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Critical Thinking Skills of Fifth-Grade Elementary School Students in Mathematics Learning through LOC-R Model: A Descriptive Study

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ABSTRACT

Purpose - This study is aimed to describe the critical thinking skills of fifth-grade students at SD Negeri Sosrowijayan after participating in mathematics learning using the LOC-R (Literacy, Orientation, Collaboration, Reflection) model.

Methodology - The study is employing a quantitative descriptive design with 20 students. The data were collected through questionnaires based on indicators, then analyzed using descriptive statistics in the form of average scores, percentages and ability categories.

Findings - The result of the study revealed an average critical thinking score of 85,2 (high category), The highest-scoring indicator was connecting concepts (88%), while the lowest was identifying problems (79%).

Novelty - This study integrated LOC-R model to mathematics learning in elementary school and assess its impact to eight specific indicator of critical thinking.

Significance - The finding of the study provide evidence that implementation of LOC-R model is effective in enhancing students' critical thinking, making it an alternative mathematics teaching strategy for fostering 21st-century competencies.

Keywords: LOC-R, Critical thinking, Mathematics, Elementary school

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1. Introduction

Twenty-first-century education requires schools not only to deliver factual knowledge, but also to cultivate higher-order thinking skills (HOTS) such as critical thinking skills, problem solving, and metacognitive abilities (Gunartha, 2024). These skills are essential for enabling learners to analyze

information, evaluate evidence, and make rational decisions in real life context. Such competencies are emphasized in both national education policies and various international frameworks (OECD, 2019). Twenty-first-century learning demands that students acquire three broad categories of competencies: foundational literacies, competencies, and character qualities. Foundational literacies encompass proficiency in language, numeracy, science, information technology, finance, culture, and citizenship, all of which support students' ability to perform daily tasks effectively. Competencies include critical thinking, creativity, communication, and collaboration—skills needed to navigate complex life challenges. Meanwhile, character qualities such as curiosity, initiative, perseverance, adaptability, leadership, and social awareness are vital for thriving in a constantly evolving world. In the context of the Fourth Industrial Revolution, education must produce human resources who are not only technically competent but also possess the ability to think critically, creatively, and collaboratively.

At the elementary school level, particularly in mathematical learning, several studies have reported that students often struggle with HOTS-oriented questions (Salsabilla & Hidayati, 2021) (Agustiana et al., 2023). Students tend to rely on procedural knowledge and rote memorization rather than analytical and argumentative skills (Afni et al., 2024). Analyses of HOTS question quality alongside empirical research in various schools, indicate low student performance, especially on items requiring conceptual connections and knowledge transfer (Irmawati et al., 2021) (Intan et al., 2020). Therefore, there is a need for instructional strategies capable of fostering critical thinking skills in the context of foundational mathematics. Enhancing student comprehension and involvement is a top priority in mathematics education (Kania et al., 2025).

The LOC-R model (Literacy, Orientation, Collaboration, Reflection) has emerged as a relatively recent approach that integrates contextual literacy activities, goal-oriented learning, collaborative work, and metacognitive reflection (Segara et al., 2022). Studies conducted between 2023 and 2025 have reported that LOK-R is effective in enhancing student engagement, academic literacy, and various aspects of thinking skills such as numerical literacy, mathematical disposition, and argumentation skills (Dhesita, 2022) (Effrisanti, 2023) (Safitri et al., 2024). Designed to increase student participation, conceptual understanding, and critical thinking, LOC-R model weaves together four interconnected components: Literacy, Orientation, Collaboration, and Reflection (Segara et al., 2022). The application of LOC-R is believed to improve learning outcomes by encouraging students to observe, process information, examine concepts, and reflect on their learning—both individually and collaboratively (Yasin, 2023). It integrates observation, problem-solving, and reflection as integral parts of the learning process (Khasanah & Sholihah, 2024). The model is aiming to create a holistic learning environment in which students not only understand the material but also apply it in diverse contexts (Purnasari & Sadewo, 2020).

The Literacy component emphasizes the importance ability to read, understand, and use information, particularly in mathematical contexts. Students are guided to identify, analyze, and solve problems based on texts, graphs, or data relevant to everyday life. The Orientation stage introduces students to the learning objectives and the real-world problems they will address. This stage is building initial understanding and linking new content to prior knowledge.

