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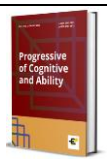

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The Effect of the LOC-R Learning Model on Fifth-Grade Students' Critical Thinking Skills in Mathematics Learning

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ABSTRACT

Purpose – This study aims to examine the effect of the LOC-R (Literacy, Orientation, Collaboration, and Reflection) learning model on fifth-grade students' critical thinking skills in mathematics, addressing the need for instructional approaches that move beyond procedural learning toward higher-order thinking.

Methodology – A quasi-experimental method with a one-group pretest–posttest design was employed. The participants consisted of 20 fifth-grade students from SD Negeri Sosrowijayan. The intervention involved the implementation of the LOC-R learning model in mathematics instruction. Data were collected using a critical thinking skills questionnaire developed based on eight critical thinking indicators. Data analysis included descriptive statistics, normalized gain (N-gain), and a paired-sample t-test to determine the significance of the observed differences.

Findings – The results revealed a substantial improvement in students' critical thinking skills following the implementation of the LOC-R learning model. The mean score increased from 65 on the pretest to 85 on the posttest, with an N-gain value of 0.67, indicating a moderate-to-high level of improvement. The paired-samples t-test showed a statistically significant difference between pretest and posttest scores ($p < 0.05$), confirming the intervention's effectiveness.

Novelty – This study provides experimental-based empirical evidence on the effectiveness of the LOC-R learning model, which has predominantly been examined through descriptive approaches in previous research.

Significance – The findings offer practical implications for elementary school teachers, curriculum developers, and education researchers seeking effective instructional models to enhance students' critical thinking skills in mathematics learning.

Keywords: Critical thinking; Elementary education; LOC-R model; Mathematics education;

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1. Introduction

A pleasant learning culture is a crucial element in creating a conducive, productive, and sustainable learning environment (Hapsari, 2025). Critical thinking skills are one of the key competencies that must be developed in 21st-century education (Thornhill-miller et al., 2023; Gunartha, 2024; Arifin & Mu'id, 2024), in line with global demands for human resources capable of analytical, reflective, and problem-solving-based thinking (Rehman et al., 2024). In the context of mathematics learning, critical thinking skills play a very important role because they enable students not only to perform calculations (Nurhasanah et al., 2025), but also to understand problems, analyze relevant information, construct logical arguments, evaluate various solution alternatives, and draw rational and systematic conclusions. These abilities form the foundation for students to connect mathematical concepts with real-life situations and apply them meaningfully in everyday life. However, various research findings indicate that at the elementary school level, mathematics learning is still dominated by procedural approaches and formula memorization (Fry et al., 2025). As a result, students tend to solve problems mechanistically without deep conceptual understanding, causing critical thinking skills to remain underdeveloped.

The low level of students' critical thinking skills can be observed in their difficulties in solving problems oriented toward HOTS or Higher Order Thinking Skills (Khaesarani & Ananda, 2022), particularly tasks that require analysis, evaluation, and reasoning. Many students struggle to identify problems, interpret the given information, and connect relevant mathematical concepts to find appropriate solutions. This condition indicates that mathematics learning has not fully provided opportunities for students to actively engage in higher-order thinking processes. Therefore, a learning model is needed that not only emphasizes the achievement of final outcomes but also encourages active, contextual, collaborative, and reflective cognitive engagement throughout the learning process. One learning model considered relevant to these needs is the LOC-R model (Literacy, Orientation, Collaboration, and Reflection) (Tamami et al., 2024). The LOC-R model aims to enhance learning effectiveness by integrating various holistic and structured approaches (Supriadi et al., 2025). This learning model has several advantages, including improving students' literacy, developing their ability to comprehend texts, providing systematic learning steps, and encouraging critical thinking (Anastasia et al., 2024).

