

The Effectiveness of Culturally Responsive Teaching-Based E-Motic in Improving The Critical Thinking Skills of Elementary School Students

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ABSTRACT

This study aims to analyze the effectiveness of *The Effectiveness of Culturally Responsive Teaching-Based E-Motic in Improving The Critical Thinking Skills of Elementary School Students* in improving the critical thinking skills of elementary school students. The study used a quasi-experimental design with a non-equivalent control group design model. The participants involved 60 students in Grade V, who were divided into two groups, namely 30 students in the experimental group and 30 students in the control group, with relatively homogeneous characteristics in terms of age, socioeconomic background, and initial academic achievement. The research instruments included critical thinking ability tests based on indicators of interpretation, analysis, evaluation, inference, explanation, and self-regulation; observation sheets on learning implementation; and student response questionnaires. Data were analyzed using descriptive and inferential statistical tests through independent sample t-tests and effect size calculations. The results showed a significant difference between the experimental group and the control group after treatment ($p < 0.05$), with a large effect-size category. The increase in critical thinking scores in the experimental group was higher than in the control group across all indicators. In addition, the implementation of learning was in the “very good” category, and the students’ responses to the use of E-MOTIC showed a very positive acceptance rate. These findings indicate that the integration of thematic digital modules with a culturally responsive teaching approach is effective in creating contextual, meaningful learning oriented toward strengthening higher-order thinking skills in primary schools.

INTRODUCTION

Digital transformation in 21st century education demands the integration of learning technologies that are not only substitutive, but also transformative in building higher-level thinking competencies (Alshafei et al., 2025; Jabli, 2024; Kgosi et al., 2026; Pachler, 2023; Warneri et al., 2025). Reports from various international assessments, such as the Organisation for Economic Co-operation and Development (OECD) through the Programme for International Student Assessment (PISA) program, have consistently shown that students' critical thinking and problem-solving skills are still a challenge in many developing countries, including Indonesia. The results of PISA in recent cycles indicate that most students are still at the middle to lower level of ability to understand, analyze, and evaluate information in depth. These findings reinforce the urgency of developing learning strategies and media that are able to stimulate high-level cognitive processes from the elementary school level (N. D. Shalikhah et al, 2023).

On the other hand, the penetration of digital technology in the world of education is increasingly widespread, especially after the COVID-19 pandemic (Al Masud et al., 2023; Chaturvedi & Ranjan, 2025; Kgosi et al., 2026; Rahman et al., 2023; Zancajo et al., 2022). Elementary schools are starting to utilize various digital platforms and electronic modules as an alternative to learning (Faustyna, 2024). However, a number of studies show that the use of technology in the classroom is often still oriented towards delivering material in an informative manner, not optimally designed to encourage knowledge construction and critical thinking development. In other words, digitalization has not been fully accompanied by pedagogical innovations that are oriented towards strengthening the essential competencies of students.

These problems become more complex when they are associated with the context of cultural diversity in Indonesia. Learning that does not consider the social and cultural background of students has the potential to cause a gap in conceptual understanding and low learning engagement. In this context, the Culturally Responsive Teaching (CRT) approach pioneered by Gloria Ladson-Billings emphasizes the importance of integrating students' cultural identities into the learning process so that learning becomes more meaningful, contextual, and empowering. This approach is relevant to be applied at the elementary school level, which is a fundamental phase of the formation of students' cognitive and social schemes (Ayush Mehta, 2024).

Previous studies have demonstrated that e-modules and digital teaching materials can enhance student motivation and learning outcomes across various educational levels. Perdana et al. (2017), Susanti et al. (2025), and Rusnawati, Santyasa, and Tegeh (2021) reported that e-modules and project-based e-learning effectively improved critical thinking skills at the senior high and vocational levels. At the elementary level, Hasanah et al. (2021), Lestari et al. (2021), and Rahmawati (2021) examined learning models such as synectic, RADEC, and problem-based learning to enhance higher-order thinking skills. However, these studies predominantly focused on pedagogical strategies without integrating digital modules. Recent studies have begun exploring Culturally Responsive Teaching (CRT) in digital learning contexts. Alwi et al. (2024) and Bayu Ivanka, Pratiwi, and Listiani (2025) developed CRT-based digital media to improve reading skills in elementary schools. Hart (2025), Farida Istiqomah and Anggoro (2025), and Hikmah and Purwati (2025) applied CRT approaches to enhance critical reasoning and learning outcomes. Prabawati and Amarulloh (2025) tested CRT-based modules for mathematics, while Juliani, Permanasari, and Patras (2024) explored CRT for creative thinking development. However, most of the research focused on improving general learning outcomes or basic literacy, rather than specifically on critical thinking skills. In addition, the integration of culturally responsive approaches in e-module design at the elementary school level is still relatively limited and has not been empirically tested for effectiveness.