Then the Collaboration component plays a key role in developing students' social and teamwork skills. At this stage, students work in groups to discuss, exchange ideas, and solve mathematical problems together. Through collaboration, they learn from one another's perspectives, deepen their understanding, and build confidence in expressing their opinions (Taher, 2023). Finally, the Reflection stage allows students to evaluate both their learning process and outcomes,

considering what they have learned, what requires improvement, and how they might apply the knowledge in real-world situations.

The LOC-R model is highly relevant for elementary mathematics instruction (Lirhan & Hamka, 2024). It encourages students to develop mathematical literacy, enabling them to understand fundamental concepts in a deep and meaningful way. For example, when learning about fractions, students may read a relevant problem situation (literacy), identify the steps needed to solve it (orientation), collaborate with peers to complete the task (collaboration), and then evaluate their work through a class discussion (reflection).

From a theoretical perspective, LOC-R supports critical thinking Syawaludin (2024) through several mechanisms: (1) contextual literacy provides authentic stimuli that spark critical questioning and reduce abstraction topics; (2) orientation clarifies cognitive goals so students are aware of the direction of problem-solving; (3) collaboration fosters exchange of ideas and argumentation among learners; and (4) reflection cultivates metacognitive awareness for evaluating and refining thinking strategies. A systematic review in mathematics education supports the effectiveness of combining contextual, collaborative, and reflective strategies to nurture HOTS (Safitri et al., 2024).

Recent studies (2023–2025) have shown positive results from applying LOC-R across different subjects and grade levels (elementary to junior high school), including improvements in literacy scores, active student participation, and various indicators of critical thinking and mathematical disposition. For example, research by Lirhan & Hamka (2024) and Agustin & Devi (2024) reported significant gains in conceptual understanding and solution construction skills when the LOC-R syntax was implemented systematically.

Despite these promising early findings, most LOC-R studies remain descriptive, case-based, or quasi-experimental, with variations in instruments and intervention duration. Few research have focused on systematically and comprehensively measuring elementary students' critical thinking skills, particularly in specific mathematics topics such as the area of plane figures. Therefore, the present study aims to describe the critical thinking skills of fifth-grade students following the implementation of LOK-R in mathematics learning, with an emphasis on the distribution of scores across individual indicators.

2. Methods

The study employed a quantitative descriptive design aimed at portraying students' critical thinking skills following mathematics learning using LOC-R. This design was chosen because the research focus was not to test hypotheses concerning differences or relationship among variables, but rather to systematically present real conditions based on numerical data.

The research subject consisted of 20 fifth grade students at SD Negeri Sosrowijayan, comprising 10 boys and 10 girls, aged between 10 and 11 years old. The subjects were selected using purposive sampling, as the class was currently studying the topic of Area of Plane Figures and the teacher was willing to implement the LOC-R model in her/his class.

The primary instrument used was a critical thinking skills questionnaire developed based on the indicators proposed by (Ennis, 1984), adapted to the context of elementary school students. The instrument comprised 16 positive and negative statements covering 8 indicators of critical thinking skills: identifying problem, analyzing information, providing argument, connecting concepts, designing solutions, evaluating solutions, reflection and drawing conclusions. A detailed description of these indicators is presented in Table 1.

Table 1 - Critical Thinking Skill Indicators

No	Critical Thinking Skill Indicator	Description
1	Identifying problem	Students are able to recognize and comprehend the problem or situation at hand.
2	Analyzing information	Students are able to sort, process, and evaluate relevant information.
3	Providing logical argument	Students are able to express opinions or propose solutions supported by clear reasoning.
4	Connecting concept	Students are able to relate mathematical concepts to contextual situations.
5	designing solutions and strategies	Students are able to design solutions and outline the steps for problem resolution.
6	Evaluating solution	Students are able to assess the effectiveness of proposed solutions and identify areas for improvement.
7	Reflecting on the result of the thought	Students are able to reflect on the thinking process and the solutions produced.
8	Drawing conclusion based on analysis	Students are able to formulate conclusions grounded in data, facts, or logical analysis.

