JPPIPA 11(10) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

The Effectiveness of the RADEC (Read, Answer, Discuss, Explain, Create) Learning Model on Students' Critical Thinking Skills in the IPAS Subject

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Received: August 19, 2025
Revised: September 06, 2025
Accepted: October 25, 2025
Published: October 31, 2025

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DOI: 10.29303/jppipa.v11i9.12763

Abstract: Learning in elementary schools is still dominated by the expository method, in which teachers explain while students passively listen, take notes, and complete assignments. This teacher-centered approach restricts the development of students' critical thinking skills. This study aims to examine the effectiveness of the RADEC (Read, Answer, Discuss, Explain, Create) learning model in improving the critical thinking skills of fourth-grade students in the science subject at SDN 31 Negeri Katon Pesawaran. The study employed a quasi-experimental design with a non-equivalent control group. The sample consisted of 37 students, with 17 students in the control class applying the Problem-Based Learning (PBL) model and 20 students in the experimental class using the RADEC model. The research instrument was a critical thinking skills test in the form of pretest and post-test, consisting of five essay questions. Data analysis included prerequisite tests (normality and homogeneity) and an independent sample t-test. The results indicated a significance value of $p = 0.000$, which is smaller than 0.05 ($p < 0.05$), suggesting a significant difference between the two groups. These findings demonstrate that the RADEC model is more effective in enhancing students' critical thinking skills compared to the PBL model.

Keywords: Critical thinking; Learning model; Learning skills; RADEC

Introduction

Twenty-first century education demands that students possess higher-order thinking skills, particularly critical thinking, in order to face increasingly complex global challenges (Rusmin et al., 2024; Thornhill-Miller et al., 2023; ŽivkoviĿ, 2016). Critical thinking skills enable students to analyze information, construct logical arguments, and make sound decisions in both academic contexts and everyday life (Batdı et al., 2024; Franco et al., 2017; Sharma et al., 2022). In line with this, UNESCO also emphasizes the importance of learning that integrates critical thinking skills from the elementary level as a foundation for mastering scientific and social literacy (Akther, 2020).

In Indonesia, the demand for strengthening critical thinking skills has been reflected in the Merdeka Curriculum, which prioritizes competency-based learning (Annam et al., 2023; Hariyanti et al., 2024; Pasaribu, 2023; Rohali & Hamimi, 2024). However, its implementation in elementary schools continues to face various challenges, particularly in the Integrated Science and Social Studies (IPAS) subject. Studies by Fadila et al. (2025), Yorke-Servis (2012), and Ernita et al. (2024)

How to Cite:
Fiteriani, I., Sopandi, W., Wahyudin, & Hernawan, A. H. (2025). The Effectiveness of the RADEC (Read, Answer, Discuss, Explain, Create) Learning Model on Students' Critical Thinking Skills in the IPAS Subject. *Jurnal Penelitian Pendidikan IPA*, *11*(10), 305–311. https://doi.org/10.29303/jppipa.v11i10.12763

revealed that teachers still tend to rely on the expository or lecture method, which results in low student participation and limited opportunities to practice analytical skills. Consequently, students' critical thinking skills remain underdeveloped, even though the IPAS subject has great potential to stimulate such abilities, as it covers contextual issues closely related to students' daily lives.

Similar findings were also reported in several elementary schools in Pesawaran District, including SDN 31 Negeri Katon. Preliminary research showed that teaching in fourth-grade classes is still dominated by the lecture method. Teachers tend to provide routine exercises without guiding students to analyze and draw conclusions, making it difficult for them to comprehend concepts. The average scores of class IV A (38) and class IV B (41) were far below the minimum mastery criterion (70). These data further confirm that students' critical thinking skills have not developed optimally due to the limited application of innovative learning models.

Previous studies have consistently emphasized that active learning is an effective strategy for developing critical thinking skills. Tsai (2024) demonstrated that the use of active strategies in science education successfully enhanced students' analytical skills, even under pandemic conditions. Similarly, Gonzalez-Cacho & Abbas (2022) and Wang (2024) revealed that interactive learning environments can foster student engagement while simultaneously developing critical thinking in higher education. This evidence indicates a strong relevance between active learning models and critical thinking skills, although research at the elementary school level remains limited.

