, solving the problems, comparing and discus-sing, and concluding (Aini et al., 2023; Baharuddin et al., 2025).

Ethnomathematics can express cultural relationships with mathematical knowledge in the form of ideas and procedures, as well as mathematical practices that are applied in accordance with certain characteristics (Widiantari et al., 2022). In learning loaded with ethnomathematics, the learning environment will shift to one that is enjoyable for teachers and students, enabling active learning grounded in the culture they are already familiar with, thereby achieving optimal learning outcomes (Pernanda et al., 2023). With ethnomathematics, students not only learn about mathematical material but also about their own culture (Khatimah & Fatimah, 2023). Ethnomathematics is also a part that can be used to organize contextualized mathematics learning to improve numeracy skills and character education (Khatimah & Fatimah, 2023).

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The RME approach can improve numeracy (Abidah & Ardani, 2024; Elisa & Saputro, 2024; Putra & Purnomo, 2023) and critical reasoning character (Abidah & Ardani, 2024). Likewise, Ethnomathematics can improve numeracy skills (Abidah & Ardani, 2024; Khatimah & Fatimah, 2023; Putra & Purnomo, 2023; Susanto et al., 2022) and critical reasoning skills (Pramartha et al, 2025). This also does not rule out the possibility that the RME-based ethnomathematics module could increase learning success. Learning successes that can be improved include students' numeracy skills and critical reasoning character.

This study aims to test the influence and effectiveness of the RME-based ethnomathematics module in improving students' numeracy skills and critical reasoning character at junior high schools in Melawi Regency.

METHOD

This is an experimental study with *a pretest-posttest control group design.* This design uses two classes: a control class and an experimental class. Both classes were given a pretest with the same instrument. Next, the experimental class was given instructions using the RME-based ethnomathematics module (Sugiyono, 2017), while the control class was taught using the lecture method. After the learning process, both classes were given a posttest. The pretest and *posttest results* in the experimental and control classes were then compared to determine their effectiveness (Sugiyono, 2017).

The study population consisted of 7th-grade students at SMPN 6 Nanga Pinoh and SMPN 7 Nanga Pinoh. The research sample consisted of 56 students and 57 students for the experimental class.

The instruments used were tests and non-tests. The test instrument consisted of *pretest* and *posttest questions* to measure students' numeracy skills. The pretest and posttest questions were designed based on students' numeracy indicators. The non-test was a critical reasoning character questionnaire. The critical reasoning character questionnaire was designed based on indicators in the critical reasoning dimension.

The instrument was tested on 39 students. After the test, the validity of the numeracy test and critical reasoning character questionnaire was measured. The instrument is considered valid if the question item value is declared valid, if the calculated r is greater than the table r (Taherdoost, 2018). Since the subjects were 39 and the significance level was set at 5%, the table shows that *the Pearson product-moment* correlation obtained r = 0.316. The results of the validation of the numeracy literacy test instrument are shown in Table 1.

Table 1. Validation Results of the Numeracy Literacy Test Instrument

Question Number	Pearson Correlation	Sig (2-tailed)	Category
1	0.651	0,000	Valid
2	0.594	0,000	Valid
3	0.502	0.001	Valid
4	0.579	0,000	Valid
5	0.170	0.302	Invalid
6	0.745	0,000	Valid
7	0.534	0,000	Valid
8	0.554	0,000	Valid

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The validity of the numeracy test instrument is then calculated for its reliability. Reliability calculations can only be carried out if the questionnaire is valid at the time the validity test is conducted (Busschaert et al., 2015). The most commonly used measure of reliability is *Cronbach's alpha*. *Cronbach's alpha* is the most commonly used test for assessing the reliability of a questionnaire. An acceptable reliability score is > 0.60 (Busschaert et al., 2015) . If a variable shows a Cronbach's Alpha value > 0.60, it can be concluded that the variable is reliable or consistent in measurement (Busschaert et al., 2015). The reliability results for the numeracy test instrument are shown in Table 2. Table 2 shows that Cronbach's Alpha is 0.705, which is > 0.60; thus, the numeracy test instrument is reliable.

Table 2. Reliability Results of Numeracy Test Instruments

Reliability Statistics	
Cronbach's Alpha	N of Items
,705	7

A validity test was then conducted on the critical reasoning character questionnaire. The validation results of the critical reasoning character questionnaire are shown in Table 3.

