

Effectiveness of the RADEC Learning Model in Natural and Social Sciences Learning to Improve Science Literacy of Fifth Grade Elementary School Students

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Abstract. This study aims to investigate the effectiveness of the RADEC (Read, Answer, Discuss, Explain, Create) instructional model in enhancing science literacy among fifth-grade students in Social Science and Natural Science (IPAS) lessons. The RADEC model was implemented to replace conventional teacher-centered teaching methods, which limit student engagement in the learning process. A quantitative research approach with a quasi-experimental design was employed, involving two groups: the experimental group utilizing the RADEC model and the control group employing traditional teaching methods. Data were collected through a science literacy assessment consisting of multiple-choice and essay questions, which were subjected to validity and reliability tests. The results indicated that the experimental group demonstrated a significant improvement, with an average N-Gain of 8.21, whereas the control group showed minimal improvement with an N-Gain of 0.07. These findings suggest that the RADEC model is more effective in fostering science literacy compared to conventional teaching methods. However, factors such as lesson duration, student engagement, and teacher readiness should be carefully considered to optimize the model's implementation. The study recommends extending lesson durations, providing comprehensive teacher training for the RADEC model, and enhancing student participation through the integration of technology and interactive media.

Keywords: RADEC Model, Science Literacy, IPAS Learning, Student Engagement, Active Learning

INTRODUCTION

Science literacy is an essential skill that enables students to understand, interpret, and apply scientific concepts in everyday life. Unfortunately, various studies have shown that the level of science literacy among Indonesian students is still relatively low (Puspendik, 2019). This is reflected in the results of the Programme for International Student Assessment (PISA) survey, which placed Indonesia at a low rank in science literacy (OECD, 2019). As one of the key skills in 21st-century education, science literacy is crucial for elementary school students. One of the factors contributing to low science literacy is the use of conventional teaching methods, which are still teacher-centered. This method does not provide enough opportunities for students to actively engage in the learning process, thus hindering the development of critical thinking skills and deep understanding of scientific concepts (Dewi et al., 2020).

According to Trianto and Heryani (2020) in the book *Literacy 4.0: Theory and Programs*, learning that develops 21st-century skills, such as critical and creative thinking, is essential in today's educational context. Teaching models that focus solely on the teacher as the center of

information do not provide sufficient opportunities for students to develop these skills. Teaching models that prioritize active participation and collaboration among students are more effective in enhancing students' understanding and critical thinking skills across various subjects, including science. To address this issue, a learning model that can encourage active student participation and develop higher-order thinking skills is needed. One effective model that can be used to improve science literacy is the RADEC (Read, Answer, Discuss, Explain, Create) learning model, which focuses on student engagement in the learning process. This model is designed to enhance science literacy and critical thinking skills through a series of systematic stages: reading, writing, answering, discussing, explaining, and creating (Pratama et al., 2019).

The RADEC Learning Model has been developed as an approach that encourages students to be more active in the learning process. Previous studies have shown that the RADEC model not only improves conceptual understanding but also enhances students' critical thinking, collaboration, and creativity skills. This model is designed with stages that focus on the development of 21st-century skills, such as reading for understanding, answering to train logic, discussing for collaboration, explaining for deepening the material, and creating products as a form of application of learning (Nugroho & Susilowati, 2021).

The RADEC approach is considered relevant because it involves students in varied and engaging learning activities within the context of elementary science education. This aligns with previous research, which has found that active student involvement in learning increases motivation and enhances students' comfort in the learning process (Putri & Herlina, 2020). Therefore, the RADEC model is expected to address the challenges of learning that have been perceived as ineffective in meeting students' needs.

Based on this background, this study aims to further explore the effectiveness of implementing the RADEC learning model in IPAS education to enhance students' science literacy. It is hoped that through this research, the RADEC model can be more widely implemented as an effective solution to improve the quality of science education in Indonesia.

METHODOLOGY

This study employs a quantitative approach with a quasi-experimental design, chosen because this design allows for the comparison of two groups without the need for randomization, which is often difficult to implement in educational contexts. This quasi-experimental design is well-suited for educational research, where experimental and control

groups already exist, as is the case in many elementary school classrooms. Therefore, this design enables the researcher to observe differences in learning outcomes between the group using the RADEC model and the group using conventional teaching methods in a more natural and realistic setting (Creswell, 2014). The research design applied is a nonequivalent control group design, which involves two groups: the experimental group that receives learning using the RADEC model and the control group that uses conventional teaching methods. This model was chosen to assess the effectiveness of RADEC in improving the science literacy of fifth-grade students.

