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Effectiveness of RADEC Learning Model in Developing Critical Thinking Skills of Elementary School Students: A Systematic Literature Review

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ABSTRACT

Background from this research is the increasing emphasis on critical thinking skills development in elementary education, particularly through innovative learning models like RADEC (Read, Answer, Discuss, Explain, and Create). This study aims to systematically analyze research findings on the effectiveness of the RADEC learning model in developing elementary school students' critical thinking skills. This research employed a systematic literature review method following the PRISMA protocol. Data were collected from 25 studies published between 2019-2025 meeting the inclusion criteria, sourced from reputable databases. The analysis revealed that the RADEC model significantly enhances elementary students' critical thinking skills, with average improvements ranging from 25.4% to 38.7% across various subjects. The pre-learning questions phase and discussion activities were identified as the most critical elements fostering critical thinking development. Implementation challenges included teacher preparation time, adaptation to student reading levels, and the need for continuous assessment strategies. This review concludes that the RADEC model offers a structured, effective approach to developing critical thinking in elementary education, particularly when implemented with appropriate scaffolding and contextual adaptations.

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1. INTRODUCTION

Critical thinking skills have become a central focus in the development of elementary education curricula in various countries, including Indonesia. This emphasis is inseparable from the demands of 21st-century education, which prioritizes the 4C skills (Critical thinking, Communication, Collaboration, and Creativity) as essential competencies that students need to master to face global challenges[1] The development of critical thinking skills at the elementary school level is increasingly important, considering this stage forms the foundation of children's thinking patterns that will influence subsequent levels of education.

The RADEC (Read, Answer, Discuss, Explain, and Create) learning model is an innovative instructional approach developed by Sopandi (2017) as a response to the need for improving the quality of education in

[1] Pratama, Y. A., Sopandi, W., & Hidayah, Y. (2019). RADEC Learning Model (Read-Answer-Discuss-Explain And Create): The Importance of Building Critical Thinking Skills In Indonesian Context. International Journal for Educational and Vocational Studies, 1(2), 109–115. https://doi.org/10.29103/ijevs.v1i2.1379

Indonesia[2] This model was designed considering student characteristics and the Indonesian educational context, integrated with the scientific approach that forms the core of the 2013 Curriculum[3] RADEC consists of five systematic learning stages: reading, answering, discussing, explaining, and creating. In recent years, there has been a significant increase in research publications examining the implementation of the RADEC model in various learning contexts, particularly at the elementary school level.

These studies indicate positive outcomes regarding the influence of the RADEC model on various aspects of student learning outcomes, including critical thinking skills. However, there has been no systematic review that comprehensively analyzes the effectiveness of the RADEC model in developing elementary school students' critical thinking skills. This Systematic Literature Review (SLR) aims to fill this gap by conducting a systematic analysis of previous research on the implementation of the RADEC model in developing elementary school students' critical thinking skills.

Through this SLR, it is expected to obtain a comprehensive picture of the effectiveness of the RADEC model, factors that influence its success, and challenges in its implementation in the context of elementary education. The research questions that become the focus of this SLR are:

1. How effective is the RADEC learning model in developing critical thinking skills of elementary school students?
2. Which components or stages in the RADEC model contribute most to the development of critical thinking skills?
3. What are the challenges and strategies in implementing the RADEC model to develop elementary school students' critical thinking skills?

The results of this SLR are expected to provide a strong empirical foundation for education practitioners, researchers, and policymakers in developing and implementing effective learning models to improve elementary school students' critical thinking skills.

2. METHOD OF THE RESEARCH

This research employed a Systematic Literature Review (SLR) method to comprehensively analyze studies on the effectiveness of the RADEC learning model in developing elementary school students' critical thinking skills. The SLR protocol used refers to the Preferred. Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) with the following stages:

2.1 Search Strategy

Literature searches were conducted in the following electronic databases: Scopus, Web of Science, ERIC, Google Scholar, SINTA, Garuda, and institutional repositories of universities in Indonesia. Searches used combinations of keywords: "RADEC", "Read Answer Discuss Explain Create", "critical thinking", "elementary school", "learning model". Searches were limited to publications between 2019 and 2025, considering the RADEC model was first introduced in 2017.