Each item employed a 4 point Likert scale (1 = strongly disagree, 4 = strongly agree). The content validity of the instrument was reviewed by two mathematics education experts and one experienced teacher, yielding a Content Validity Index (CVI) 0f 0.89, which falls into the excellent category. Reliability calculated using Cronbach's Alpha was 0.87, indicating that the instrument is reliable. The study was conducted over a three-week period in the second semester of the 2024/2025 academic year, following the steps below:

2.1. Preparation

Preparation activities:

2.1.1. Coordinating with the teacher to explain the research objectives and design.

2.1.2. Developing a lesson plan based on the LOC-R model for the topic of "Area if Plane Figures."

2.1.3. Preparing instructional media (contextual videos, reading materials, and student worksheet.

2.2. Learning Implementation

The learning activities were carried out using the LOC-R syntax, consisting of:

2.2.1. Literacy: Students read a text and watched a contextual video, such as calculating the area of public park.

2.2.2. Orientation: The teacher explained the learning objectives and linked lesson to real world problems.

2.2.3. Collaboration: Students worked in small groups to solve the problems provided.

2.2.4. Reflection: Students presented the results of their group discussions, received feedback, and conducted self-assessment of their thinking process.

2.3. Filling out The Questionnaire

After completion of the learning process, students independently completed the critical thinking skill questionnaire in class, with the teacher and researcher providing assistance to ensure understanding of the instructions.

The collected data were analyzed using descriptive statistics, including: Mean score for each indicator and for all scale, Percentage achievement compared to the maximum score, and Ability categorization: high ((≥ 80%), moderate (60–79%), and low (< 60%). The result were presented in

tables and diagrams to facilitate interpretation. This analysis aimed to identify the most prominent indicator as well as those requiring further attention in the learning process.

3. Results and Discussion

3.1. Results

The assessment of students' critical thinking skills was conducted following mathematics learning using the LOC-R model on the topic of Area of Plane Figures. Data were collected from 20 fifth grade students who completed a critical thinking skills questionnaire based on eigh indicators. The mean score, percentage achievement, and ability categorization are presented in Tabel II.

Table 2 - Average Score for Each Critical Thinking Skill Indicators

Indicator	Score (%)	Category
Identifying problem	79	Moderate
Analyzing information	83	High
Providing logical argument	84	High
Connecting concept	88	High
Designing solution and strategies	86	High
Evaluating solution	85	High
Reflecting on the result of the thought	84	High
Drawing conclusion based on analysis	86	High
Mean	**85,2**	**High**

The results indicate that most indicators fall within the high category. The highest achievement was recorded for the *connecting concepts* indicator (88%), which leads that students able to relate mathematical concepts to the contextual problems at hand. This finding aligns with the characteristics of the LOC-R model, which emphasizes contextual literacy and collaboration, thereby encouraging students to establish links between various ideas.

The lowest achievement was observed in the identifying problem (79%, moderate category). This finding suggests that some students still struggle with the initial stage of critical thinking, recognizing the problems clearly before engaging in the problem solving process. it may stem from learning habits of moving directly to calculating without clarifying the problem's context.

For the indicator analyzing information (83%) and providing arguments (84%), students achieved score within the high category. Students able to sift relevant information and present logical explanations, although some students tended to duplicate group opinion without contributing with personal arguments.

The indicators *designing solutions* (86%), evaluating solutions (85%), reflecting (84%) and drawing conclusions (86%) showed good performance. These results indicate that the LOC-R based learning approach provide students with opportunities to experiment with problem solving strategies, assess their effectiveness and draw lessons from the process for application to other problems.

Overall, the average critical thinking score was 85,2% (high category). This achievement showed that implementation of the LOC-R model has a positive impact on developing critical thinking skills on fifth grade student, particularly in mathematics learning. A visual representation of the average score for each critical thinking indicator is shown in Figure I.