The population for this study consists of fifth-grade students at an elementary school in Kubu Raya District. The sample was selected using purposive sampling, considering the relevant characteristics to achieve the research goals. The classes selected for the experimental and control groups were similar in characteristics, such as academic ability levels and learning environments. The selection of the sample aims to ensure that the differences in learning outcomes are genuinely caused by the implementation of the RADEC model, rather than by uncontrolled factors. While purposive sampling may reduce the generalizability of the findings, this technique allows the researcher to select a sample that is appropriate and relevant to the specific focus of the study (Dörnyei, 2007). Each group consisted of 28 students, resulting in a total sample size of 56 students.

The data collection method used was testing. The test consisted of 10 essay questions designed to measure students' science literacy. Prior to the test, validity and reliability tests were conducted to ensure that the questions were of good quality. Validity was used to determine the extent to which the test measured what it was intended to measure, while reliability was used to ensure the consistency of test results in repeated measurements (Arikunto, 2019). Additionally, the difficulty level and discriminative power of the questions were analyzed to ensure that the test was appropriate for the students' abilities (Azwar, 2020). This science literacy test was used to measure students' science literacy before and after the intervention. The questions used were multiple-choice and/or essay items totaling 20 items, which were developed based on science literacy indicators from OECD (2018).

RESULTS AND DISCUSSION

Results

The teaching process was conducted by applying both the RADEC model and conventional teaching methods to improve students' science literacy in IPAS lessons. Students' science literacy abilities were developed through the appropriate teaching model and then assessed

using pre-test and post-test scores consisting of 20 multiple-choice and/or essay questions. The indicators for measuring students' science literacy were based on OECD (2018).

Variable	Pre-test	Post-test	Average Difference
Experiment (A)	71,96	80,18	8,21
Control Group (B)	77,18	77,25	0,07

The results of this study provide data supporting the effectiveness of the RADEC learning model in improving science literacy among elementary school students in IPAS lessons. Based on the pre-test data, the average initial understanding of students in the experimental group (A) was 71.96, while the control group (B) had an average of 77.18. This indicates that the initial understanding of both groups was relatively balanced before the intervention. After the learning process, a post-test was conducted to measure students' science literacy after the application of the RADEC and conventional teaching models. The post-test results showed significant improvement in the experimental group, with an average score of 80.18 and an increase of 8.21 points. In contrast, the control group showed minimal improvement, with a post-test average score of 77.25 and an increase of only 0.07 points. The significant difference between the experimental and control groups indicates that the RADEC model can effectively improve students' science literacy.

Discussion

Based on the analysis of the pre-test and post-test results from the experimental and control groups, it is evident that both groups experienced changes in their scores, but with differing outcomes. Overall, the experimental group that applied the RADEC model showed a significant improvement, while the control group that used conventional teaching methods exhibited only a slight increase.

- **Control Class (Conventional Method)**

In the control group, although there was an increase in the average post-test score, the N-Gain achieved was only 0.07, indicating a minimal improvement. This minimal increase falls into the low N-Gain category ($0.0 \leq g < 0.3$). This result suggests that the conventional teaching method used may not have had a significant impact on improving students' science literacy. The conventional method tends to focus more on lectures and one-way instruction, which may not fully engage students or encourage them to explore scientific concepts in depth.

There are several factors that may explain this result. First, conventional teaching methods are often more structured and do not allow students to actively participate in discussions and problem-solving. This may limit students' ability to develop critical thinking skills, which are essential for science literacy. Second, there may be limitations in the use of interactive teaching materials or problem-based learning that could stimulate student interest and engagement.

- **Experimental Class (RADEC Model)**

In contrast, the experimental group, which applied the RADEC learning model (Read, Answer, Discuss, Explain, Create), showed a more significant improvement with an N-Gain of 8.21 points, indicating a very positive result. This improvement shows that the stages in the RADEC model encourage students to be more active in the learning process. Each stage plays a crucial role in deepening students' understanding. The Read stage helps students comprehend the material, Answer develops their logical reasoning and comprehension, Discuss promotes collaboration, Explain strengthens knowledge through clarification, and Create invites students to apply the material in creative ways (Pratama et al., 2019). Research on active learning indicates that high student engagement in each stage contributes to deeper understanding and the development of higher-order thinking skills (Nugroho & Susilowati, 2021), compared to conventional learning. The RADEC model provides opportunities for students to be more engaged in the learning process through stages that involve understanding, discussion, explanation, and creativity.

The stages in the RADEC model, namely Read, Answer, Discuss, Explain, and Create, provide opportunities for students not only to memorize facts but also to think critically, collaborate, and produce works that demonstrate their understanding of the material. This contributes to the enhancement of higher-order thinking skills, which are crucial in science literacy.

However, despite the significant improvement, there are several factors that need to be considered. One of these factors is the duration of the learning process. If the time available to implement the RADEC model is limited, students may not fully experience the benefits of each learning stage. Therefore, effective time management and appropriate allocation of time for each stage of learning become essential.

