



Enhancing Quality Education: The Synergy of Culturally Responsive Teaching and Student Interest on Learning Outcomes in Elementary Schools

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Abstract: This study examines the impact of Culturally Responsive Teaching (CRT) and learning interest on the mathematics learning outcomes of fifth-grade students, focusing on the perimeter and area of plane figures. Aimed at addressing passive engagement in conventional methods, this quasi-experimental research employed a 2x2 factorial design with 42 students. Data were collected via learning interest questionnaires and mathematics tests, then analyzed using Independent Sample T-Tests and Two-Way ANOVA. The results demonstrate that CRT significantly improves overall mathematics learning outcomes ($p = 0.000$). Specifically, CRT has a significant positive effect on students with high learning interest ($p = 0.008$) with a mean difference of 13.45 points, and on those with low learning interest ($p = 0.000$) with a mean difference of 12.15 points. Furthermore, a significant interaction exists between the teaching approach and learning interest ($p = 0.043$). These findings suggest that CRT effectively enhances outcomes across different interest levels by integrating local culture, such as the Jam Gadang, into the Merdeka Curriculum. This approach promotes inclusive, contextual, and meaningful learning in elementary education.

Keywords: CRT; Learning interest; Mathematics learning outcomes; Merdeka curriculum

Introduction

Mathematics is a field of study that explores calculations, patterns, structures, and the relationships between numbers, magnitudes, and space. Within mathematics, there is knowledge about shapes and sizes, as well as computation that can be used to solve problems (Ginanjar, 2019; Panjaitan et al., 2023; Susilawati et al., 2023). It is also a science that can enhance thinking and reasoning abilities while serving as a foundation for developing science and technology (Lestari et al., 2025; Nahdi, 2019; Purwati et al., 2022; Sulistiani & Masrukan, 2016). As one of the core fields of education studied from elementary to higher education, mathematics learning should ideally be a process that provides experiences and behavioral influences

applicable in daily life, rather than focusing solely on academic outcomes (Siagian, 2017; Zaenal et al., 2024).

Consequently, mathematics is a critical field of study for solving daily problems such as financial management and measurement. However, students often perceive it as difficult because it requires an understanding of abstract symbols, formulas, and logical concepts that are not always visible in the real world (Afrianti et al., 2024; Fathonah et al., 2023; Lestari et al., 2024). These difficulties directly impact students' learning outcomes. Global data from the Programme for International Student Assessment (PISA) confirms this issue, showing that average mathematics scores have fluctuated significantly. For instance, the lowest average score was recorded in 2003 at 360 points, and while it

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reached 391 in 2006, scores from 2009 to 2018 remained unstable (Siregar et al., 2024).

Based on observed phenomena, low mathematics learning outcomes are often caused by a lack of variation in teaching approaches. Many learning processes remain teacher-centered, leading to passive participation and a failure to connect material to students' daily activities. Teacher-centered approaches are generally ineffective in mathematics education as they focus on rote memorization of algorithms without fostering deep conceptual understanding, leading to student boredom and disengagement (Jafar, 2021; Lestari et al., 2024; Richardo, 2017). To address this, a teaching approach that aligns with the students' character and local culture is necessary. Integrating local culture into education plays a vital role in fostering noble values and improving academic performance (Agustian et al., 2025; Rakhmawati & Alifia, 2018). Therefore, there is an urgent need for the Culturally Responsive Teaching (CRT) approach, which integrates local culture into mathematics learning to create a more contextual and meaningful experience.

Method

The research method used in this study is a quantitative method in the form of a quasi-experiment. According to Sugiyono (2018) a quasi-experiment is used because, in reality, it is difficult to obtain a control group that can be used in research without variables affecting the experiment. The study consists of two classes: the experimental class and the control class. The experimental class is intentionally given the treatment of the Culturally Responsive Teaching (CRT) approach, while the control class uses the lecture approach or the approach commonly used by the teacher in class, with the same number of study hours.