Table 3. Validation results of the critical reasoning character questionnaire instrument

Statement Number	**Pearson Correlation**	**Sig (2-tailed)**	**Category**
1	0.487	0.002	Valid
2	0.398	0.012	Valid
3	0.408	0.010	Valid
4	0.558	0,000	Valid
5	0.568	0,000	Valid
6	0.367	0,000	Valid
7	0.373	0.019	Valid
8	0.368	0.021	Valid
9	0.646	0,000	Valid
10	0.445	0.005	Valid
11	0.457	0.003	Valid
12	0.365	0.022	Valid
13	0.518	0.001	Valid
14	0.340	0.034	Valid
15	0.368	0.021	Valid

Table 3 shows that the 15 questions in the critical reasoning character questionnaire have a *Pearson correlation value* (r count) > r table (0.316), so they can be declared valid. Valid instruments were then tested for reliability. The results of the critical reasoning character questionnaire reliability are shown in Table 4.

Table 4. Results of the reliability test of the critical reasoning character questionnaire

Cronbach's Alpha	**N of Items**
,694	**15**

Table 4 shows that Cronbach's Alpha is 0.705, which is> 0.60; thus, the critical reasoning character questionnaire instrument is reliable.

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The research data were analyzed using prerequisite tests, including normality tests of the pretest and posttest scores on the numeracy ability test instrument and the critical reasoning character questionnaire. Furthermore, the Mann-Whitney U-test was used to test the effect of implementing the RME-based ethnomathematics module. In contrast, the module's effectiveness in improving students' numeracy ability and critical reasoning character was analyzed using the N-Gain test.

RESULTS AND DISCUSSION

Field testing was conducted on the control and experimental classes. Both the control and experimental classes were given *pretests* . The control class used a lecture-based learning method, while the experimental class used an RME-based ethnomathematics module. The control class received two treatments, while the experimental class received three. *Posttests were then administered to both the control and experimental classes* . The pretests and posttests consisted of numeracy questions and a critical reasoning character questionnaire.

The pretest and posttest results were analyzed using prerequisite tests, namely normality and homogeneity tests. The data were analyzed using SPPS. Given that the sample size exceeded 30, the *Kolmogorov-Smirnov test* was used to assess normality (Ahadi & Zain, 2023). Data are considered normal if the sig value is > 0.050 (Chakravarti et al., 1967) .

Normality tests were conducted on the pretest and posttest data for numeracy skills and the critical reasoning questionnaire. The results of the normality test are shown in Table 5.

Table 5. Results of the normality test of numeracy ability and critical reasoning character

Variables	Class	Kolmogorov-Smirnov [a]		
		Statistics	df	Sig.
Numeracy	Control Class Pretest	,176	56	,000
	Control Class Post-test	,284	56	,000
	Experimental Class Pretest	,189	57	,000
	Experimental Class Post-test	,239	57	,000
Critical Thinking Character	Control Class Pretest Questionnaire	,143	56	,000
	Control Class Post-test Questionnaire	,124	56	,000
	Experimental Class Pretest Questionnaire	,099	57	,000
	Experimental Class Post-Test Questionnaire	,076	57	,000

Table 5 shows that, in the numeracy ability test data, the p-value is < 0.05, indicating the data are not normally distributed. In the results questionnaire, character reasoning critical pretest and posttest data: class control sig value < 0.05, so the data are not normally distributed. While the sig value on the questionnaire pretest and posttest class experiment is> 0.05, it is normally distributed. The data were then tested for homogeneity. The results of the homogeneity test are shown in Table 6.

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Table 6. Results of the homogeneity test of numeracy ability and critical reasoning character

Variables		Levene Statistics	dfl	Df2	Sig.
Numeracy	Based on Mean	2,436	3	222	,066
	Based on Median	2,574	3	222	,055
	Based on Median and with adjusted df	2,574	3	204,038	,055
	Based on the Trimmed Mean	2,718	3	222	,0.45
Critical Thinking Character	Based on Mean	4,253	3	222	,006
	Based on Median	3,980	3	222	,009
	Based on Median and with adjusted df	3,980	3	197,147	,009
	Based on the Trimmed Mean	4,181	3	222	,007

Table 6 shows th*at, based on the Mean value*s> 0.05 (0.066 for numeracy ability and 0.06 for the critical reasoning character questionnaire), the data are homogeneous. Because the data are not normally distributed but homogeneous, a nonparametric test was performed, namely the U-Mann-Whitney test (Mulianti et al., 2022). The U-Mann-Whitney test is used to test the difference between two independent samples (Mulianti et al., 2022). The results of the U-Mann-Whitney test are shown in Table 7.

