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Improving Students' Critical Thinking Skills Using the PINTAR Learning Model at Banjarmasin City Elementary School

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ABSTRACT

This study examined changes in students' observed critical thinking skills during the implementation of the PINTAR learning model in mathematics learning at Pemurus Dalam 2 State Elementary School Banjarmasin. The study employed classroom action research to examine the implementation of the PINTAR learning model and changes in students' observed critical thinking skills across four meetings. Observation is used in its data collection instruments. The results showed an increase in students' observed critical thinking skills across the four meetings in which the PINTAR learning model was implemented. Based on the data analysis carried out, students' critical thinking skills increased by 81.5 percentage points, from 12.5% in the first meeting to 94% in the fourth meeting. These findings indicate that the PINTAR learning model can be implemented as a classroom learning approach that provides opportunities for students to engage in activities related to critical thinking.

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Introduction

Education is a bridge to the progress of the nation that must be achieved gradually and through a struggle that is not easy to get the best results. The difficulties faced in the world of

education must ultimately be solved by educators who are at the forefront. Education is a planned and structured effort to create a learning environment and learning process with the aim of helping students develop into spiritually strong, emotionally stable individuals, have a great desire to pursue knowledge, have good morals, and have practical skills that are used by society, state, and nation [1]. One way to overcome existing difficulties is to use an effective learning model. Various learning models have been developed to achieve different educational goals and meet the needs of learners in diverse ways [2]. The success of learning is the goal of using the applied learning model. The learning process is considered successful if there is a positive change in behavior in all or at least most of the students [3].

The rapid development of the times requires educators to be able to adapt to these demands. Educators who design teaching and learning activities optimally can have a positive impact on improving the quality of learning [4]. An educator needs to have the skills to carry out learning according to the demands of the times. These skills include the ability to facilitate learners' learning and creativity, develop learning experiences, be role models in how to learn in school, demonstrate responsibility, and participate in professional development and leadership [5]. By mastering these skills, the opportunities to improve activities, critical thinking skills, and learners' learning outcomes become greater and more realistic.

The results of the PINTAR model research can be corroborated by research that has been carried out by other researchers in the past. Research Results Anggiana [6] About Model Implementation problem-based learning In improving students' mathematical critical thinking skills, the score of mathematical critical thinking skills increases in each cycle. Research [7] about increasing critical thinking skills in the implementation of the PRIMER model (PjBL, RME, CRH) showed the results of students' critical thinking ability that increased from meeting 1 to a score of 38.5% with the criteria of being less skilled until meeting 4 experienced a classical increase in the completeness score of 92.3% with the criteria of being highly skilled.

Previous research has focused on the use of PBL, STAD, and CRH models in teaching and learning activities in an elementary school. This study focuses on the combination of PBL, STAD, and CRH learning models by combining the advantages and covering the weaknesses of these models so that a new model is created that is specialized in improving critical thinking skills, learning activity in the classroom and providing a variety of fun learning activities in a classroom.

Learning is considered successful if almost or all students become active in learning activities, show high motivation to learn, and self-confidence. Learners' activities are crucial in determining changes in their behaviour during learning activities [8]. Activities include all actions performed both physically and non-physically [9], while learning activities include all activities carried out by students in the learning process, both physical and psychological [10].

Learning activities involve students in discussing the material, collecting information related to the material, asking questions about the material, presenting the material, and contributing to completing the exercise [1]. Student activities can be improved by creating group-based learning, where educators play the role of facilitators. According to [11], educators need to observe each learner to ensure they can manage their assignments well, by going around between groups to help if there are difficulties in group interaction.

Mathematics learning also requires the ability to think critically from students in each of their activities. Critical thinking skills play an important role in any learning process, where their relationship to learning can affect the extent to which learners understand concepts, participate in activities, and achieve their goals [8]. Critical thinking skills are essential in learning, as the learning process often involves complex problem-solving. These skills help students carefully analyze learning problems, identify relevant information, and detail resolution step. Critical thinking can be defined as the ability to evaluate, analyze, and detail information carefully and logically, including the ability to understand context, formulate arguments, and make informed decisions [12].

The real conditions in the field regarding activities, critical thinking skills, and student learning outcomes can still be said to be low. Observations and interviews with homeroom teachers in grade V at SDN Pemurus Dalam 2 Banjarmasin show that students tend to be passive in learning activities. Many of them have not been directly involved in learning, do not discuss the material, and do not gather information based on patterns, facts, phenomena, or data present in the classroom. Often, learners just wait for information to come without the initiative to ask an educator or friend, read a book, or create a study group well.

