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Implementation of RADEC Model for Improving Higher *Order Thinking Skill* (HOTS) in Science Learning at Elementary Schools

Nur Rohmatillah
Universitas Negeri Yogyakarta, Indonesia
Email: nurrohmatillah.2022@student.uny.ac.id

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ABSTRACT

Science learning in elementary schools requires Higher Order Thinking Skills (HOTS), so supportive learning model is needed. This research aims to: 1) describe the application of HOTS in science education at elementary level; 2) describe the RADEC learning model for science learning, and 3) describe the factors that support and hinder the application of RADEC to improve HOTS in science education in elementary schools. This research uses a systematic literature review method or literature review, which focuses on the process of reviewing and analyzing widely and carefully several literature relevant to the research topic. The results of this study show: 1) HOTS is indispensable in science learning; 2) The introduction of RADEC greatly improves the science HOTS skills of elementary students; 3) The application of RADEC to improve students' HOTS is influenced by many factors, including teachers' understanding and competence of the RADEC model, facilities and infrastructure, and teacher support.

Keywords: *Highers Order Thinking Skill, , HOTS, Science learning, RADEC*

INTRODUCTION

Science lessons is subjects that studied at elementary school to college. Even now it is a compulsory and verified subject at the national level. Starting from elementary school, all students are required to attend science classes to develop their ability to think logically, analytically, systematically, critically and creatively and collaborate in accordance with government regulation No. 22 of 2006. Natural Science (IPA) lessons not only teach scientific facts, but also emphasize the important scientific thinking process. With this approach, students are taught to understand how science develops through methods of observation, experimentation, and data analysis. This helps them not only to receive information, but also to be critical of the source of information and build knowledge independently (Arini, D. A., Gianistika, C., & Rahmat, R., 2019). In elementary school, the science curriculum is designed to be interesting and relevant to everyday life. For example, students learn about ecosystems, materials, energy, and weather changes through activities that involve hands-on observation of the surrounding environment. In this way, they can see the real applications of scientific concepts, which makes learning more meaningful (Amakraw, Y., & Kartika, N., 2022). At higher levels, such as in high school and college, science lessons become more complex and specific. Students study various branches of science such as biology, physics, and chemistry. They are also introduced to technology and scientific research, which is key to innovation and advancement in various fields. The skills gained from science lessons, such as data analysis and problem-solving, are essential in the world of work and daily life (Kurnia, A. R. D. (2020).

More so, science lessons also contribute to students' awareness of global issues, such as climate change, health, and sustainability. By understanding scientific concepts, students can be more sensitive to the challenges faced by society and the environment, as well as engage in science-based solutions. Overall, science lessons play an important role in education. By improving critical, analytical, and creative thinking skills, and building a collaborative attitude, this lesson helps create a generation that is ready to face the challenges of an increasingly complex world. Through quality education in the field of science, we can hope to produce future scientists, researchers, and leaders who can contribute positively to society and the environment (Hidayah, M. U., & Jumadi, J., 2023).

The integration of technology in science learning further improves the learning experience of students. Tools such as computer simulations, data analysis software, and educational apps help students understand complex concepts in a more intuitive way. For example, simulation of chemistry or physics experiments allows students to see results without safety risks, as well as deepen their understanding of scientific processes (Muzaini, M. C., et al., 2024). At a more advanced level, science lessons also introduce students to scientific research and technological development. It helps students understand how research is conducted, from the formulation of the research question to the publication of the research results. Thus, they become better prepared to contribute to research in the field of science and technology, which is very important in today's information and innovation era. Furthermore, science lessons can serve as a bridge to overcome various social issues (Herlanti, Y., 2014). With a good understanding of science, students are expected to participate in discussions on public policy related to health, the environment, and technology. For example, knowledge of biology can help students understand public health issues, while knowledge of physics and chemistry can equip them to contribute to the development of renewable energy (Wihardjo, R. S. D., & Rahmayanti, H. 2021).