One learning model oriented toward active student engagement is RADEC (Read, Answer, Discuss, Explain, Create) (Burhanudin et al., 2024; Handayani et al., 2019; Hanum et al., 2023). This model was developed by Sopandi and colleagues as a systematic alternative to stimulate higher-order thinking skills (Khaerunnisah et al., 2023). Through the stages of reading, answering, discussing, explaining, and creating, RADEC is designed not only to help students understand concepts but also to connect knowledge with real-life contexts (Pratama et al., 2019; Safitri & Yanuarto, 2025; Sumirat et al., 2022). Maspiroh et al. (2025) further showed that integrating RADEC with interactive media improved mastery of basic science concepts while also fostering critical and creative thinking among prospective elementary school teachers.

Although the effectiveness of RADEC has been demonstrated in various contexts, research focusing on its implementation in elementary schools, particularly in the IPAS subject, remains scarce. Most studies have emphasized scientific literacy at the secondary level or general skills in higher education (Fh et al., 2024). Therefore, there exists a research gap in exploring how RADEC can address the issue of underdeveloped critical thinking skills at the elementary level within the context of IPAS learning.

Based on this rationale, the present study aims to examine the effectiveness of the RADEC learning model on students' critical thinking skills in the IPAS subject at SDN 31 Negeri Katon Pesawaran. The findings of this study are expected to provide a theoretical contribution by enriching the literature on active learning innovations based on RADEC, as well as practical implications for teachers in selecting more effective learning strategies to enhance the quality of elementary education.

Method

Research Design

This study employed a quantitative approach with a quasi-experimental design of the Nonequivalent Control Group type. The design involved two groups of students: the experimental group, which implemented the RADEC (Read, Answer, Discuss, Explain, Create) learning model, and the control group, which implemented the Problem-Based Learning (PBL) model. Both groups were given a pretest prior to treatment and a posttest after treatment to evaluate improvements in students' critical thinking skills.

Table 1. Research design

Group	Pre-Test	Treatment	Post-Test
Experimental	O_1	X_1	O_3
Control	O_2	X_2	O_4

Notes:
O1 : Pretest in the experimental group
O2 : Pretest in the control group
O3 : Post-test in the experimental group
O4 : Post-test in the control group
X1 : RADEC learning model
X2 : PBL learning mode

The RADEC model is an active learning approach designed to develop students' critical thinking skills through five stages: reading, answering, discussing, explaining, and creating. These stages encourage students to actively engage in the learning process, enhance conceptual understanding, and foster both critical and creative thinking skills. Lasari et al. (2023) reported that the implementation of the RADEC model significantly improved students' critical thinking skills, with an average post-test score of 86.4, which was higher than the average score for creative thinking skills (82.5).

Population and Sample

The population of this study consisted of all fourth-grade students at SDN 31 Negeri Katon Pesawaran. The sample comprised 37 students, including class IV A (17 students, control group/PBL) and class IV B (20 students, experimental group/RADEC). Purposive sampling was applied to ensure comparable initial academic abilities between groups, thereby strengthening the internal validity of the study.

Table 2. Research design

Variable	Symbol	Description
Independent Var	X1	RADEC learning model (experimental group)
Independent Var	X2	PBL learning model (control group)
Dependent Var	Y	Students' critical thinking skills

Research Instrument

The research instrument consisted of five essay-type questions designed to measure critical thinking skills, administered as both pretest and posttest. The test items were developed based on Ennis' indicators of critical thinking (Safitri & Yanuarto, 2025). Content validity was assessed through expert judgment, while reliability was tested using statistical methods to ensure measurement consistency.

Data Analysis Technique

Data were analyzed using both descriptive and inferential statistics. Descriptive analysis was employed to present pretest and posttest scores, while inferential analysis was used to test the research hypotheses. Prior to hypothesis testing, prerequisite analyses—including normality and homogeneity tests—were conducted, followed by an independent sample t-test to examine differences in critical thinking skills between the experimental and control groups (Ghasemi & Zahediasl, 2012). In addition, the N-Gain test was applied to evaluate the level of improvement in students' critical thinking skills, thereby providing a comprehensive understanding of the effectiveness of RADEC compared to PBL (Lasari et al., 2023).