This condition is certainly not expected because it has a negative impact on activities, critical thinking skills, and the achievement of student learning outcomes. Students cannot understand various formulas, concepts, and explanations from educators if they are not actively involved in learning mathematics. In addition, they do not yet have good critical thinking skills in learning mathematics, which makes it difficult for them to understand the learning material on certain topics.

To address these classroom conditions, the learning process needs to provide students with structured opportunities to identify problems, exchange ideas, determine solution strategies, and evaluate their reasoning. The PINTAR learning model integrates three established instructional approaches: Problem-Based Learning (PBL), Student Teams Achievement Divisions (STAD), and Course Review Horay (CRH). PBL provides a problem-oriented learning context in which students investigate and solve problems; STAD provides a collaborative structure that encourages peer interaction and shared responsibility; and CRH provides opportunities for review and evaluation of students' understanding. In the PINTAR

model, these elements are organized into an integrated sequence of learning activities rather than being treated as three independent models.

The integration is intended to connect problem identification and investigation with collaborative problem solving and subsequent review and evaluation. This structure provides opportunities for students to explain information, understand problems from their basic concepts, determine strategies and tactics, and conduct in-depth analysis. The distinctive feature of PINTAR therefore lies in the integration and sequencing of these learning activities around the development of critical thinking in elementary mathematics learning.

Material and Methods

A. Research Design and Participants

This study employed Classroom Action Research (CAR) as the primary research design. The research followed the Kemmis and McTaggart framework consisting of four stages: planning, action, observation, and reflection. This study was conducted in four cycles, defined as four sessions. Each session lasted approximately 2 × 35 minutes. The study was conducted at SDN Pemurus Dalam 2 Banjarmasin, Indonesia, involving an intact class of 23 fifth-grade students, consisting of 10 male and 13 female students aged approximately 10–11 years. The study focused on mathematics learning, particularly the topic of data processing. The class was selected based on the classroom context and the teacher's consideration of students' learning needs. Preliminary observations and interviews indicated that students' participation in mathematics learning was not evenly distributed. Some students tended to wait for teacher explanations and required guidance in identifying relevant information, explaining their reasoning, determining solution strategies, and analyzing problems in greater depth. The CAR procedure consisted of planning, action, observation, and reflection. During the planning stage, the researchers and classroom teacher prepared the lesson plans, learning materials, PINTAR learning activities, and observation instruments. The action stage involved implementing the PINTAR learning model. During the observation stage, students' learning activities and critical thinking performance were systematically recorded. Reflection was conducted at the end of each cycle to identify aspects requiring improvement in the subsequent cycle. Qualitative procedures were integrated within the CAR framework rather than treated as a separate research design. Classroom observations, teacher interviews, and documentation were used to describe the learning process and contextualize the changes observed in students' critical thinking performance. Thus, CAR served as the primary methodological approach, while qualitative procedures supported the interpretation of the classroom action process.

B. PINTAR Learning Model Implementation

The PINTAR learning model integrates three instructional approaches: Problem-Based Learning (PBL), Student Teams Achievement Divisions (STAD), and Course Review Horay

(CRH). Each component contributes a distinct function within an integrated instructional sequence. PBL provides the problem-oriented context, STAD structures collaborative group learning, and CRH supports review and evaluation of students' learning outcomes. The PINTAR implementation began with the presentation of a contextual mathematics problem. Students identified relevant information and discussed the problem in heterogeneous groups. They subsequently analyzed the problem, determined appropriate strategies, and worked collaboratively to formulate solutions. Groups then presented their solutions and explained the reasoning behind their answers. The learning process continued with question review and evaluation through CRH activities, followed by reflection on the problem-solving process. The teacher acted as a facilitator by presenting problems, organizing groups, guiding discussion, providing clarification, monitoring problem solving, and facilitating review activities. Students were positioned as active participants who identified problems, discussed information, formulated strategies, solved problems, communicated their reasoning, and evaluated their solutions.