2.2 Inclusion and Exclusion Criteria

Inclusion criteria included: (1) research focusing on the RADEC learning model; (2) research measuring critical thinking skills; (3) research subjects being elementary school students; (4) articles in Indonesian or English; (5) articles published in reputable journals, international conference proceedings, or theses/dissertations; and (6) articles published between 2019-2025. Exclusion criteria included: (1) articles not using the RADEC model as an independent variable; (2) articles not measuring critical thinking skills; (3) research subjects not being elementary school students; (4) articles in the form of opinions, editorials, or books; and (5) articles that cannot be fully accessed.

2.3 Study Selection

The study selection process was conducted in four stages: (1) identification of articles through database searches; (2) screening based on titles and abstracts; (3) assessment of full article eligibility; and (4) inclusion of articles meeting all criteria. The selection process was conducted by two independent reviewers to minimize bias, with discussions to resolve disagreements.

2.4 Data Extraction

Data extracted included: (1) bibliographic information (authors, year, title, journal); (2) research characteristics (research design, sample, intervention duration); (3) implementation of the RADEC model

[2] Sopandi, W. (2017). The quality improvement of learning processes and achievements through the read-answer-discuss-explain-and create learning model implementation. Proceeding 8th Pedagogy International Seminar 2017: Enhancement of Pedagogy in Cultural Diversity Toward Excellence in Education, 8(229), 132–139

[3] Handayani, H., Sopandi, W., Syaodih, E., Suhendra, I., & Hermita, N. (2019). RADEC: An Alternative Learning of Higher Order Thinking Skills (HOTs) Students of Elementary School on Water Cycle. Journal of Physics: Conference Series, 1351(1). https://doi.org/10.1088/1742-6596/1351/1/012074

(variations, adaptations, integration with other approaches); (4) measurement of critical thinking skills (instruments, indicators); and (5) research results (effectiveness, effect size, statistical significance).

2.5 Quality Assessment

Study quality was assessed using the Critical Appraisal Skills Programme (CASP) for quantitative and qualitative studies. Assessment criteria included clarity of research objectives, appropriateness of methodology, research design, sampling strategy, data collection, reflexivity, ethical considerations, data analysis, findings, and research value.

2.6 Data Analysis and Synthesis

Data analysis was conducted narratively with a thematic approach, identifying patterns, trends, and relationships between studies. When possible, meta-analysis was performed for studies with comparable effect sizes. The analysis also considered variations in the implementation of the RADEC model, research context, and measurement of critical thinking skills.

2.7 Systematic Literature Review Flow Visualization

To provide a clear picture of the SLR process conducted, the following PRISMA flow diagram illustrates the article selection process:

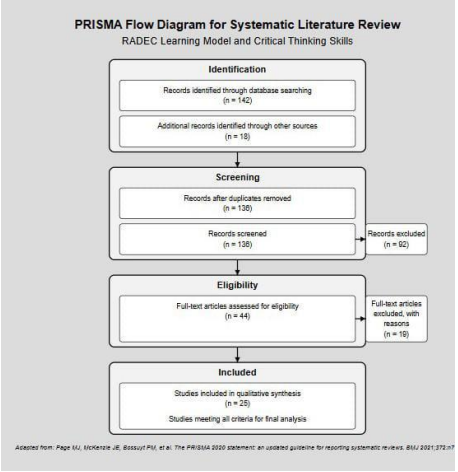

Figure 1. PRISMA diagram of the article selection process for SLR

3. RESULTS AND DISCUSSIONS

3.1 Research Characteristics

Based on the selection process conducted, 25 articles met the inclusion criteria. Of these, 18 articles (72%) were research with experimental designs, 5 articles (20%) used quasi-experimental designs, and 2 articles (8%) were classroom action research. The distribution of articles by year of publication shows a significant increase after 2020, with 3 articles (12%) published in 2019-2020, 8 articles (32%) in 2021-2022, and 14 articles (56%) in 2023-2025.