The LOC-R model integrates contextual literacy activities to build students' initial understanding, learning orientation to clarify learning objectives and directions, collaborative work to promote interaction and the exchange of ideas among students, and reflection to help students evaluate their thinking processes and outcomes (Effrisanti, 2023; Intan et al., 2025). The integration of these four components positions LOC-R as a learning model oriented toward the development of thinking processes rather than mere content mastery. Several studies have reported that the implementation of the LOC-R model can enhance student learning engagement (Intan et al., 2025), academic literacy (Khairunnisa et al., 2025), and conceptual understanding across various subjects, including mathematics (Pasaribu et al., 2025). Nevertheless, most existing studies remain descriptive in nature and therefore have not provided strong empirical evidence regarding the causal relationship between the implementation of the LOC-R model and the improvement of students' critical thinking skills.

The limited availability of experimental-based empirical evidence regarding the effectiveness of the LOC-R model, particularly in improving elementary school students' critical thinking skills in mathematics learning, represents a research gap that needs to be addressed. Experimental research designs are required to ensure that improvements in critical thinking skills are genuinely attributable to the implementation of the LOC-R learning model. Therefore, this study aims to empirically examine the effect of the LOC-R learning model on the critical thinking skills of fifth-grade students in mathematics learning. Based on this objective, the research question of this study is as follows:

Does the implementation of the LOC-R learning model have a significant effect on the critical thinking skills of fifth-grade students in mathematics learning?

2. Methods

2.1 Research Design

This study employed a quasi-experimental one-group pretest–posttest design. This design was applied to examine the effect of the LOC-R learning model by comparing students' critical thinking skills before and after the instructional intervention.

2.2 Research Participants

The research participants were 20 fifth-grade students from SD Negeri Sosrowijayan, comprising 10 male and 10 female students aged 10-11 years. The participants were selected through purposive sampling, based on the suitability of the learning materials and the teacher's readiness to implement the LOC-R learning model.

2.3 Research Instrument

The research instrument was a critical thinking skills questionnaire developed based on critical thinking indicators proposed by Ennis. The instrument consisted of 16 statements representing eight indicators, namely: (1) identifying problems, (2) analyzing information, (3) providing logical arguments, (4) connecting concepts, (5) designing solutions, (6) evaluating solutions, (7) conducting reflection, and (8) drawing conclusions. The assessment employed a four-point Likert scale. The instrument had been tested for content validity, yielding a Content Validity Index (CVI) value of 0.89, and for reliability, with a Cronbach's Alpha coefficient of 0.87, indicating high reliability.

2.4 Research Procedure

The study was conducted over a three-week period and followed these stages:

a. Pretest, administered to measure students' critical thinking skills prior to the intervention;
b. Implementation of the LOC-R learning model in mathematics instruction on the topic of plane figure area;
c. Posttest, administered to measure students' critical thinking skills after the intervention.

2.5 Data Analysis Techniques

The data were analyzed using descriptive statistics to determine mean scores, normalized gain (N-gain) to measure improvements in students' critical thinking skills, and a paired-sample t-test to examine the significance of differences between pretest and posttest scores.

3. Results and Discussion

3.1. Results

3.1.1. Descriptive Analysis Results

A descriptive analysis was conducted to examine changes in students' critical thinking skills before and after the implementation of the LOC-R learning model. Measurements were carried out through the administration of a pretest prior to the intervention and a posttest after the completion of the entire learning process using the LOC-R model.

The descriptive analysis indicates an increase in students' mean scores on critical thinking skills. The mean pretest score was 65, indicating that students' critical thinking skills prior to the intervention were in the moderate range. After implementing the LOC-R learning model, the mean posttest score increased to 85, placing it in the high category.

Table 1 - Mean Scores of Students' Critical Thinking Skills

Test	Mean Score
Pretest	65
Posttest	85

The increase of 20 points in the mean score suggests that mathematics learning integrating contextual literacy, goal orientation, collaborative activities, and reflection has a positive impact on students' critical thinking skills. Descriptively, these results indicate that students became more capable of understanding problems, processing information, developing solution strategies, and drawing logical conclusions after participating in learning activities using the LOK-R model.