Table 1. Research design based on treatment

Class	Treatment	Final Test
Experimental	X	T
Control	O	T

Explanation:

X : Culturally Responsive Teaching (CRT) approach

O: Conventional approach (lecture) or the approach commonly used by the teacher in the classroom

T : Final Learning Outcomes Test

Population refers to all research subjects that meet certain criteria (Fetzer, 2020; Mohsin, 2021; Sulistiyowati & Astuti, 2021; Suriani et al., 2023). In this study, the population includes fifth-grade students of SDN Gugus 2 in Ampek Nagari Subdistrict, Agam Regency, West Sumatra Province, for the 2024/2025 academic year. The

population consists of four schools: SDN 20 Lubuk Alung with 17 students, SDN 13 Lubuk Alung with 14 students, SDN 15 Pudung with two learning groups (Rombel A with 20 students and Rombel B with 18 students), and SDN 23 Malabur with 14 students. The sample in this study is a part of the population being studied and represents that population. Two sample classes were selected using the Purposive Sampling technique, which involves sample selection based on the researcher's consideration (Sugiyono, 2018). After conducting normality and homogeneity tests, SDN 15 Pudung was selected as the sample due to its two learning groups, which facilitated the study. Rombel A (experimental group) and Rombel B (control group) became the research samples. The variables studied in this research consist of three types. The independent variable is the Culturally Responsive Teaching (CRT) approach, which affects the dependent variable, students' learning outcomes. Additionally, there is a moderator variable, students' learning interest, divided into high and low interest. This study uses two instruments to collect data: a test instrument and a non-test instrument. The learning interest questionnaire instrument was developed based on learning interest indicators through theoretical studies and the preparation of a blueprint, adapted from (Jannah et al., 2021).

Table 2. Research design based on learning interest interaction

	Learning Approach	CRT Approach (A1)	Conventional Approach (A2)
Learning Interest (B)			
Learning interest (B)	High (B1)	A1B1	A2B1
	Low (B2)	A1B2	A2B2

Explanation:

A1: The group of students who learn with the CRT approach

A2: The group of students who learn with the conventional approach (lecture)

B1 : The group of students with high learning interest

B2 : The group of students with low learning interest

A1 B1: Learning outcomes of students who learn with the CRT approach and have high learning interest

A1 B2: Learning outcomes of students who learn with the CRT approach and have low learning interest

A2 B1: Learning outcomes of students who learn with the conventional approach (lecture) and have high learning interest

A2 B2: Learning outcomes of students who learn with the conventional approach (lecture) and have low learning interest

The scoring guide in this study was developed based on the blueprint that was created, resulting in statement items with possible answers. This instrument is used to measure students' learning interest, with alternative responses developed using the Likert Scale model.

Table 3. Scoring guide

Answer Alternatives	Item	
	-	+
Never	5	1
Rarely	4	2
Sometimes	3	3
Often	2	4
Always	1	5

After scoring calculations, the data are analyzed using the learning interest grouping criteria table.

Table 4. Learning interest grouping criteria

Formula	Category
$X < \mu$	Low
$X \leq \mu$	High

Explanation:

X : Raw score of the sample

μ : Mean of the distribution in the population

The instrument validation was carried out through content validation by three lecturers who provided feedback to improve the questionnaire items to make them easier to understand and more effective in measuring students' learning interest. After revisions, the questionnaire was pilot-tested on sixth-grade students of SDN 13 Lubuk Alung, and the results were analyzed to test its validity and reliability. The validity of the questionnaire was tested using Pearson Correlation Product Moment with SPSS 16.0, and the results showed that 20 statement items were valid. For reliability, the test was conducted using the Cronbach's Alpha formula, with a Cronbach's Alpha value of 0.982, indicating that the instrument is highly reliable.