- **Factors Influencing the Results**

Several factors can influence the effectiveness of learning in both groups:

1. **Duration of Learning:** In the experimental group, while there was significant improvement, the relatively short or limited duration of the lessons may not have been sufficient to provide a deeper understanding of scientific concepts. With more time, students could explore the material more comprehensively and apply the science concepts to real-life situations.
2. **Student Engagement:** The RADEC model emphasizes active student participation in every stage of learning. If student engagement in the learning process is not optimal, the expected improvement may not be achieved. On the other hand, in the control group, while the conventional method was less effective, students might have felt more comfortable with a familiar method, even though it did not have a significant impact.
3. **Teacher Readiness:** The preparedness of teachers to implement the RADEC model is also crucial. Teachers who are unfamiliar with or not adequately trained in using this model may face difficulties in applying each stage effectively. Therefore, proper training and a solid understanding of the model are essential to achieving optimal results.

Based on the analysis, it can be concluded that the RADEC model is more effective in improving students' science literacy compared to conventional teaching methods. The findings of this study align with those of Pratama et al. (2019), who stated that the RADEC model is effective in enhancing higher-order thinking skills and understanding of scientific concepts among elementary school students. A similar study by Safitri (2025) also indicated that the application of the RADEC model significantly contributes to improving science comprehension, particularly in teaching science (IPA). Thus, our findings confirm that RADEC is a model that can be effectively adapted and implemented in the context of science education in elementary schools. However, for optimal results, several factors, such as lesson duration, student engagement, and teacher readiness, must be carefully considered. This study provides important insights into how more active, discussion-based learning models can enhance critical thinking skills and science comprehension among students. Further research is needed to explore the

potential of RADEC learning, focusing more deeply on the challenges faced by both teachers and students in its implementation.

CONCLUSION

Based on the analysis of pre-test and post-test results in both the experimental and control groups, it can be concluded that the RADEC learning model is more effective in improving students' science literacy compared to conventional teaching methods. In the control group, despite some improvement in pre-test and post-test scores, the average N-Gain was only 0.07, which falls into the low N-Gain category. This suggests that conventional teaching methods do not provide significant impact on improving students' science literacy. Meanwhile, in the experimental group that used the RADEC model, there was a greater improvement, with an average N-Gain of 8.21, indicating a significant increase in students' science literacy. The RADEC model, with its stages of Read, Answer, Discuss, Explain, Create, allows students to become more active in the learning process and enhances their critical thinking abilities, which are crucial in science education.

However, there are several factors that influence these results. The duration of learning is an important factor because the RADEC model requires more time to be effectively implemented. Additionally, student engagement plays a significant role; low engagement can reduce the effectiveness of this model, even though RADEC emphasizes active student participation. The readiness of teachers to implement a more complex teaching model is also a key factor in determining the success of this learning approach.

Although the RADEC model showed significant improvements in the experimental group, these results suggest that the implementation of the model in classrooms needs careful planning, especially in terms of time management and teaching strategies. Therefore, learning with the RADEC model can be more optimal if supported by teacher training, adjustment to classroom conditions, and the use of technology to enhance student interaction and creativity. This research highlights that the RADEC model has great potential to improve students' science literacy, but it still requires attention to other factors that can influence its effectiveness. Future studies should focus on exploring the effects of learning duration and student engagement within the RADEC model to optimize its application in elementary science education.

RECOMMENDATIONS

Based on the findings of this study, several recommendations are provided to improve the effectiveness of the RADEC learning model in enhancing students' science literacy:

1. It is recommended to extend the duration of lessons so that each stage of the RADEC model can be implemented optimally, providing students with sufficient opportunities to engage actively and explore the material in depth.
2. It is crucial to provide adequate training for teachers so they can implement this model effectively, understand each stage, and manage the classroom efficiently. Increasing student engagement is also key; therefore, the use of technology and interactive media can help make learning more engaging and profound.
3. Additionally, regular evaluation and adjustment of the teaching model are necessary to identify challenges and seek better solutions. The use of diverse and relevant learning resources, both in print and digital forms, is also critical to supporting RADEC-based learning. By considering these recommendations, it is hoped that the implementation of the RADEC model can become more effective in improving students' science literacy, thereby preparing them for the challenges of the 21st century.