C. Critical Thinking Measurement and Data Collection

Students' critical thinking skills were measured through structured classroom observation during all four meetings. Four indicators were assessed: (1) simple explanation, (2) understanding problems from the basics, (3) determining strategies and tactics in solving problems, and (4) conducting in-depth problem analysis. Each indicator was represented by three observable behavioral descriptors, resulting in 12 observation descriptors. Each descriptor was assessed using a four-point performance scale, ranging from 1 to 4. A score of 1 represented behavior that was not yet demonstrated, whereas a score of 4 represented behavior demonstrated consistently and independently. The maximum possible score for each student was 48 points (12 descriptors × 4 points). The percentage score was calculated using:

$$CTS = \frac{OS}{48}\ x\ 100 \qquad (1)$$

Where
CTS = Critical Thinking Score (%)
OS = Obtained Score

Two observers participated in the classroom observations. Before data collection, both observers were briefed on the operational definitions of each indicator and the scoring criteria. A trial scoring session using sample classroom behaviors was conducted to align the interpretation of the rubric. The observation instrument was reviewed by two experts in elementary education and learning assessment to examine the relevance and clarity of the indicators and behavioral descriptors. Revisions were made based on their suggestions before the instrument was used in the classroom. In addition to observation, data were collected through semi-structured interviews with the classroom teacher and documentation. Interviews provided contextual information concerning students' participation and learning

responses, while documentation consisted of photographs, learning records, and other relevant evidence of the implementation.

D. Data Analysis

The data were analyzed using descriptive quantitative and qualitative procedures. Quantitative analysis was used to calculate students' critical thinking scores for each meeting, while qualitative data from observations, interviews, and documentation were used to explain the learning process and contextualize changes in students' performance. The percentage of critical thinking performance was calculated by comparing the obtained score with the maximum possible score. The results from the four meetings were then compared descriptively to identify changes during the implementation of the PINTAR model. The criterion for evaluating the classroom action was set at at least 75% of students demonstrating a good or very good level of critical thinking. The criterion was used as an internal indicator for evaluating the progress of the classroom action rather than as evidence of the effectiveness of PINTAR compared with another instructional approach. Because the study involved one intact class and no comparison group, the findings were interpreted as an improvement in students observed critical thinking performance during the implementation of PINTAR. The study does not establish that PINTAR alone caused the observed improvement. Repeated exposure to the learning activities, students' increasing familiarity with the learning procedures, teacher adaptation, and other classroom factors may also have contributed to the changes.

Results and Discussions

This research focuses on improving students' critical thinking skills through the implementation of the PINTAR model in mathematics learning, especially in data processing materials in grade V of SDN Pemurus Dalam 2 Banjarmasin.

Reflection and evaluation in learning will bring improvements in each activity because the shortcomings that occur in each meeting will be minimized so that learning can occur effectively [13]. At each meeting, there was a significant improvement in students' critical thinking skills. This increase was observed alongside the reflection and evaluation activities conducted by educators and students after each learning activity. The learning process continues to be improved, which causes students to be able to understand mathematical concepts better and develop their critical thinking skills.

Students increased critical thinking skills can be seen as a result of improved learning quality, the right approach from educators, as well as continuous reflection from both sides. The better the quality of a learning activity will magnify the improvement in honing students' logic and critical thinking skills [14]. With increasing critical thinking skills, students can

develop the ability to string information clearly, understand problems from the root causes, determine strategies and tactics in solving problems, and conduct in-depth problem analysis.

The emphasis on critical thinking skills in mathematics learning is an important aspect that educators need to pay attention to. Mathematics learning cannot be separated from logic and critical thinking skills because students will always be honed in solving mathematical problems using their thinking skills [15]. This ability is not only useful in academic contexts, but it also has far-reaching benefits in everyday life, including in communication, problem-solving, decision-making, and leadership development.

Improving students' critical thinking skills can be the main focus of learning. This skill helps students in stringing information clearly, understanding problems from the basics, determining strategies and tactics in solving problems, and conducting in-depth problem analysis. Through learning that is oriented towards the development of critical thinking skills, learners can gain broad benefits in various aspects of life. Mathematics-focused learning will also be easier if paired with improving critical thinking skills [16].

Each meeting gets an improvement in critical thinking skills that can be strengthened by systematic observation and a track record of student development over time. This increase is not only due to the students, but also related to the improved quality of learning and the right approach from educators. Thus, the findings indicate that students' observed critical thinking skills increased during the implementation of the PINTAR model. However, the observed increase should not be interpreted as evidence of a causal effect of the model because the study did not include a comparison group.

Classroom teacher of class V of Pemurus Dalam 2 State Elementary School Banjarmasin, said that students in class V are still not used to using technology-based learning media such as projectors and *Power Point*. Existing students are still not used to problem-oriented learning at the *HOTS* level so that students still have difficulty in dealing with problems related to critical thinking skills. The learning of the PINTAR model will be a model that helps students overcome these problems.