Theoretically, critical thinking includes the ability to analyze, evaluate, interpret, and draw logical inferences. The widely referenced critical thinking framework, such as that put forward by Peter A. Facione, asserts that the development of these abilities requires a challenging, reflective, and contextual learning environment. Therefore, the integration of learning technologies designed with CRT principles has the potential to be an innovative strategy to connect students' cultural contexts with high-level cognitive processes. This

combination conceptually brings together pedagogical, cultural, and digital aspects in one integrated learning design (Omer Elsheikh Hago Elmahdi, 2025).

However, a review of the literature shows that there is a research gap. First, research on the effectiveness of e-modules at the elementary school level is still dominated by the measurement of cognitive learning outcomes at the elementary to middle levels. Second, research that integrates the principles of Culturally Responsive Teaching in the development of digital media is relatively rare, especially in the context of thematic learning in elementary schools. Third, there have not been many studies that explicitly test the impact of CRT-based e-modules on critical thinking indicators in a comprehensive and measurable manner.

This gap shows that there is still a need for research that empirically tests the effectiveness of digital learning media that is not only technologically innovative, but also sensitive to the cultural context of students. The urgency of this research is even stronger considering that the national curriculum emphasizes strengthening critical thinking competencies as part of the Pancasila student profile. Thus, the development and testing of E-MOTIC (E-Thematic Module Based on Culturally Responsive Teaching) has become relevant to answer the needs of 21st century adaptive, contextual, and competency-oriented learning.

The novelty of this research lies in the systematic integration of digital thematic e-modules and the principles of Culturally Responsive Teaching in a structured learning design, as well as direct testing of its effectiveness on the critical thinking skills of elementary school students. Not only developing products, this study also evaluates the impact of interventions on clearly operationalized critical thinking indicators, thereby making an empirical contribution to the literature on the development of technology-based culturally responsive learning media.

Based on this description, this research examines the effectiveness of E-MOTIC, a Culturally Responsive Teaching-based thematic e-module, in improving elementary students' critical thinking skills by analyzing differences between E-MOTIC and conventional learning, measuring improvement levels, and describing implementation and student responses. Theoretically, it contributes to literature on integrating culturally responsive pedagogy with digital media in elementary education and provides empirical evidence on combining technological, pedagogical, and cultural aspects. Practically, it offers teachers an innovative contextual tool, provides students meaningful learning experiences, serves as a reference for curriculum developers, supports schools in implementing the independent curriculum, and provides a foundation for future research. The research problem focuses on whether E-MOTIC significantly improves critical thinking compared to conventional learning and its implications for developing more responsive, contextual, and meaningful learning practices.

METHOD

This research uses a quantitative approach with a quasi-experimental nonequivalent control group design. This design was chosen because the researcher did not randomize the subjects in full, but used classes that had been naturally formed in the context of elementary schools. The study aims to test the effectiveness of the use of E-MOTIC (Thematic E-Module

Based on Culturally Responsive Teaching) in improving students' critical thinking skills compared to conventional learning.

The research design involved two groups, namely the experimental group that obtained learning using E-MOTIC based on Culturally Responsive Teaching (CRT) and the control group that participated in thematic learning using conventional methods. Both groups were given a pretest and a posttest to measure the improvement in critical thinking skills before and after treatment.

The research participants consisted of elementary school grade V students in the even semester of the current school year. The number of participants was 60 students divided into two classes, 30 students each in the experimental group and 30 students in the control group. The characteristics of the participants were relatively homogeneous in terms of age (10–11 years), socioeconomic background, and average academic achievement based on the previous semester's report card scores.