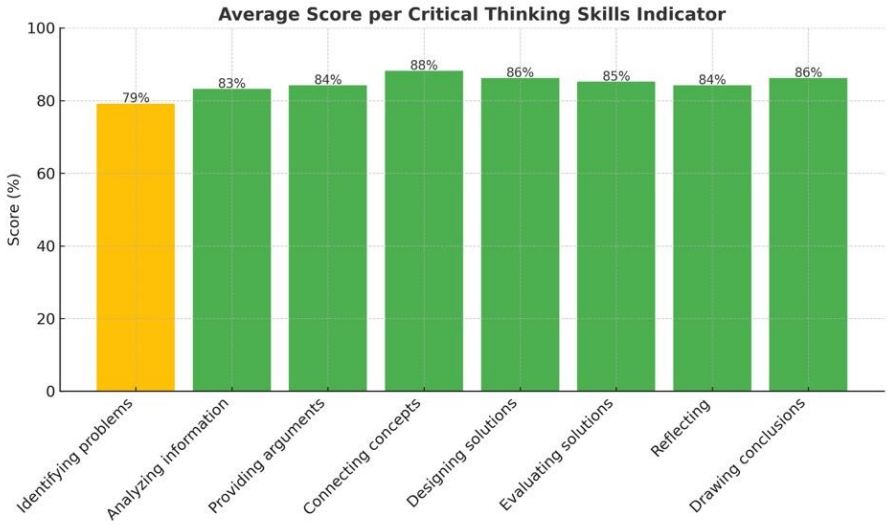

Figure 1. Average Score for Each Critical Thinking Skill Indicator

3.2. Discussion

The results of this study showed that the implementation of the LOC-R model in fifth-grade mathematics instruction deliver an average student critical thinking score of 85.2%, which falls within the high category. This finding reinforce previous research reports indicating that the application of instructional models emphasizing contextual literacy, collaboration, and reflection can enhance the quality of higher-order thinking skills (Effrisanti, 2023).

More detail, the connecting concepts indicator achieved the highest score (88%), suggesting that the students were able to relate the mathematical concepts they learn with to real life situations, aligning with the goals of contextual learning (Apriyanti et al., 2023). Literacy stage at the beginning of LOC-R enabled students to develop a stronger initial understanding of given problems, thereby facilitating the process of concept integration (Effrisanti, 2023).

Meanwhile, the *identifying problems* indicator recorded the lowest score (79%), although still within the moderate category. This skill involves process of understanding the context, determining the problem focus, and formulating the main questions (Ennis, 1984). This low achievement in this indicator may be caused by students' tendency to jump directly to find the answer or calculation procedure without conducting adequate preliminary analysis. To overcome this, teachers could integrate problem framing or problem posing activities prior to the collaboration stage. It could train students to recognize and define problems.

Other indicators, such as analyzing information (83%), providing arguments (84%), and drawing conclusions (86%) also scored high, indicating that the LOC-R provides sufficient opportunities for students to explore information, discuss ideas, and reach conclusions in a structured manner. The collaboration stage on LOC-R model supported by group discussion. It provide evidence that LOC-R model enhance students' logical argumentation skills (Effrisanti, 2023).

The result also in line with the study by Erlin et al., (2021). The study provides evidence that reflection-based learning models can improve students' metacognitive awareness, thereby they enable to evaluate and refine their thinking strategies. The indicator *reflecting* (84%) and *evaluating solution* (85%) in this study support that claim.

Overall, the high achievement across most of the indicators indicate that LOC-R model demonstrates strong potential as a mathematics-teaching strategies for fostering critical thinking. These findings further reinforce Vygostsky theory of social constructivism, which emphasizes the importance of social interaction and scaffolding in cognitive development ((Vygotsky, 1978; adapted by OECD, 2019). Through a syntax that involves literacy, orientation, collaboration, and reflection,

students are having chance to construct knowledge through active and meaningful learning experiences.

However, this study is limited by its small sample size and descriptive design. It restrict the generalizability of the findings. Future research is recommended employ experimental design with control group to examine the effectiveness of LOC-R model comparatively, and extend the mathematics topics, such as spatial geometry or measurement.

4. Conclusions

The result of the research showed that the implementation of LOC-R (Literacy, Orientation, Collaboration, Reflection) learning model in mathematics learning for fifth grade elementary school students can optimally develop critical thinking skills, with average achievement of 85,2%, which is classified high. Most of the indicators, such as connecting concepts, constructing solutions, evaluating solutions, doing reflections, and making conclusions, being in a high category, indicating that structured learning syntax and oriented to collaboration and reflection has a positive impact on student's thinking quality. Nevertheless, for identify problems indicator gets the lowest score, it is indicating that problem formulation skill require an extra attention in the learning process. The implication of these findings is that LOC-R can be one of effective alternative learning strategy for elementary school teachers, particularly in supporting achievement of 21st century competencies that emphasize critical thinking skills. Future research recommended to use experimental design with larger sample size and more diverse material context, so that the effectiveness of this model can be tested more comprehensively and the results can be generalized to various elementary school setting.

Conflict of Interest

The authors declare no conflicts of interest.

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