Through video or image observation, learners can develop sharp observation skills. They learn to pay attention to detail, analyze visual information, and identify important aspects of a problem. When learners are faced with real problems to solve, they are trained to think critically and analytically. They learn to ask questions, evaluate information, and look for solutions based on the data they observe.

Group learning encourages students to work together and help each other in achieving common goals. They learn to share tasks, communicate effectively, and resolve conflicts that may arise. These skills are essential in daily life and future work environments. Group learning often involves discussion, debate, and joint problem-solving. This activity makes students

more active in the learning process, compared to just listening to lectures. This active participation can improve the understanding and retention of the material studied.

Giving presentations in front of friends and teachers can help increase students' confidence. The experience of speaking in front of an audience and receiving positive feedback can build their confidence in their ability to communicate and convey information. In preparing for a presentation, students need to analyze the information they have and synthesize it into a cohesive and logical presentation. This enhances their ability to integrate various sources of information and present them systematically.

Through presentations, learners learn to convey their ideas clearly and effectively. They practice public speaking, set voice intonation, and use appropriate body language. By helping learners present the results of the discussion through presentation activities, educators not only help them develop important communication skills but also strengthen their understanding of the material being studied.

Based on the observation results, students' critical thinking skills showed a progressive increase across the four meetings during the implementation of the PINTAR learning model. The participants consisted of 23 fifth-grade students. The observed critical thinking score increased from 12.5% in the first meeting to 25% in the second meeting, 50% in the third meeting, and 94% in the fourth meeting. The observed performance progressed from the less-skilled category in the initial meetings to the highly skilled category in the fourth meeting. The detailed results are presented in Table 1.

Table 1. Students' Observed Critical Thinking Skills Across Four Meetings

Meeting	Number of Students	Mean/ Percentage Score	Critical Thinking Category
1	23	12.5	Less Skilled
2	23	25	Less Skilled
3	23	50	Moderately Skilled
4	23	94	Highly Skilled

Table 1 shows a progressive increase in the observed critical-thinking score across the four meetings. The score increased from 12.5% in Meeting 1 to 25% in Meeting 2, representing an increase of 12.5 percentage points. The score subsequently increased to 50% in Meeting 3 and reached 94% in Meeting 4. The increase from Meeting 2 to Meeting 3 was 25 percentage points, while the increase from Meeting 3 to Meeting 4 was 44 percentage points. Overall, the observed critical-thinking score increased by 81.5 percentage points from Meeting 1 to Meeting 4, calculated as 94% − 12.5% = 81.5 percentage points.

Table 2 shows an increasing pattern across all four observed critical-thinking indicators. The simple explanation indicator increased from 10% in Meeting 1 to 93% in Meeting 4. The ability to understand problems from the basics increased from 12% to 92%, while the strategies and tactics indicator increased from 15% to 95%. In-depth problem

analysis increased from 13% to 96%. The increase across all indicators was accompanied by an increase in the overall observed critical-thinking score from 12.5% to 94%.

Table 2. Students' Critical Thinking Scores by Indicator Across Four Meetings

Critical Thinking Indicator	Meeting 1	Meeting 2	Meeting 3	Meeting 4
Simple explanation	10%	20%	40%	93%
Understanding problems from the basics	12%	25%	45%	92%
Strategies and tactics	15%	30%	55%	95%
In-depth problem analysis	13%	25%	60%	96%
Overall Mean	**12.5%**	**25%**	**50%**	**94%**
Overall Category	**Less Skilled**	**Less Skilled**	**Moderately Skilled**	**Highly Skilled**

This increase is due to an improvement in the quality of teaching and learning activities carried out by educators and the optimization of the application of the model implemented by educators. Increasing students' critical thinking skills in each meeting fosters creativity and also high reasoning so that students increasingly understand every problem from the basic concept and easily follow learning which has an impact on increasing students' critical thinking skills.

In Meeting 1, all 23 students participated in the observation. The overall observed critical-thinking score was 12.5%, categorized as less skilled. The indicator scores were 10% for simple explanation, 12% for understanding problems from the basics, 15% for strategies and tactics, and 13% for in-depth problem analysis. During this meeting, students were introduced to the learning activities and the PINTAR learning procedures. The observation also indicated that students were still adapting to the learning environment and instructional procedures.