Table 5. Instrument reliability criteria

Limit	Category
$0.81 < r_{11} \leq 1.00$	Very high (excellent)
$0.61 < r_{11} \leq 0.80$	High (good)
$0.41 < r_{11} \leq 0.60$	Moderate (Average)
$0.21 < r_{11} \leq 0.40$	Low (poor)
$0.00 < r_{11} \leq 0.20$	Very low (very poor)

In addition, the test items were also tested for validity and reliability, with 7 out of 10 items being valid. The discrimination power and difficulty index of the questions were also tested, with results showing that most of the questions had good discrimination power and appropriate difficulty levels.

$$D = \frac{B_A}{J_A} - \frac{B_B}{J_B} \tag{1}$$

Explanation:

D : Discrimination power

B_A : Number of correct answers from the upper group

B_B : Number of correct answers from the lower group

J_A : Number of participants in the upper group

J_B : Number of participants in the lower group

Table 6. Differential power coefficient

Differential Power Coefficient	Interpretation
D : 0.60 – 1.00	Excellent
D : 0.40 – 0.60	Good
D : 0.20 – 0.40	Satisfactory
D : 0.00 – 0.20	Poor

$$P = \frac{B}{J_s} \tag{2}$$

Explanation:

P: Difficulty level

B: Number of students who answered correctly

J_s : Total number of students in the test

Table 7. Difficulty index criteria

Difficulty Index Coefficient	Interpretation
P 0.10 to 0.30	Difficult
P 0.30 to 0.70	Moderate
P 0.70 to 1.00	Easy

The valid and reliable data were then used for further analysis in the study. The data analysis technique employed in this research used inferential statistical analysis to test the hypotheses with t-tests and two-way ANOVA. Before that, prerequisite tests were conducted, including a normality test to determine if the data were normally distributed using the Kolmogorov-Smirnov Test, and a homogeneity test to ensure that the variance of the sample groups was the same using Levene's Test. Subsequently, the t-test was used to compare the differences between two groups, while two-way ANOVA was used to examine the interaction between the Culturally Responsive Teaching (CRT) approach and learning interest in influencing mathematics learning outcomes. Conclusions were drawn based on the significance value, with H_0 being rejected if the Sig. value was < 0.05 , and H_a being accepted.

Result and Discussion

Students' Mathematics Learning Interest Data

Before applying the teaching approach, students in the experimental and control groups were given a questionnaire to measure their learning interest. The analysis results grouped students into low and high

interest categories. In the experimental group, out of 20 students, 13 were categorized as having low interest and 7 as having high interest. Meanwhile, in the control group, out of 18 students, 12 were in the low interest category and 6 in the high interest category.

Students' Mathematics Learning Outcomes Data

A pretest was conducted to assess the initial ability of students before the implementation of the Culturally Responsive Teaching (CRT) approach. The pretest results showed that out of 20 students, 19 did not meet

the minimum competency and 1 did. After the implementation of CRT, the posttest results showed that 17 students passed, with 10 from the low interest category and 7 from the high interest category. The 3 students who did not pass were from the low interest category. This indicates that the CRT approach effectively improves mathematics learning outcomes for both low and high interest students. A comparison of the pretest and posttest results shows significant improvement in the experimental group.