Apart from the academic aspect, science lessons also build interpersonal skills. The group project in this lesson teaches students about cooperation, communication, and time management. These skills are essential in the world of work and help students build healthy and productive relationships in the future. Thus, science lessons not only focus on mastering scientific content, but also contribute to the development of students' character and social skills. This is in line with the broader goal of national education, which is to create a generation that is not only academically intelligent, but also has integrity, empathy, and concern for others and the environment. Science lessons, therefore, are an important foundation in creating a knowledgeable, innovative, and responsible society.

Scientists must have this ability to extract, process and apply information to exist in existence that ever-changing, ambiguous and competitive. The results of the data analysis from research before using the Newman procedure reveal that student errors include reading errors at 0.51%, comprehension errors at 2.5%, transformation errors at 16.24%, process skill errors at 39.5%, and encoding errors at 41.63%. The increase in the percentage of errors from reading to encoding is due to students' inability to solve problems correctly after encountering difficulties (Aisah et al., 2024)

Studying science in elementary school requires students to analyze problems for research. By observation natural science related with research, discovery, problem solving, and understanding of the natural environment scientifically and systematically. (Arkiang & Nurhana, 2023). Science is evidence to establish certain justifications and predict general miracles, including wisdom gained from such actions (National Academy

of Sciences, 2008). These subjects not only for mastering the factual knowledge, concepts, or principles, but also discover processes that will develop students' scientific ideas, processing skills, and attitudes. Higher order thinking skills are one of the important thinking skills for science students.

Higher Order Thinking Skills (HOTS) need to be included in science learning in elementary schools for encouraged the students to think critically and creatively with experiment assignments. In the HOTS-oriented educational process, the tasks of educational and methodological activities should be solved by adjusting the development of younger students' thinking, curriculum, the nature of science as a product, process and scientific worldview.(Rintyati, Syavaludin dan Istiyati, 2020).

Higher Order Thinking Skills (HOTS) is needed in elementary schools's science learning, so a learning model is needed to support this. As stated (Tulliana and Amini, 2021), HOTS in science learning is an important thing that must be developed by a teacher, but in reality there are still many learning activities that are not in accordance with HOTS, one of the learning models to be applied. What is trying to be analyzed Related to HOTS in science learning is the RADEC model. This study aims to: 1) describe the application of HOTS in the science learning process at the elementary level.

One of the advantages of the RADEC learning model is that the learning focuses on teaching and problem-solving skills, so in other words RADEC is a learning model that seems to be able to improve Higher Order Thinking Skills (HOTS). RADEC learning steps consist of 5 steps that are very easy to remember according to the name of the learning model itself, namely: (1) Read (R); (2) Answer (A); (3) Inscuss / Discussion (D); (4) Explain and (5) Create (C). It is expected that at each stage of training RADEC will develop HOTS. Students must be able to explore and participate in the learning process so that higher-order thinking skills can be honed.

METHOD

The systematic literature review or literature review used in this study focuses on the process of carefully and comprehensively reviewing and analyzing some literature relevant to the research topic. A systematic literature review is a type of research that focuses on processes and activities to identify, analyze, evaluate, and draw conclusions from all relevant research findings to be used as a basis for addressing various problems (Triandini, 2019: 64).(Ananda et al., 2020).

This study relied on secondary data or information from previous studies that did not require direct observation (Muhyani, 2019: 96). The literature data used as the main source of this research is 10 papers published in the last 5 years (2018-2022) and obtained from electronic indices such as Google Scholar, Direct of Open Access Journals (DOAJ), and Garuda Portal. who passed the selection stage and were selected according to the criteria.

The steps to be followed in a systematic literature review study include : (1) *Planning*: At this stage, the researcher must decide on the research questions and steps to be taken; (2) *Review* in which researchers select and classify literature, filter and select relevant literature, and draw conclusions from the entire literature series; This activity is an implementation stage that focuses on the process of searching electronic literature; (3) Discovery and comprehensive description of the results of the selected literature is documentation. These findings form the basis for answering research questions.