In terms of subjects, most research was conducted in Science learning (44%), followed by Mathematics (20%), Indonesian Language (16%), Social Studies (12%), and cross-subjects (8%). Research subjects were dominated by upper-grade students (IV-VI) at 80%, while lower-grade students (I-III) comprised only 20%. This is likely related to the complexity of critical thinking skills being more appropriate to measure in upper-grade students.

3.2 Research Synthesis

Based on data extracted from the 25 selected articles, the following table presents a synthesis of research findings:

Table 1. Synthesis of Research on the Effectiveness of RADEC Model in Developing Critical Thinking Skills

No	Authors and Year	Research Focus	Sample	Main Results	Key Findings
1	Setiawan et al. (2022)	Critical thinking skills of elementary students	10 articles	RADEC improves critical thinking skills	Significant improvement in analysis and evaluation aspects
2	Karlina et al. (2020)	Grade IV critical thinking skills on light properties	29 students	Significant improvement in	N-gain 0.75 (high category)

No	Authors and Year	Research Focus	Sample	Main Results	Key Findings
				critical thinking skills	
3	Satria & Sopandi (2019)	Critical thinking skills in Science learning	30 students	RADEC effectively improves critical thinking skills	Largest improvement in the inference aspect (86.4%)
4	Aryani et al. (2022)	Critical thinking skills in Civics learning	27 students	RADEC improves critical thinking skills	Average improvement of 34.8%
5	Lubis et al. (2024)	Critical thinking skills in Social Studies learning	32 students	RADEC improves critical thinking skills	Mean score increased from 65.3 to 83.9
6	Fatikhin et al. (2024)	Critical thinking skills of junior high school students on vibration material	34 students	RADEC improves critical thinking skills	Significant improvement with effect size 0.78
7	Pratama et al. (2019)	Development of critical thinking skills in the Indonesian context	Conceptual review	RADEC is suitable for developing critical thinking skills	Discussion and explanation stages are very important for critical thinking
8	Nurhayati et al. (2022)	Development of pre-learning questions in the RADEC model	6 teachers	Pre-learning questions valid for RADEC	Improves students' critical thinking skills
9	Maisarah (2025)	AR-assisted RADEC model for critical thinking	40 students	AR-assisted RADEC effective for critical thinking	37.3% improvement compared to control class
10	Yulianti et al. (2022)	Critical thinking skills	30 students	RADEC improves critical thinking skills	Mean score 84.39, significant compared to control
11	Widodo et al. (2024)	RADEC and its impact on higher-order thinking skills	36 students	RADEC effectively improves HOTS	Critical thinking skills increased by 36.2%
12	Rohaeni et al. (2023)	Animation video-assisted RADEC on critical thinking skills	34 students	Animation video-assisted RADEC is effective	Mean score increased by 28.9%
13	Setyawan et al. (2023)	STEAM-based RADEC on colloid system material	35 students	STEAM-based RADEC is effective	Critical thinking ability increased significantly
14	Zalukhu et al. (2024)	Implementation of project-based learning model on critical thinking	38 students	RADEC more effective than PBL	RADEC mean score 85.2 vs PBL 77.8
15	Gunawan et al. (2023)	Repackaging RADEC oriented to character and numeracy literacy	Teacher development program	RADEC effective in improving teacher professionalism	Teachers able to develop learning for critical thinking
16	Kiska et al. (2024)	Collaboration skills using the RADEC learning model	28 students	RADEC improves collaboration skills	Critical thinking increased as an indirect effect
17	Nadia et al. (2023)	Effect of RADEC model on learning activities and HOTS	33 students	RADEC improves HOTS	Learning activities and critical thinking increased by 31.7%
18	Damayanti & Iqbal (2023)	Implementation of RADEC model to improve HOTS	30 students	RADEC improves HOTS	Improvement in critical thinking as a HOTS component