The sample selection technique uses purposive sampling by considering the equivalence of academic characteristics and the availability of digital learning facilities. Class selection is carried out based on the school's recommendations by considering the similarity of the curriculum, supporting teachers, and learning environment conditions to minimize disruptive variables.

The data in this study was collected through the following techniques:

1. Critical Thinking Ability Test

The main instrument of the research is in the form of a description test based on critical thinking indicators which includes the ability to analyze, evaluate, interpret, and infer skills. Tests were given in the form of pretest and posttest to both groups. The instrument was developed based on critical thinking indicators that have been conceptually validated and tested for content validity through expert judgment.

2. Observation of Learning Implementation

Observations were made to measure the implementation of CRT-based E-MOTIC during the learning process. The observation sheet contains aspects of teacher and student activities, the integration of local cultural contexts, and student involvement in higher-level thinking activities.

3. Student Response Questionnaire

The questionnaire was used to find out students' perceptions and responses to the use of E-MOTIC in learning. The questionnaire uses a four-level Likert scale to measure aspects of ease of use, appeal, cultural relevance, and benefits to concept understanding.

4. Documentation Documentation includes Learning Implementation Plans (RPP), student work results, and documentation of learning activities as supporting data.

Quantitative data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to calculate mean scores, standard deviations, and percentage improvements in critical thinking skills. Prior to hypothesis testing, assumption tests, including normality and homogeneity tests, were conducted.

Hypothesis testing was performed using an independent samples t-test to determine differences in critical thinking skill improvement between the experimental and control

groups. In addition, N-gain scores were calculated to measure the magnitude of improvement within each group. The significance level was set at 0.05.

Observation and questionnaire data were analyzed descriptively by calculating mean scores and categorizing them into interpretive levels. These analyses were used to support the main findings regarding the effectiveness of E-MOTIC in terms of implementation quality and student responses.

RESULT AND DISCUSSION

The study involved 60 elementary school grade V students who were divided into two groups, namely 30 students in the experimental group and 30 students in the control group. All participants were between 10–11 years old. Based on data on the previous semester's report card scores and information on the socioeconomic background of parents, the two groups have relatively homogeneous characteristics. This is reinforced through preliminary statistical analysis of previous academic scores.

Table 1. Participant Characteristics

Characteristics	Experimental Group (n=30)	Control Group (n=30)
Average Age	10.6 years	10.5 years
Average Report Card Score	78,42	77,95
Socio-Economic Background	Intermediate	Intermediate
Gender (L/P)	16 / 14	15 / 15

Source: Primary data processed (2026)

The data showed that there was no marked difference between the two groups before the treatment was given.

The pretest is given to determine students' initial critical thinking skills before the Culturally Responsive Teaching based E-MOTIC intervention.

Table 2. Descriptive Statistics Pretest

Groups	N	Red	SD	Minimum	Maximum
Experiments	30	58,47	6,21	48	69
Controls	30	57,93	6,08	47	68

Source: Primary data processed (2026)

An independent sample t-test on the pretest score showed a value of Sig. = 0.732 ($p > 0.05$), which means that there was no significant difference between the two groups. Thus, students' initial critical thinking skills are declared equal.

Posttest Results of Critical Thinking Ability

After treatment for four meetings, a posttest was carried out to measure the improvement of students' critical thinking skills.

Table 3. Posttest Descriptive Statistics

Groups	N	Red	SD	Minimum	Maximum
Experiments	30	82,63	5,74	72	92
Controls	30	70,21	6,02	60	81

Source: Primary data processed (2026)

It was seen that the experimental group experienced a higher increase than the control group.

To determine the level of improvement in critical thinking skills, an N-Gain analysis was carried out.

Table 4. N-Gain Calculation Results

Groups	Red N-Gain	Categories
Experiments	0,58	Medium–High
Controls	0,29	Low–Medium

Source: Primary data processed (2026)

These results showed that the improvement in critical thinking skills in the experimental group was almost double that of the control group.