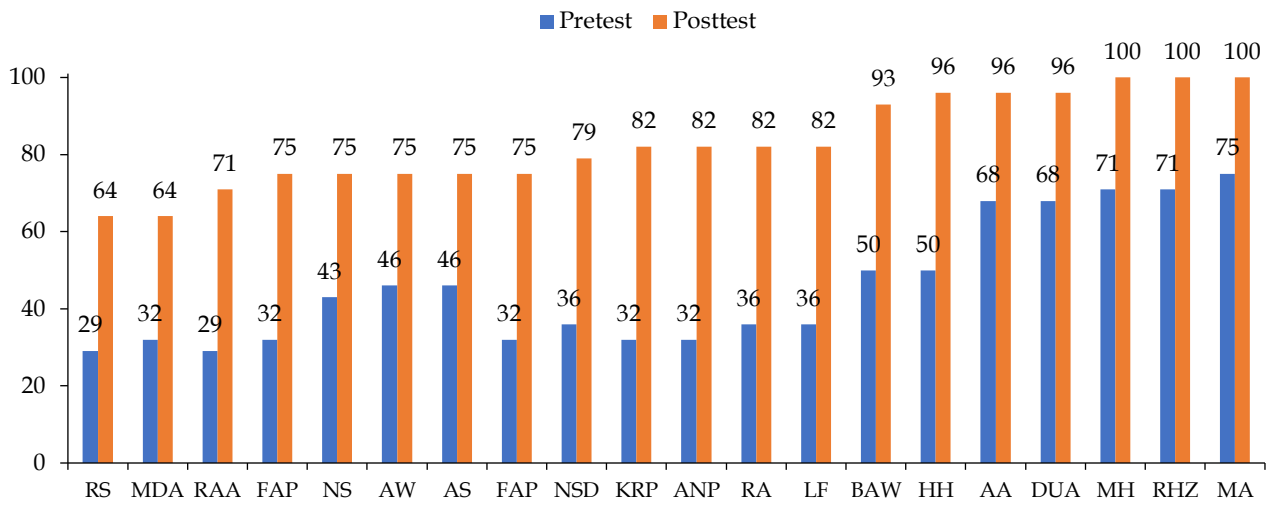


Figure 1. Comparison of pretest and posttest learning outcomes in the experimental group

Students' Learning Outcomes in the Control Group

In the control group, a pretest was conducted to measure the students' initial abilities. The results showed that none of the students passed, with 12 students from the low interest category and 6 from the high interest category. After the implementation of

conventional teaching, the posttest showed that only 3 students passed, all from the high interest category. Most students with low interest, as well as some with high interest, did not achieve the minimum competency. This indicates that the conventional approach has not been effective in improving overall learning outcomes.

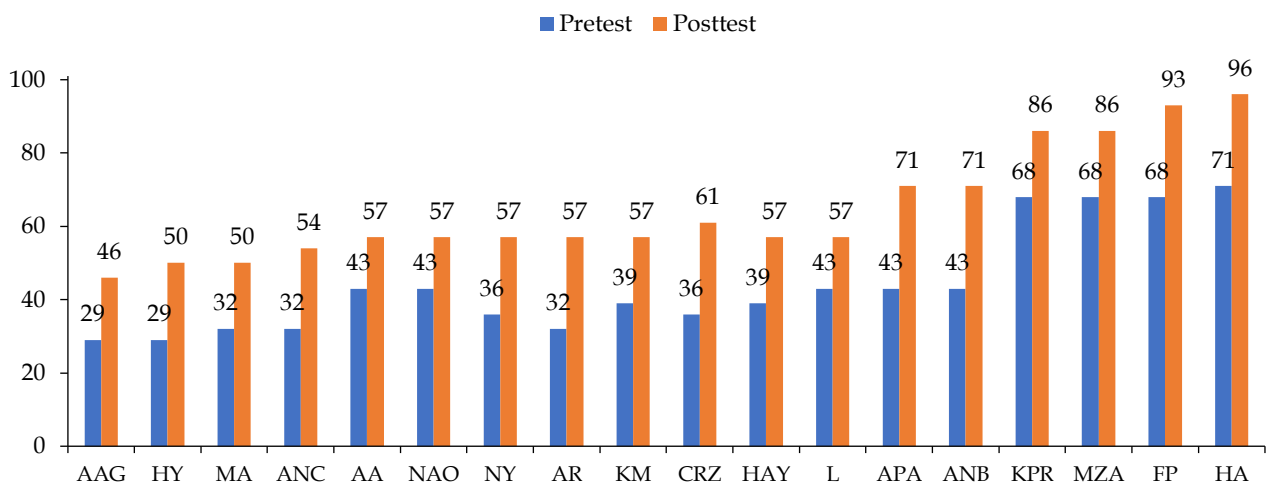


Figure 2. Comparison of pretest and posttest learning outcomes in the experimental group