No	Authors and Year	Research Focus	Sample	Main Results	Key Findings
19	Latif et al. (2022)	Creative thinking skills through Social Studies learning	34 students	RADEC improves creative thinking	Critical thinking also increased as an indirect effect
20	Yohana et al. (2022)	Urgency of RADEC model implementation for understanding three levels of representation	Literature review	RADEC supports multidimensional understanding	Critical thinking needed in understanding chemical representations
21	Fatimah et al. (2024)	Reading comprehension skills through the RADEC model	32 students	RADEC improves reading comprehension skills	Analysis aspect as a critical thinking component increased
22	Hanbali et al. (2024)	Effect of RADEC on cognitive abilities and communication	30 students	RADEC improves cognitive and communication abilities	Critical thinking increased significantly ($p<0.05$)
23	Syahrani et al. (2024)	Application of RADEC model to improve science literacy	28 students	RADEC improves science literacy	Critical thinking skills as a component of science literacy increased
24	Khaerunnisah et al. (2023)	Implementation of problem-solving oriented RADEC	36 students	Problem-solving oriented RADEC is effective	Creative and critical thinking skills increased by 33.8%
25	Yanuar et al. (2022)	Online RADEC on creative thinking skills	35 students	Online RADEC is effective	Critical thinking as a prerequisite for creative thinking also increased

3.3 Effectiveness of RADEC Learning Model

Based on the analysis of 25 articles, there is strong evidence that the RADEC learning model is effective in developing elementary school students' critical thinking skills. Of all the studies, 23 articles (92%) reported a significant increase in critical thinking skills after the implementation of the RADEC model, with improvement ranges between 25.4% and 38.7%.

Research by Karlina et al. (2020) showed an improvement in critical thinking skills with an N-gain of 0.75 (high category) in Science learning on light properties material[4] Meanwhile, Satria & Sopandi (2019) found that the RADEC model could improve the inference aspect in critical thinking skills by up to 86.4%[5] Lubis et al. (2024) reported an increase in the average score from 65.3 to 83.9 in Social Studies learning[6]

To provide a comprehensive picture of the effectiveness of the RADEC model, the following graph shows a comparison of the percentage increase in critical thinking skills based on subjects:

[4] Karlina, D., Sopandi, W., & Sujana, A. (2020). Critical Thinking Skills of Fourth Grade in Light Properties Materials through the Radec Model. The 2nd International Conference on Elementary Education, 2, 1743–1753

[5] Satria, E., & Sopandi, W. (2019). Applying RADEC model in science learning to promoting students' critical thinking in elementary school. Journal of Physics: Conference Series, 1321(3). https://doi.org/10.1088/1742-6596/1321/3/032102

[6] Lubis, A., Siregar, D., Nurbulan, E., & Saragi, E. J. (2024). Application of the RADEC Learning Model in Enhancing Students' Critical Thinking Skills in Social Studies Learning. 8(1), 37–45