Table 5. Normality Test (Kolmogorov-Smirnov)

Variable	Groups	Sig.	Remarks
Pretest	Experiments	0,200	Normal
Pretest	Controls	0,187	Normal
Posttest	Experiments	0,154	Normal
Posttest	Controls	0,165	Normal

Source: Primary data processed (2026)

Table 6. Homogeneity Test (Levene Test)

Variable	Sig.	Remarks
Pretest	0,721	Homogeneous
Posttest	0,684	Homogeneous

Source: Primary data processed (2026)

The data meet the assumptions of normality and homogeneity so that parametric analysis can be used.

Hypothesis Test

Table 7. Independent Sample t-test results

Variable	Mean Experiment	Mean Control	t	Sig. (2-tailed)	Cohen's d
Posttest	82,63	70,21	8,47	0,000	2,09

Source: Primary data processed (2026)

A significance value of 0.000 ($p < 0.05$) indicates a significant difference between the two groups. The effect size of 2.09 is included in the large category, which shows that E-MOTIC based on Culturally Responsive Teaching has a strong impact on improving students' critical thinking skills.

Analysis Per Critical Thinking Indicator

The analysis was carried out based on critical thinking indicators according to Peter A. Facione.

Table 8. Score Increase Per Indicator (%)

Indicator	Experiments (%)	Control (%)
Interpretation	21	10
Analysis	26	12
Evaluation	24	9
Inference	22	11
Explanation	19	10
Self-regulation	18	8

Source: Primary data processed (2026)

The experimental group showed a higher improvement in all indicators, especially in the analysis and evaluation aspects.

Results of E-MOTIC Implementation Observations

Observation of the implementation of learning based on the principle of Culturally Responsive Teaching from Gloria Ladson-Billings showed very good results.

Table 9. Observation Results

Aspects	Red	Categories
Cultural Integration	3,75	Excellent
Student Engagement	3,60	Excellent
HOTS Activities	3,70	Excellent
Use of E-MOTIC	3,65	Excellent
Reflective Interactions	3,70	Excellent
Average	3,68	Excellent

Source: Primary data processed (2026)

Student Response Questionnaire Results

Table 10. Student Response to E-MOTIC

Aspects	Red	Categories
Facilities	3,60	Very Positive
Attraction	3,68	Very Positive
Cultural Relevance	3,72	Very Positive
Benefits	3,65	Very Positive
Engagement	3,70	Very Positive
Concept Understanding	3,66	Very Positive
Average	3,67	Very Positive

Source: Primary data processed (2026)

As many as 87% of students stated that E-MOTIC helped them understand the material in a more in-depth and contextual way.

Summary of Findings

1. There was no significant difference in initial ability between the experimental and control groups.
2. There was a significant difference in posttest scores ($p < 0.05$).
3. CRT-based e-MOTIC is effective in improving critical thinking skills with a large effect size ($d = 2.09$).

4. The implementation of learning went very well and received a positive response from students.

CONCLUSION

This study aimed to test the effectiveness of *The Effectiveness of Culturally Responsive Teaching-Based E-Motic in Improving The Critical Thinking Skills of Elementary School Students* (E-MOTIC: Thematic E-Module Based on Culturally Responsive Teaching) in improving the critical thinking skills of elementary school students. The results showed that E-MOTIC was significantly more effective than conventional learning in improving students' critical thinking skills. The significant differences between the experimental and control groups after treatment, along with large effect size values, indicate that the intervention had a strong practical impact.

Improvement in critical thinking skills occurred across all indicators, including interpretation, analysis, evaluation, inference, explanation, and self-regulation. The integration of local cultural contexts within the digital module encouraged students to understand concepts more deeply, relate learning materials to real-life experiences, and develop higher-order thinking skills more effectively. These findings confirm that combining educational technology with a culturally responsive pedagogical approach creates a more contextual, reflective, and meaningful learning environment.

In addition, the implementation of E-MOTIC-based learning was rated in the "very good" category, and students' responses indicated a very positive level of acceptance. This suggests that E-MOTIC was not only cognitively effective but also supported student engagement and learning motivation.

Overall, E-MOTIC based on Culturally Responsive Teaching proved effective in improving the critical thinking skills of elementary school students. This study contributes empirically to the development of culturally responsive digital learning media and offers practical implications for teachers in designing contextual thematic learning oriented toward strengthening higher-order thinking skills. Further research is recommended to examine its long-term effectiveness, application across different grade levels, and implementation in more diverse sociocultural contexts to enhance the generalizability of the findings.

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