When conducting a systematic literature review, the following steps should be considered to achieve effective and efficient results:

Determine the research question. Researchers will formulate and select current relevant research-related questions. The following is the formulation of the problem, namely: 1) How is the application of HOTS in science learning at the elementary level?; 2) how is the application of the RADEC learning model to improve HOTS in science learning? and 3) What are the supporting and inhibiting factors for the implementation of RADEC to improve HOTS science education in elementary schools?

The stage of searching and deepening indexed electronic literature such as Garuda Portal, Direct of Open Access Journals (DOAJ), and Google Scholar is called the search process. Researchers evaluate whether the three data on which they are based can be used to accurately answer the research question.

Inclusion and exclusion criteria. At this stage, researchers determine several literature criteria that are considered relevant to the research topic and are used as reference sources, including: 1) Publication of full texts in the form of journals and conferences 2) The publication deadline covers a period of at least five years, from 2018 to 2022 3) RADEC and Higher Order Thinking Skills (HOTS) are discussed in the literature. 4) Literature is presented in Indonesian or English.

Quality Assessment. In this step, literature that has been selected as a reference and is considered relevant to the subject matter will be selected based on the inclusion and exclusion criteria discussed earlier. This question is asked to assess the feasibility of the selected literature. The following inclusion and exclusion criteria were used to select the questions: 1). Is the literature used at conferences and journals presented in full? 2). Has the source literature been published in the last five years (2018-2022)? 3): Have RADEC and Higher Order Thinking Skills (HOTS) been considered and discussed in the literature? 4). Literary presentation in Indonesian or English? After passing the identification stage, the Accepted Literature will contain information based on the questions outlined above. Yes for the literary category, relevant to the question of the quality of assessment. Not for the kind of literature that does not meet the quality of assessment. Data analysis process. This stage refers to the process of analyzing and refining conclusions drawn from selected literature. Conclusions are given as a basis for problem solving and answers to research questions that have been established based on the results.

RESULTS AND DISCUSSION

H Here are some stages of literature review carried out by researchers systematically, as follows:

Stage 1 is defining research questions, where 3 research questions or problem formulations are presented, namely: 1) How is the application of HOTS in science learning at the elementary level?; 2) how is the application of the RADEC learning model to improve HOTS in science learning? and 3) What are the supporting and inhibiting factors for the implementation of RADEC to improve HOTS science education in elementary schools? The results of steps 2, 3 and 4, namely the process of searching for articles and determining inclusion or exclusion criteria and conducting quality assessments can be seen in the following table:

Table 1. Result of literature review

No	TITLE	RESEARCHER	METHOD	OBJECTIVES
1.	HOTS (Higher Order Thinking Skills) based on the study of basic sciences meets the requirements of 21st century learning	Fahrour Rosie, Bahadur Khanum (Rozi & Hanum, 2019)	Literature method	understand the meaning, characteristics, and indicators of HOTS questions, as well as practice procedures