To further illustrate the comparison of students' mean critical thinking scores at the pretest and posttest, the data are presented in a bar chart (Figure 1).

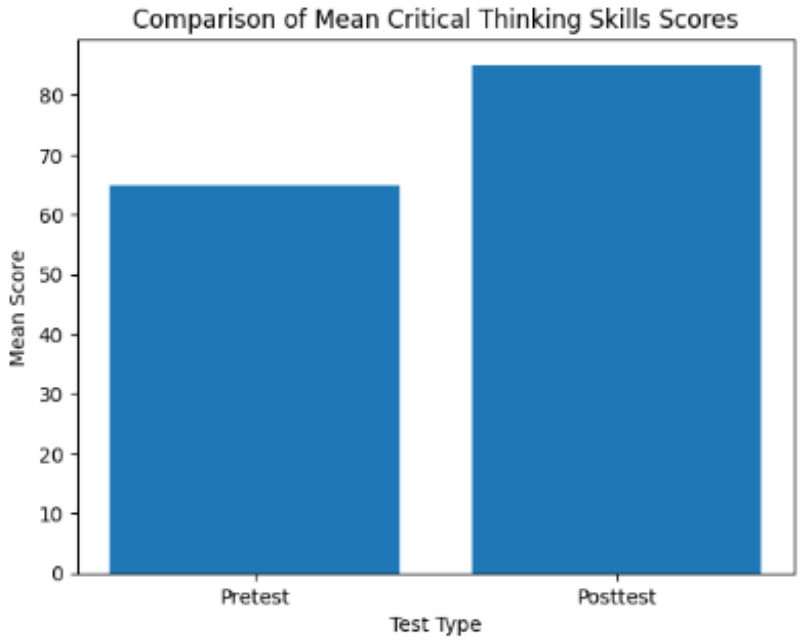

Figure 1. Comparison of Students' Mean Critical Thinking Skills Scores

The graph shows a consistent increase from pretest to posttest scores, indicating a positive change in students' critical thinking skills following the implementation of the LOK-R learning model.

3.1.2. Normalized Gain (N-gain) Analysis

To determine the effectiveness level of the improvement in students' critical thinking skills, a normalized gain (N-gain) analysis was conducted. The results showed an N-gain value of 0.67, which falls within the moderate-to-high category. This value indicates that the improvement in students' critical thinking skills after the implementation of the LOC-R learning model was reasonably effective.

The moderate-to-high N-gain category suggests that most students experienced a meaningful improvement in critical thinking skills, not only in learning outcomes but also in thinking processes involving analysis, evaluation, and reflection. Thus, the LOC-R learning model is shown to effectively facilitate substantial improvements in students' critical thinking skills in mathematics learning.

3.1.3. Paired-Sample t-Test Results

To confirm that the improvement in students' critical thinking skills was statistically significant, a paired-sample t-test was conducted on the pretest and posttest scores. The test results revealed a significance value (p-value) of less than 0.05 ($p < 0.05$). These findings indicate a statistically significant difference between students' critical thinking skill scores before and after the implementation of the LOK-R

learning model. Therefore, the observed increase in scores was not due to chance but represents a direct effect of the instructional intervention. Based on the results of the descriptive analysis, N-gain analysis, and paired-sample t-test, it can be concluded that the LOK-R learning model has a significant effect on improving the critical thinking skills of fifth-grade students in mathematics learning.

3.2. Discussion

The results of this study indicate that the implementation of the LOC-R learning model (Literacy, Orientation, Collaboration, and Reflection) significantly improves the critical thinking skills of fifth-grade students in mathematics learning. This improvement is reflected in the meaningful differences between pretest and posttest scores, as well as N-gain values that fall within the moderate to high category. These findings suggest that mathematics learning designed in a structured manner, emphasizing active student engagement, social interaction, and reflective thinking, is able to foster the development of higher-order thinking skills, particularly critical thinking.