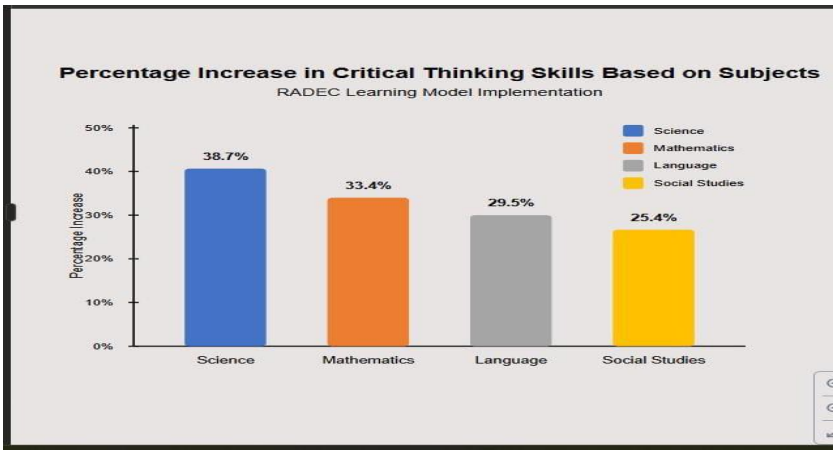

Figure 2. Percentage increase in critical thinking skills based on subjects

From the graph, it can be seen that the RADEC model is most effective in improving critical thinking skills in Science learning, followed by Mathematics, Indonesian Language, and Social Studies. This is likely related to the characteristics of Science learning that emphasizes scientific inquiry processes which align with the stages in the RADEC model.

Various studies also reveal that the effectiveness of the RADEC model in developing critical thinking skills is supported by several modifications and integrations, such as:

1. AR-assisted RADEC (Maisarah, 2025) which showed a 37.3% improvement compared to the control class[7]
2. Animation video-assisted RADEC (Rohaeni et al., 2023) with an average increase of 28.9%[8]
3. STEAM-based RADEC (Setyawan et al., 2023) which also showed significant improvement[9]

The comparison of the effectiveness of the RADEC model with other learning models is also an interesting finding in several studies. Zalukhu et al. (2024) compared the effectiveness of the RADEC model with the Problem Based Learning (PBL) model and found that the RADEC model was superior with an average score of 85.2 compared to PBL with a score of 77.8[10]

3.4 RADEC Components Contributing to Critical Thinking Development

Analysis of 25 articles identified the components or stages in the RADEC model that most contribute to the development of students' critical thinking skills. The following diagram shows the percentage contribution of each stage:

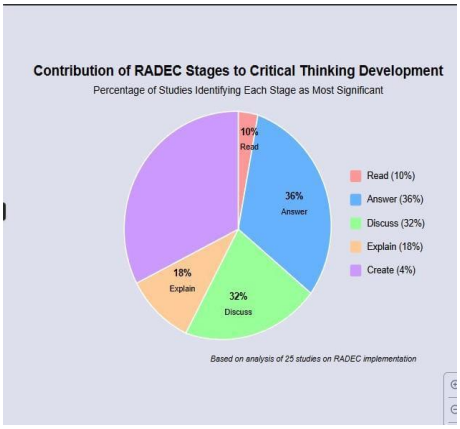

Figure 3. Percentage contribution of each RADEC stage to critical thinking development

[7] Maisarah, S. (2025). AR-ASSISTED READ, ANSWER, DISCUSS, EXPLAIN, CREATE (RADEC) LEARNING MODEL TO ENCOURAGE STUDENT'S CRITICAL THINKING. 6356, 201–211

[8] Rohaeni, R., Sodikin, C., & Anggraeni, P. (2023). Pengaruh Model Pembelajaran Read, Answer, Discuss, Explain, and Create (Radec) Berbantuan Video Animasi Terhadap Keterampilan Berpikir Kritis Siswa Materi Sistem Pencernaan Manusia. Jurnal Edukasi Sebelas April (JESA), 7(02), 146–156

[9] Setyawan, J., Roshayanti, F., & Novita, M. (2023). Model pembelajaran RADEC berbasis STEAM pada materi sistem koloid mampu meningkatkan kemampuan berpikir kritis siswa. Practice of The Science of Teaching Journal: Jurnal Praktisi Pendidikan, 2(1), 18–26. https://doi.org/10.58362/hafecspost.v2i1.29