Figure 1 illustrates the research procedure, beginning with the identification of the population, namely all fourth-grade students at SDN 31 Negeri Katon Pesawaran. The sample was purposively selected, with class IV A assigned as the control group (PBL, X2) and class IV B as the experimental group (RADEC, X1). Both groups were first administered a pretest (O1 and O2) to measure their initial critical thinking skills, followed by the respective treatments based on the assigned learning model. After treatment, both groups were given a posttest (O3 and O4). Subsequently, the data were analyzed through prerequisite tests (normality and homogeneity), independent sample t-tests, and N-Gain analysis to assess the extent of improvement in students' critical thinking skills, which ultimately led to the formulation of the study's conclusions.

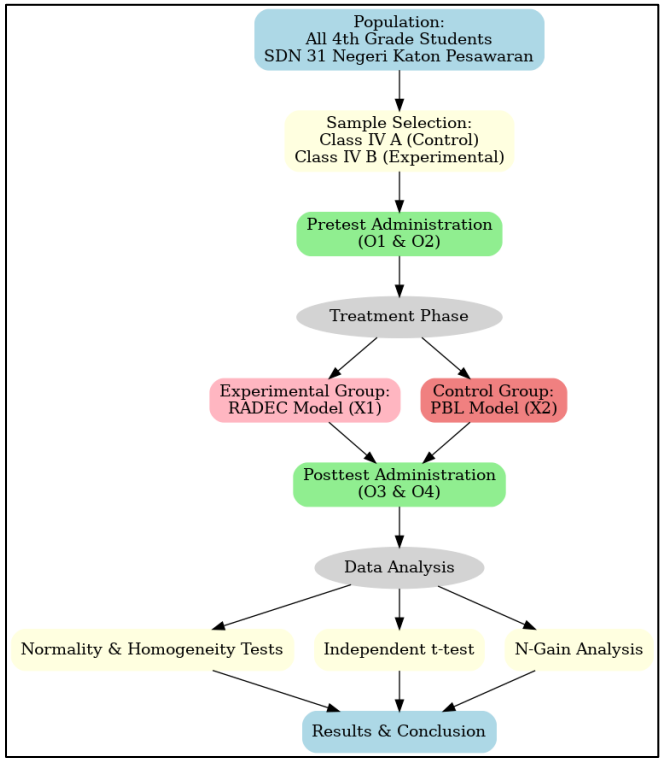

Figure 1. Research procedure

Result and Discussion

The effectiveness of students' critical thinking skills was measured through pretest and posttest scores. The improvement in critical thinking skills was analyzed using the N-Gain test, as presented in Table 3.

Table 3. Improvement of students' critical thinking skills

Class	Pre-test	Post-test	N-Gain	Category
Experimental	40	82	0.72	High
Control	42	71	0.56	Medium

As shown in Table 3, both groups experienced an improvement in critical thinking skills after the learning process. However, the increase in the experimental class (RADEC) was higher than that of the control class (PBL). The mean pretest score of the experimental class was 40, which increased to 82 in the posttest, resulting in an N-Gain of 0.72 categorized as high. Meanwhile, the control class improved from 42 to 71, with an N-Gain of 0.56 categorized as medium. This difference indicates that the RADEC model is more effective than PBL in enhancing students' critical thinking skills.

To further strengthen the analysis, a hypothesis test was conducted using the independent sample t-test. The results of this analysis are presented in Table 4.

Table 4. Results of independent samples test

Variable	Levene's Test (F)	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI (Lower)	95% CI (Upper)
Critical thinking skills	0.000	0.987	-5.234	35	0.000	-11.35	2.168	-15.76	-6.94

Based on Table 4, Levene's test showed a significance value of 0.987 (> 0.05), indicating that the variances of the two groups were homogeneous. Furthermore, the t-test result produced t = -5.234, df = 35, and a significance value of 0.000 (< 0.05). These results demonstrate that there is a significant difference between the critical thinking skills of students taught using the RADEC model and those taught with the PBL model.

The mean difference of -11.35, with a 95% confidence interval ranging from -15.76 to -6.94, indicates that the experimental class (RADEC) obtained higher critical thinking scores compared to the control class (PBL). Thus, these findings confirm that the RADEC model is more effective in improving the critical thinking skills of elementary school students.