The improvement in students' critical thinking skills can be explained through the characteristics of the LOC-R model syntax, which systematically guides students toward deep thinking processes. In the literacy stage, students are presented with contextual problems relevant to everyday life. This stage plays a crucial role in building students' initial understanding of problem situations and encouraging their ability to identify relevant information (Effrisanti, 2023). Recent studies indicate that contextual literacy approaches in mathematics learning can significantly enhance students' analytical skills and conceptual understanding (Siregar et al., 2020; Apriyanti et al., 2023). By reading, observing, and interpreting the problem context, students do not immediately focus on computational procedures but instead first grasp the mathematical meaning of the given problems (Widyatma et al., 2024; Ramadani et al., 2025; Cahyanti et al., 2025).

The orientation stage functions to clarify learning objectives and guide the direction of students' learning activities. At this stage, students are guided to understand what needs to be achieved and the thinking steps required to solve problems. Clear cognitive orientation has been shown to help students develop goal awareness, which is an essential component of critical thinking. Research by (Khasanah & Sholihah, 2024) demonstrates that explicit learning orientation can assist students in organizing information and improving the accuracy of problem-solving strategies.

Furthermore, the collaboration stage makes a significant contribution to the development of critical thinking skills through social interaction. During this stage, students work in groups to discuss problems, express opinions, present arguments, and evaluate their peers' ideas. This process encourages students to defend arguments logically while remaining open to alternative perspectives. These findings are consistent with studies by (Taher, 2023) and (Lirhan & Hamka, 2024), which report that collaborative learning can enhance argumentation, reasoning, and idea evaluation skills key indicators of critical thinking. Through group discussions, students not only learn from the teacher but also socially construct knowledge together with their peers.

The reflection stage is a vital component of the LOC-R model, as it plays a key role in developing students' metacognitive awareness. At this stage, students are encouraged to reflect on their thinking processes, evaluate the effectiveness of the strategies used, and identify strengths and weaknesses in problem-solving. Reflection helps students understand how they think, rather than merely what they think. Recent studies show that learning processes involving systematic reflection can enhance students' self-evaluation and thinking regulation skills (Effrisanti, 2023). Thus, the reflection stage in the LOC-R model directly contributes to strengthening critical thinking skills, particularly in the indicators of evaluation and conclusion drawing.

Theoretically, the findings of this study align with Vygotsky's social constructivist theory, which emphasizes that knowledge is constructed through social interaction and reflective processes (Ardi et

al., 2021; Hidayatulloh et al., 2025; Sumarni & Palennari, 2025). In the context of LOC-R learning, interactions among students during the collaboration and reflection stages function as scaffolding that helps students develop higher-level thinking abilities. The results of this study reinforce previous findings indicating that social constructivist-based learning is effective in developing elementary school students' critical thinking skills (Kusumawati et al., 2022; Agustiana et al., 2023; Subarjo et al., 2024).

Compared to previous descriptive studies, this research provides stronger empirical contributions by employing a quasi-experimental design to examine the effects of the LOC-R model. Thus, this study not only demonstrates the existence of a relationship between the implementation of LOC-R and critical thinking skills but also proves that LOC-R has a significant effect on improving students' critical thinking skills. These findings strengthen the position of the LOC-R model as an effective alternative mathematics learning strategy to support the achievement of 21st-century competencies, particularly at the elementary school level.

4. Conclusions

Based on the findings of this study, it can be concluded that the LOC-R learning model has a significant effect on improving the critical thinking skills of fifth-grade students in mathematics learning. The increase in pretest to posttest scores, along with the moderate-to-high N-gain value, indicates that the LOC-R model is effective in fostering students' critical thinking abilities. The LOC-R learning model is therefore recommended as an alternative instructional strategy for mathematics learning at the elementary school level to support the development of 21st-century competencies. Future studies are encouraged to employ experimental designs with control groups and larger sample sizes to enhance the generalizability of the findings.

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