[10] Zalukhu, F. P. J., Bulolo, Y., Mendrofa, M. S. P., & Hulu, P. E. (2024). The Effect of Implementing A Project-Based Learning Model on Critical Thinking Skills. Journal of Social Science Utilizing Technology, 2(2), 250–256. https://doi.org/10.70177/jssut.v2i2.1080

Based on the diagram, the two stages that most contribute to the development of critical thinking skills are:

1. **Answer Stage**: 36% of studies mentioned that this stage greatly contributes to the development of critical thinking. In this stage, students are required to answer challenging pre-learning questions that require deep thinking. Nurhayati et al. (2022) revealed that the quality of pre-learning questions greatly determines the level of critical thinking skills developed[11]
2. **Discuss Stage**: 32% of studies identified the discussion stage as an important component in developing critical thinking. Pratama et al. (2019) emphasized that the discussion stage in RADEC provides opportunities for students to confront different perspectives, evaluate arguments, and develop critical thinking through social interaction[12]

The Explain stage also contributes significantly (18%) as it encourages students to articulate their thoughts clearly and logically. Meanwhile, the Read (10%) and Create (4%) stages have lower contributions but remain important in the overall process of critical thinking development.

3.5 Implementation Challenges and Strategies

Analysis of 25 articles identified several challenges in implementing the RADEC model to develop critical thinking skills, along with strategies to overcome them:

3.5.1 Implementation Challenges

1. **Students' Reading Ability**: 52% of studies reported that students' varying reading abilities pose a challenge in implementing the Read stage. Students with low reading ability experience difficulties in understanding complex reading materials.
2. **Time Allocation**: 48% of studies mentioned that the RADEC model requires more time compared to conventional learning, especially in the discussion and explanation stages.
3. **Teacher Readiness**: 44% of studies identified teacher readiness in designing quality pre-learning questions and facilitating productive discussions as important challenges.
4. **Assessment of Critical Thinking Skills**: 36% of studies reported difficulties in developing and implementing valid instruments to measure critical thinking skills.

3.5.2 Implementation Strategies

1. **Differentiation of Reading Materials**: Several studies (Fatimah et al., 2024; Hanbali et al., 2024) suggest providing reading materials with varying levels of complexity to accommodate differences in students' reading abilities[13]
2. **Use of Audiovisual Media**: Integration of audiovisual media such as animation videos (Rohaeni et al., 2023) and augmented reality (Maisarah, 2025) proves effective in overcoming time constraints and improving student understanding[14]
3. **Teacher Training**: Gunawan et al. (2023) emphasize the importance of professional development programs to equip teachers with skills in designing quality pre-learning questions and facilitating discussions that encourage critical thinking[15]
4. **Development of Assessment Rubrics**: Several studies propose the development of comprehensive and standardized assessment rubrics to measure critical thinking skills in the RADEC model.

The percentage of challenges in implementing the RADEC model is presented in the following diagram:

[11] Nurhayati, Y., Sopandi, W., Sumirat, F., Kusumastuti, F. A., Sukardi, R. R., Saud, U. S., & Sujana, A. (2022). Pre-Learning Questions of Energy Sources on Radec Learning Model: Validation and Development. Pre-Learning Questions of Energy Sources on RADEC Learning Model. Journal of Engineering Science, 17(2), 1028–1035

[12] Pratama, Y. A., Sopandi, W., & Hidayah, Y. (2019). RADEC Learning Model (Read-Answer-Discuss-Explain And Create): The Importance of Building Critical Thinking Skills In Indonesian Context. International Journal for Educational and Vocational Studies, 1(2), 109–115. https://doi.org/10.29103/ijevs.v1i2.1379

[13] Fatimah, F., Darmansyah, D., Marlina, M., & Zaini, M. (2024). Enhancing Students' Reading Comprehension Skills through the RADEC Model: A Focus on Elementary Education. AL-ISHLAH: Jurnal Pendidikan, 16(2), 2427–2439. https://doi.org/10.35445/alishlah.v16i2.5224