Normality Test Results

Table 8. The normality test results for the pretest mathematics learning outcomes of students in the experimental and control groups

One-Sample Kolmogorov-Smirnov Test			
		Experiment	Control
N		20	18
Normal Parameters ^a	Mean	45.70	44.11
	Std. Deviation	16.151	14.393
Most Extreme Differences	Absolute	.226	.309
	Positive	.226	.309
	Negative	-.166	-.174
Kolmogorov-Smirnov Z		1.010	1.309
Asymp. Sig. (2-tailed)		.259	.065

a. Test distribution is Normal.

Based on the normality test, the pretest results for the experimental group (0.259) and the control group (0.065) showed Sig. values greater than 0.05, indicating that the data for both groups are normally distributed.

Table 9. Normality test results for posttest mathematics learning outcomes of students in the experimental and control groups

One-Sample Kolmogorov-Smirnov Test			
		Experiment	Control
N		20	18
Normal Parameters ^a	Mean	83.10	64.61
	Std. Deviation	11.876	15.515
Most Extreme Differences	Absolute	.187	.299
	Positive	.187	.299
	Negative	-.161	-.138
Kolmogorov-Smirnov Z		.836	1.270
Asymp. Sig. (2-tailed)		.487	.080

a. Test distribution is Normal.

Based on the normality test, the posttest results for the experimental group (0.487) and the control group (0.080) showed Sig. values greater than 0.05, indicating that the data for both groups are normally distributed.

Homogeneity Test Results

Table 10. Homogeneity test results for pretest mathematics learning outcomes of students in the experimental and control groups

Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	Sig.
Learning outcome	.727	1	36	.399

Based on Levene's test, the pretest results for the experimental and control groups are homogeneously distributed with a Sig. value of 0.399 > 0.05.

Table 11. Homogeneity test results for pretest mathematics learning outcomes of students in the experimental and control groups

Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	Sig.
Learning outcome	1.539	1	36	.223

Based on Levene's test, the posttest results for the experimental and control groups are homogeneously distributed with a Sig. value of 0.818 > 0.05.

T-Test Results

The results show that the Culturally Responsive Teaching (CRT) approach is more effective than the conventional approach in improving the mathematics learning outcomes of fifth-grade students. Hypothesis testing using the Independent Sample T-Test with SPSS 16.0 revealed a significance value (Sig. 2-tailed) of 0.000 for both the experimental and control groups, which is smaller than $\alpha = 0.05$, indicating a significant difference between the two approaches. This applies not only to students overall but also to those with both high and low learning interest. For students with high learning interest, the mean difference of 13.452 indicates that their learning outcomes, when taught with CRT, are 13.452 points higher than those taught with the conventional approach. Meanwhile, for students with low learning interest, the mean difference of 2.150 indicates that those using the CRT approach have learning outcomes 2.150 points higher. Therefore, it can be concluded that the CRT approach significantly influences the mathematics learning outcomes of students, both with high and low learning interest.

ANOVA Results

Interaction hypothesis testing was conducted using Two-Way ANOVA with SPSS 16.0 to determine whether there is an interaction between the Culturally Responsive Teaching (CRT) approach and learning interest levels in influencing the mathematics learning outcomes of fifth-grade students. Below is the output of the Two-Way ANOVA test.

Based on the test output, the significance value for the interaction between the teaching approach and learning motivation is 0.043, which is smaller than 0.05, indicating a significant interaction between the two in influencing mathematics learning outcomes. Therefore, the Culturally Responsive Teaching (CRT) approach and learning interest together affect mathematics learning outcomes. The influence of the teaching approach varies according to students' learning interest, and conversely, the influence of learning interest is also affected by the teaching approach. This interaction can be seen in the following graph (Figure 3).