In Meeting 2, the same 23 students participated in the learning activities. The overall observed critical-thinking score increased to 25%, which remained in the less-skilled category. The indicator scores were 20% for simple explanation, 25% for understanding problems from the basics, 30% for strategies and tactics, and 25% for in-depth problem analysis. Students demonstrated greater familiarity with the learning procedures and began to participate more actively in group-based activities.

In Meeting 3, the overall observed critical-thinking score increased to 50%, corresponding to the moderately skilled category. The scores for simple explanation, understanding problems from the basics, strategies and tactics, and in-depth problem analysis were 40%, 45%, 55%, and 60%, respectively. Students demonstrated increased participation in group discussions and greater ability to identify problems and determine solution strategies.

In Meeting 4, the overall observed critical-thinking score reached 94%, corresponding to the highly skilled category. The indicator scores were 93% for simple explanation, 92% for understanding problems from the basics, 95% for strategies and tactics, and 96% for in-depth problem analysis. Students demonstrated more consistent participation in discussions, clearer

explanations of their ideas, and greater ability to determine and communicate solution strategies.

The Grade V homeroom teacher stated that students who participated in learning activities using the PINTAR model showed improvement in their confidence and problem-solving activities across the four meetings. These observations were consistent with the increase in students' observed critical thinking scores during the classroom action research. Rather than establishing a causal effect, the findings indicate that the implementation of the PINTAR model was accompanied by improvements in students' observed critical thinking performance. These findings provide a basis for further refinement of the learning activities to support the continued development of students' critical thinking skills.

This increase occurs because educators and students always reflect and evaluate each activity in each meeting so that educators can find out which steps are not carried out well or have been carried out appropriately, and at the last meeting the educator tries to improve his activities so that an almost maximum score of 94% is obtained.

Students' observed critical thinking performance increased across the four meetings in which the PINTAR model was implemented in fifth-grade mathematics at SDN Pemurus Dalam 2 Banjarmasin. This pattern can be discussed in relation to instructional design rather than attributed to a single cause. Research on problem-based learning in elementary education reports favorable critical-thinking outcomes, while evidence syntheses identify the importance of structured tasks and teacher guidance [17], [18]. Designing mathematics activities that connect contextual problems, collaborative inquiry, and review can provide opportunities for students to explain their reasoning and evaluate possible solutions [19], [20].

The first observed aspect was students' ability to provide simple explanations. In the PINTAR observation rubric, this involved organizing information logically, demonstrating understanding of the lesson, and explaining mathematical concepts using appropriate and accessible words. The indicator improved across the four meetings, as reported in Table 2. Mathematical classroom interactions provide opportunities for students to articulate and negotiate meanings, and reasoning frameworks emphasize how students formulate and substantiate mathematical claims [21], [22].

Clear explanations require more than restating procedures: students must relate ideas to mathematical evidence and communicate why an interpretation or solution is reasonable. Structured whole-class discussion can make alternative responses visible and support the comparison of mathematical reasoning [23]. Accordingly, the observed improvement in simple explanation should be interpreted as growth in the specific classroom behaviors assessed by the rubric, rather than as a direct measure of all aspects of communication or leadership.

The second observed aspect was understanding problems from the basics. The rubric addressed students' capacity to identify essential information, analyze underlying concepts, examine relevant relationships, and connect a problem to broader mathematical ideas. Research on students' reasoning difficulties indicates that teachers need to recognize whether a difficulty arises during interpretation, strategy selection, or solution construction before providing appropriate support [24].

In the present classroom, improved scores on this indicator suggest that students increasingly demonstrated the assessed problem-understanding behaviors during PINTAR activities. Research on primary students' metacognitive problem solving also highlights planning, monitoring, and evaluation as distinguishable processes that may help explain how learners approach unfamiliar tasks [25]. Nevertheless, without separate diagnostic tasks or interviews for every student, the present observations cannot establish which cognitive mechanism produced the change.

The third observed aspect was selecting strategies and tactics for solving mathematical problems. Students were assessed on choosing appropriate approaches, considering alternatives, using creative strategies, and evaluating the usefulness of their choices. Research on mathematical problem solving emphasizes that formulating problems, exploring representations, and testing solution approaches are interconnected learning activities [26].