The findings also reveal that both the RADEC (Read, Answer, Discuss, Explain, Create) model and the PBL (Problem-Based Learning) model contributed to the improvement of students' critical thinking skills, albeit with different levels of effectiveness. PBL proved effective in fostering critical thinking through contextual problem-solving; however, its effectiveness largely depends on teachers' readiness to manage time and facilitate student participation. This is consistent with the findings of Alarangi (2021) who reported that the success of PBL is strongly influenced by teachers' preparedness in managing class time, facilitating student engagement, and aligning problem challenges with students' abilities.

In contrast, the RADEC model demonstrated greater advantages, as it provides a more systematic and structured learning sequence, starting from reading, answering, discussing, explaining, and finally creating. This syntax not only helps students understand the subject matter but also trains their critical thinking skills step by step—from analysis to synthesis. These findings align with those of Candraswari & Suniasih, (2024), Satria & Sopandi (2019), and Sumirat et al. (2022), who affirmed that RADEC is effective in promoting higher-order thinking skills among elementary school students.

Furthermore, Satria & Sopandi (2019) also found that RADEC enables students to better evaluate information and generate creative ideas compared to conventional models. This highlights the strong relevance of RADEC for application in elementary school learning contexts, where critical thinking skills need to be developed early through strategies that are compatible with students' cognitive development stages.

Therefore, the present findings underscore the importance of selecting appropriate learning models by teachers. RADEC can serve as a strategic alternative to enhance students' critical thinking skills, particularly in the IPAS subject, without neglecting the potential of PBL, which remains relevant when designed with sufficient time allocation and adequate teacher facilitation.

This study contributes to the existing literature by providing empirical evidence on the comparative effectiveness of RADEC and PBL in fostering critical thinking skills in elementary school contexts, an area that has received limited attention in international research. While previous studies have predominantly examined PBL in higher education or secondary schools, this research highlights how the structured and staged nature of RADEC better accommodates the developmental characteristics of younger learners. The findings imply that RADEC has the potential to be adopted as an alternative instructional model in primary education to systematically cultivate critical thinking, complementing the problem-based approaches that are already widely implemented. For educational practitioners, this study underscores the importance of selecting models that align not only with curricular objectives but also with students' cognitive readiness, thereby enhancing the quality of classroom practices and contributing to the broader agenda of preparing 21st-century learners.

Conclusion

Based on the results of data analysis, it can be concluded that both the RADEC learning model (X1) and the PBL learning model (X2) have a significant effect on students' critical thinking skills (Y) in primary school science and social studies (IPAS). However, their levels of effectiveness differ. The N-Gain analysis shows that the experimental class using RADEC achieved a high improvement category (0.72), while the control class using PBL only reached a moderate category (0.56). Furthermore, the independent sample t-test with a

significance value of 0.000 (< 0.05) confirms a significant difference between the two groups. RADEC proves to be more effective because it provides a structured learning flow through the stages of Read, Answer, Discuss, Explain, and Create, which enables students to be more active, guided, and consistent in practicing critical thinking skills. In contrast, although PBL encourages real-world problem-solving, its effectiveness is often limited by time constraints and uneven student participation. These findings are in line with constructivist theory and are reinforced by previous studies that highlight the effectiveness of RADEC in fostering higher-order thinking skills among primary school students, while PBL remains relevant if supported by adequate time management and facilitation strategies. Therefore, RADEC can be considered a strategic alternative learning model to develop critical thinking skills from an early age, while also opening opportunities for further research to examine its application in other subjects and grade levels, as well as to explore the potential integration of RADEC and PBL in enhancing the quality of learning.

Acknowledgments
Thank you to all parties who have supported this research. We hope this research proves beneficial.

Author Contributions
I.F. was responsible for conceptualization, methodology, writing—initial draft preparation, and results and discussion; W.S. was responsible for validation, methodology, and writing—reviewing; W. contributed to data curation, formal analysis, and investigation; A.H.H. was responsible for supervision, conclusion, and reviewing.

Funding
The researchers funded this research independently.

Conflicts of Interest
The researchers funded this research independently.

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