Table 12. Two-Way ANOVA test output

Source	Tests of Between-Subjects Effects				
	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8960.604 ^a	3	2986.868	66.023	.000
Intercept	211100.367	1	211100.367	4.666E3	.000
Learning Interest	6052.762	1	6052.762	133.792	.000
Class Group	1990.659	1	1990.659	44.002	.000
Learning Interest * Class Group	199.288	1	199.288	4.405	.043
Error	1538.159	34	45.240		
Total	223799.000	38			
Corrected Total	10498.763	37			

Dependent Variable = Learning Outcome

a. R Squared = .853 (Adjusted R Squared = .841)

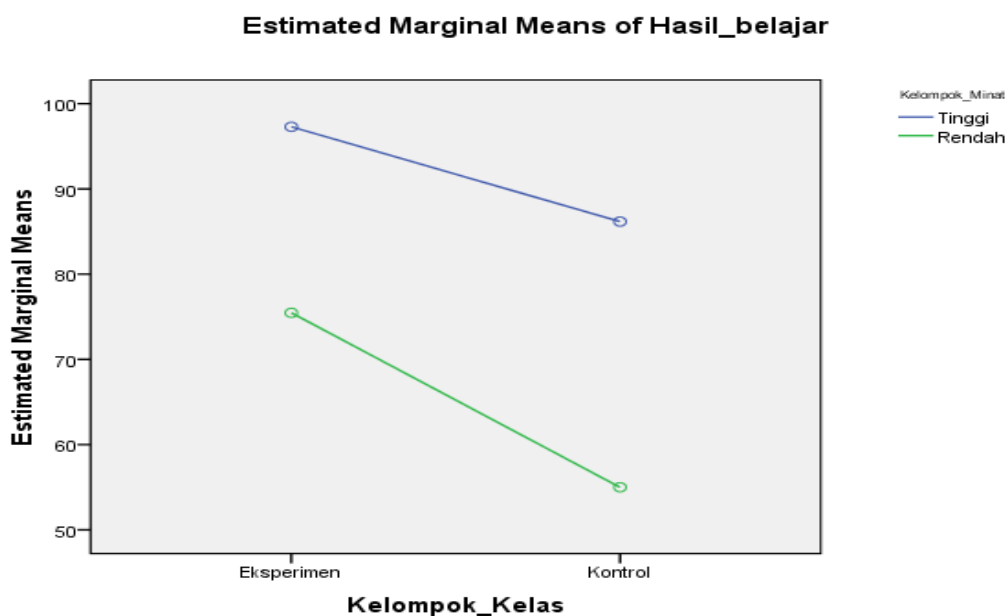


Figure 3. Interactive test plot graphic

Conclusion

Based on the analysis results, it can be concluded that the Culturally Responsive Teaching (CRT) approach significantly affects the mathematics learning outcomes of fifth-grade students, especially in the topics of perimeter and area of plane figures. CRT-based learning that integrates local cultural contexts, such as Jam Gadang in West Sumatra, creates a more meaningful and relevant learning experience. First, the CRT approach generally improves mathematics learning outcomes more significantly compared to the conventional approach. Student engagement increases because the material is linked to real-world objects with cultural value. Second, CRT is effective in improving the learning outcomes of students with high interest, strengthening intrinsic motivation and understanding of mathematical concepts. Third, although the learning

outcomes of students with low interest do not match those with high interest, CRT still has a positive impact. This shows the flexibility of CRT, reaching students from various interest backgrounds. Fourth, the significant interaction between the teaching approach and learning interest shows that both variables influence learning outcomes, with CRT's success depending on the students' affective readiness. Therefore, it can be concluded that CRT, which integrates local cultural contexts, creates an inclusive and effective learning environment. Teachers must master the material, methods, and understand the characteristics and social-cultural environment of students, making CRT an effective strategy to improve mathematics learning outcomes.

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Author Contributions

Conceptualization, data curation, M. and J.; methodology, software, formal analysis, M. and D.; investigation, resources, writing – original draft preparation, M.; writing – review and editing, supervision, F.Y.J. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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