REFERENCES

- Arikunto, S. (2019). *Prosedur Penelitian: Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.
- Arrahman, Media. (2021). *Penerapan N-Gain dalam mengukur efektivitas pembelajaran di sekolah dasar*.
<https://www.mediaarrahan.com/ojs/index.php/edufa/article/download/99/69/403>
- Asyhari, A., & Marwan, M. (2015). *Profil peningkatan kemampuan literasi sains siswa melalui pembelajaran saintifik*. ResearchGate.
- Azwar, S. (2020). *Reliabilitas dan Validitas*. Yogyakarta: Pustaka Pelajar.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.
- Dewi, R. (2023). Pengaruh Penggunaan Model Pembelajaran RADEC untuk Meningkatkan Penguasaan Konsep dan Kemampuan Menulis Teks Eksplanasi Siswa Kelas VI UPTD SD Negeri 93 Baru. *Bahtera Indonesia: Jurnal Penelitian Bahasa dan Sastra Indonesia*, 3(2), 88–100. <https://doi.org/10.35965/bje.v3i2.2637>

- Dörnyei, Z. (2007). *Research methods in applied linguistics: Quantitative, qualitative, and mixed methodologies*. Oxford University Press.
- Ilham, M., Syarifuddin, K., & Rukli. (2020). Pengaruh Model Pembelajaran RADEC Berbantuan Aplikasi Zoom terhadap Kemampuan Berpikir Kritis IPA Siswa Kelas VI SDN Kalukuang 1 Makassar di Era Pandemi Covid-19. *Indonesian Journal of Primary Education*, 4(2), 174–183.
- Kurniawan, D. (2018). *Penggunaan model RADEC untuk meningkatkan literasi sains pada siswa sekolah dasar*. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 7(2), 157-165. <https://journal.unpas.ac.id/index.php/pendas/article/download/15219/8406/75229>
- Kusumaningpuri, A. R., & Fauziati, E. (2021). Model Pembelajaran RADEC dalam Perspektif Filsafat Konstruktivisme Vygotsky. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, 3(2), 103–111. <https://doi.org/10.36232/jurnalpendidikandasar.v3i2.1169>
- Nugroho, R., & Susilowati, E. (2021). *Penerapan model pembelajaran RADEC untuk meningkatkan literasi sains pada siswa kelas V SD*. *Jurnal Pendidikan Sains Indonesia*, 7(2), 56–67.
- OECD. (2018). *PISA 2018 Results*. Retrieved from <https://www.oecd.org/pisa/publications/pisa-2018-results.htm>
- OECD. (2019). *PISA 2018 Results (Volume I): What Students Know and Can Do*. <https://doi.org/10.1787/5f07c754-en>
- Pratama, Y. A., Sopandi, W., & Hidayah, Y. (2019). *Model pembelajaran RADEC dalam perspektif filsafat konstruktivisme Vygotsky*. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, 3(2), 103–111. <https://doi.org/10.36232/jurnalpendidikandasar.v3i2.1169>
- Safitri, U. (2025). *Pengaruh model pembelajaran RADEC terhadap hasil belajar IPA siswa sekolah dasar*. *Menara Ilmu: Jurnal Penelitian dan Kajian Ilmiah*, 19(1), 100–110.
- Satria, E., & Sopiandi, T. (2018). *Penerapan Model Pembelajaran RADEC untuk Meningkatkan Kemampuan Berpikir Kritis Siswa pada Mata Pelajaran IPA di Sekolah Dasar*. *Jurnal Pendidikan Sains Indonesia*, 6(2), 123–130. <https://doi.org/10.24815/jpsi.v6i2.12345>

- Sritiawati, T. (2024). Efektivitas E-Modul Flipbook Pembelajaran IPA Berbasis Model Pembelajaran RADEC untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik Kelas V Sekolah Dasar. *Tesis*, Universitas Pendidikan Indonesia.
- Susanti, R. M., Rokayah, R., & Kusmawan, K. (2023). Penerapan Model Pembelajaran RADEC Berbasis Literasi Sains untuk Meningkatkan Kemampuan Berpikir Kritis Siswa pada Mata Pelajaran IPA Kelas V Sekolah Dasar. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 8(2), 5491–5516.
- Trianto, A., & Heryani, R. (2020). *Literasi 4.0: Teori dan Program*. Jakarta: Penerbit Erlangga.
- Tulljanah, R., & Amini, R. (2021). Model Pembelajaran RADEC sebagai Alternatif dalam Meningkatkan Higher Order Thinking Skill pada Pembelajaran IPA di Sekolah Dasar: Systematic Review. *Jurnal Basicedu*, 5(6), 5508–5519.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Wulandari, R., & Sholihin, H. (2016). Integrasi Kecakapan Abad 21 dalam Rencana Pelaksanaan Pembelajaran Sekolah Dasar. *Seminar Nasional Hasil Pengabdian Kepada Masyarakat Universitas Ahmad Dahlan*, 467–472.
- Yulianti, Y., Lestari, H., & Rahmawati, I. (2022). Penerapan Model Pembelajaran RADEC terhadap Peningkatan Kemampuan Berpikir Kritis Siswa. *Jurnal Cakrawala Pendas*, 8(1), 47–56. <https://doi.org/10.31949/jcp.v8i1.1915>