Strategic selection also requires students to check whether answers are reasonable. Studies of primary students' judgments about computational results demonstrate the importance of examining solutions in context, rather than assuming that correct calculation alone guarantees appropriate reasoning [27]. In PINTAR, the integration of group discussion and review provides occasions for students to compare and reconsider approaches. A meta-analysis of collaborative learning in elementary mathematics further supports the relevance of structured peer interaction to mathematical reasoning, although its outcomes are not identical to the PINTAR indicator [28].

The fourth observed aspect was in-depth problem analysis. Its descriptors involved understanding the context, identifying contributing factors, applying relevant analytical approaches, and drawing reasoned conclusions. The rise in this indicator from Meeting 1 to Meeting 4 indicates improved observed performance on these specific behaviors. A meta-analysis of realistic problem-based mathematics learning suggests that contextual problems can support critical thinking and mathematical problem solving in elementary education [29].

Analyzing a problem in depth can also involve examining representations and reconsidering assumptions. Research involving elementary students has explored how visual instructional media may support analytical thinking, although such findings should not be treated as evidence that PINTAR itself produced the observed gains [30]. Similarly, evidence

on elementary students' argumentative discourse points to the potential value of discussing and justifying competing claims [31]. These perspectives clarify possible instructional mechanisms but do not substitute for direct measurements in the present study.

The present findings should also be positioned accurately alongside earlier studies. Anggiana [6] examined problem-based learning in relation to mathematical problem-solving ability, while Pranowo and Ardiyaningrum [7] examined cooperative STAD learning and problem-solving outcomes. These publications offer relevant background for the problem-oriented and collaborative components of PINTAR, but they should not be described as studies of the PRIMER model or as direct evidence of the precise critical-thinking outcome measured here.

Overall, the findings are consistent with a body of literature suggesting that problem-oriented tasks, clear mathematical explanations, collaborative interactions, and opportunities to evaluate strategies can support reasoning. In this classroom action research, observed critical-thinking performance increased across four meetings. Because the study involved one class without a comparison group, these results establish a descriptive pattern during PINTAR implementation, not a causal effect attributable exclusively to the model.

Conclusion

This study examined the implementation of the PINTAR learning model to address the need for classroom learning approaches that support the development of elementary students' critical thinking skills in mathematics. The findings showed an increase in students' observed critical thinking performance across the four meetings, from 12.5% in the first meeting to 94% in the fourth meeting, representing an 81.5 percentage-point increase. The improvement was observed across the critical-thinking indicators used in the study, including explaining problems simply, understanding problems from the basics, determining strategies and tactics, and conducting in-depth problem analysis.

The findings were generally consistent with the expected outcome of implementing a learning model that combines problem-oriented, collaborative, and review activities. No unexpected result was specifically identified in the collected data. The study contributes classroom-based evidence on the implementation of the PINTAR model and provides a structured example of integrating Problem-Based Learning, STAD, and Course Review Horay activities to support students' engagement with mathematical problems and reasoning processes.

The findings should be interpreted within the scope of the classroom action research design, which involved repeated observations across four meetings and did not include a comparison group. Therefore, the observed increase describes students' critical-thinking development during the implementation of PINTAR rather than establishing a causal effect of

the model. Future research should examine the PINTAR model with a comparison group, a larger and more diverse sample, and more rigorous measurement procedures to further investigate its contribution to students' critical thinking development.

Limitation and Suggestions

This study has several limitations that should be considered when interpreting the findings. First, the research was conducted in a single Grade V class at one elementary school, which limits the transferability of the findings to students, schools, and learning contexts with different characteristics. Second, the classroom action research was conducted through repeated observations across four meetings without a comparison group. The observed increase in students' critical thinking performance may therefore have been influenced not only by the implementation of the PINTAR learning model but also by students' increasing familiarity with the learning activities, repeated exposure to mathematical problems, teacher adaptation, and the reflection process conducted across meetings. Third, the study relied primarily on observational assessment of four critical-thinking indicators. Although this approach provided information about students' performance during classroom activities, it may not fully capture changes in critical thinking beyond the observed learning context.

Based on these limitations, future studies should examine the implementation of the PINTAR learning model with participants from multiple classes or schools to provide evidence from more diverse educational contexts. A comparison group or a more controlled research design could also be employed to examine the contribution of the PINTAR model more systematically and to distinguish its effects from other factors associated with repeated classroom exposure. Future research may additionally combine classroom observation with validated critical-thinking tests, student work analysis, interviews, or other sources of evidence to provide a more comprehensive assessment of students' critical-thinking development. Longer implementation periods may also be considered to examine whether the observed development is sustained over time.

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