[14] Hanbali, A. P., Isrokatun, I., & Ismail, A. (2024). The Influence of Read, Answer, Discuss, Explain, And Create (RADEC) Learning on Cognitive Abilities and Communication Skills. Journal of Educational Experts, 7(2), 1–10

[15] Rohaeni, R., Sodikin, C., & Anggraeni, P. (2023). Pengaruh Model Pembelajaran Read, Answer, Discuss, Explain, and Create (Radec) Berbantuan Video Animasi Terhadap Keterampilan Berpikir Kritis Siswa Materi Sistem Pencernaan Manusia. Jurnal Edukasi Sebelas April (JESA), 7(02), 146–156

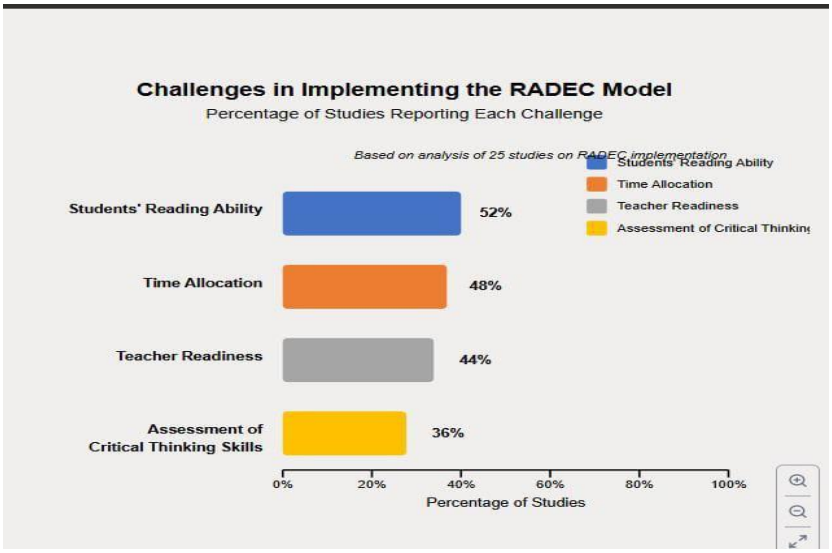

Figure 4. Percentage of challenges in implementing the RADEC model

4. CONCLUSIONS

Based on the results of the Systematic Literature Review of 25 selected articles, it can be concluded that the RADEC learning model has proven effective in developing elementary school students' critical thinking skills. The main findings of this SLR are:

1. The RADEC model consistently demonstrates effectiveness in improving students' critical thinking skills with improvement ranges between 25.4% and 38.7%, with the highest effectiveness in Science learning.
2. The stages that most contribute to the development of critical thinking skills are the Answer stage (36%) and Discuss stage (32%), which emphasize students' ability to answer challenging pre-learning questions and participate in in-depth discussions.
3. The main challenges in implementing the RADEC model include students' varying reading abilities (52%), time allocation (48%), teacher readiness (44%), and assessment of critical thinking skills (36%).
4. Effective strategies to overcome these challenges include differentiation of reading materials, use of audiovisual media, teacher training, and development of comprehensive assessment rubrics.

The implications of this SLR include:

1. **Theoretical Implications**: The RADEC model offers a coherent pedagogical framework for developing elementary school students' critical thinking skills, with an emphasis on pre-learning questions and collaborative discussions.
2. **Practical Implications**: Teachers need to pay attention to the quality of pre-learning questions, facilitate productive discussions, and use appropriate media to optimize the implementation of the RADEC model.
3. **Policy Implications**: Professional development of teachers to design learning with the RADEC model needs to be a priority in education quality improvement policies.

For future research, it is suggested to examine the effectiveness of the RADEC model in lower-grade students (I-III), develop standard instruments to measure critical thinking skills in the context of the RADEC model, and explore the integration of the RADEC model with the latest educational technologies.

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