Table 7. Results of the U-Mann-Whitney test for numeracy ability and critical reasoning character

Variables		Result
Numeracy	Mann-Whitney University	1224,000
	Z	-2.103
	Asymp. Sig. (2-tailed)	,035
Critical Thinking Character	Mann-Whitney University	914,000
	Z	-3,813
	Asymp. Sig. (2-tailed)	,000

a. Grouping Variable: Class

Table 7 shows that *the Asymp.Sig (2-tailed*) value is <0.05, so it is concluded that there is an influence of the RME-based ethnomathematics module on students' numeracy abilities and critical reasoning character.

Next, an N-Gain test was conducted to determine the effectiveness of the RME-based ethnomathematics module on numeracy skills and critical reasoning skills. The results of the N-Gain test are shown in Table 8.

Table 8. Results of the n-gain test of numeracy ability and critical reasoning character

Variables	Class		Statistics	Criteria
Numeracy	Experiment	Mean	76.60	Effective
		Minimum	20	
		Maximum	100	
	Control	Mean	76.85	Effective
		Minimum	26	
		Maximum	100	

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Variables	Class		Statistics	Criteria
Critical Thinking Character	Experiment	Mean	90.57	Effective
		Minimum	69	
		Maximum	100	
	control	Mean	65.59	Quite Effective
		Minimum	8	
		Maximum	100	

Table 8 shows that the mean numeracy score in the experimental class was 76.60, while in the control class it was 76.85. Meanwhile, the mean critical reasoning character score in the experimental class was 90.57, and in the control class, it was 65.59. Based on these mean scores, it can be concluded that the use of the RME-based ethnomathematics module is effective in improving students' numeracy skills and critical reasoning character.

Research findings indicate that integrating the Dayak Muntak wedding culture into mathematics learning through an RME-based ethnomathematics module positively contributes to student learning. A contextual learning environment can improve students' numeracy skills (Fauzan et al., 2024) and higher-order thinking skills (Sutarni et al., 2024), as well as the development of character and 21st-century skills (Akker, 1999).

Several factors influencing this improvement include integrating mathematics with culture, which allows students to understand concepts through more context-rich learning (Ritonga et al., 2025). Furthermore, the use of the RME approach makes learning more meaningful and reflective because students can connect mathematical concepts to their surrounding culture, particularly the culture of the Muntak Dayak tribe. Thus, students actively construct their knowledge from the contexts they are familiar with.

In learning, use the ethnomathematics RME-based module; participants are accustomed to collaborating in groups. This can help participants learn by linking knowledge of mathematics with local values and culture, so that they make learning more meaningful, contextual, and relevant to their lives.

Furthermore, the module's effectiveness is reflected in students' active engagement during the learning process. The module, structured based on the RME principle, encourages students to rediscover mathematical concepts through exploration, discussion, and reflection. Thus, the module serves not only as a learning resource but also as a tool to guide students in the gradual process of concept discovery, moving from real-world situations to abstract mathematical forms.

The study has its own advantages, including the use of an RME-based module of ethnomathematics, capable of presenting learning in a contextual and meaningful way through the integration of local culture, which contributes to the improvement of participants' numeracy and critical reasoning abilities. In addition, the use of modules as teaching materials provides a structured, systematic, and encouraging learning environment for students to build knowledge independently through activity exploration and collaboration. However, research also has limitations, including a limited sample context and culture, so the study's generalization results are still limited, and the

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development and implementation module of ethnomathematics requires a relatively long time and careful planning, more complex than learning conventional methods.

Thus, the results of this study imply that integrating local culture through an RME-based ethnomathematics module effectively enhances students' meaningfulness and understanding of mathematical concepts. The impact is seen in improvements in numeracy skills, higher-order thinking, character, and student engagement and collaborative skills. In terms of contribution, this study provides empirical evidence that local culture-based learning can be an innovative alternative for creating contextually and relevantly designed mathematics learning.

CONCLUSIONS

Research conducted on mathematics learning using an RME-based ethnomathematics module found that the module was effective in improving students' numeracy skills and critical reasoning skills. Contextual learning, which involved exploration, discussion, and collaboration, also encouraged active student engagement and the development of 21st-century skills. The suggestion that can be drawn from the research is that future researchers can integrate other local cultures to improve students' abilities.

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