2.	The concept of Higher Order Thinking Skills (HOTS) in thematic learning in elementary / MI	Sudirman and Angga Saputra.(Syudirman, 2020)	Literature method	Comprehensive thematic application using a scientific approach
3.	RADEC Learning Model as an Alternative to HOTS Counseling in Science Education in Elementary Schools	Rahmiya Tuljana, Risda Amin.(Tulljanah & Amini, 2021)	*Systematic Review*	To find out more about the RADEC learning model as an alternative to improving HOTS in elementary science learning.
4.	Implementation of HOTS-Based Learning During the Covid-19 Pandemic in Indonesian Elementary Schools	Annis Maulia Fatimahtuzzaroh, Ali Mustadi, Mukh. Nur Wangid.(Fatimahtuzzaro, Mustadi and Wangid, 2021)	qualitative research with phenomenological type of research.	describes the learning process focused on HOTS during the Covid-19 pandemic
5.	Improving the Ability to Write Science Questions Focusing on HOTS for Elementary School Teachers in the Pandanaran Dabin IV Cluster of UPTD Central Semarang	Unita Sari; Andarini Permata Kahyaningtyas; Mega Mulianing.(Sari et al., 2019)	HOTS-Based Science Question Training for Elementary School Teachers	improve teachers' ability to ask science HOTS-based questions
6	Analysis of HOTS Students' Ability on Science Material in Elementary School	Arrofa Acesta.(Acesta, 2020)	Qualitative descriptive research methods	to assess higher-order thinking skills in science classes in elementary school
7	RADEC: Alternative Teaching Higher Order Thinking (HOT) for Primary School Students in the Water Cycle	Khandayani V. Sopandi, E. Xiaodihi, I. Suhendra, and N. Ermita.(Handayani et al., 2019)	Descriptive and experimental research methods	describe existing RADEC learning models that implement learning models
8	Improving the ability to compile science questions focusing on HOTS for elementary school teachers of Pandanaran IV UPTD Semarang	Unita Sari, Andarini Permata Kahyaningthias, Maharani, Sari Justian.(Sari et al., 2019)	HOTS-Based Science Question Training for Elementary School Teachers	improve the ability to formulate scientific problems loaded with HOTS, supported by facts or data from the field.
9	The Impact of Using LKS Focusing on HOTS on Cognitive Learning Outcomes of Students of SD Muhammadiyah 4 and 5 Jakarta	Viratamasari Sarvinda, Septi Fitri Meilana.(Sarwinda, n.d.)	Quantitative research methods with pseudo-experimental research design	Find out how the cognitive outcomes of grade V students of SD Muhammadiyah 4 and 5 Jakarta changed after using HOTS-based LKS IPA.
10	*Application of RADEC Model in Science Education for Advanced Research Critical thinking of students in primary school*	E. Satria dan V. Sopandi.(Satria and Sopandi, 2019)	Descriptive research methods	observe and describe improved critical thinking in science studies after applying the RADEC model

Source: Data Processing

Based on the results of some studies above, it can be understood that HOTS is a complex thinking process to connect, manipulate, and transform existing knowledge and experience to think creative critically in an effort to make decisions and solve problems in new situations that inseparable from everyday life. Therefore, alternative learning models are needed. One such learning model is the RADEC learning model. The RADEC is a learning model whose syntax is very easy to remember and understand to practice because the learning steps are an abbreviation of RADEC itself.

Table 2. The learning potential of HOTS through the RADEC model

No	RADEC STEP	HOTS TRAINING POTENTION
1	Read (before learning)	Potentially improve critical and creative thinking if reading material encourages and requires students to have HOTS
2	Answer (after learning)	Ask questions that require students to display creativity, critical thinking, and problem-solving skills.
3	Discuss	Give assignments to students that require creative thinking and critical thinking.
4	Explain	Responsible for presenting and critiquing ideas that require HOTS discussion
5	Create	Challenge students to bounce ideas out, share them with other students, explore projects, and solve problems.

Source: Data Processing

The first step is Read. Can improve critical and creative thinking skills if reading materials are facilitated and require students to have HOTS. Usually, teachers ask students to read various reading materials, both print and nonprint/web. Before taking the first step, students are asked many preliminary questions. Step two Answer. Educators usually ask questions that require critical, creative thinking and problem solving from students, so students are encouraged to answer these questions. This is an important means for educators to provide HOTS training to learners. The third step is Discuss. At this stage students are given tasks that require critical and creative thinking, usually students in groups discuss answers to questions or work outside the classroom or at home before starting the lesson.The fourth step is Explain. At this stage educators provide presentations and critical tasks that require careful consideration in discussions, usually classical presentation events are held. The fifth stage is Create. At this stage, the teacher assigns tasks to students to have ideas and share them with other students, as well as conduct project research and problem solving, usually encouraging students to learn to use the knowledge gained to generate ideas or creative thinking. .

This is supported by research findings that HOTS can be studied in the Reading (R) phase, providing the widest opportunity for students to explore and search for information from various sources, both print and online. In the Answer (A) phase, HOTS can be taught by asking students to look for various alternative answers and solutions. In the Discuss (D) phase, HOTS can be taught without limiting students to guesses, ideas, or opinions. In the Explain (E) stage, HOTS can be taught by presenting and reporting the results of the group's response honestly and responsibly, and other groups will respond. Although the final stage is Create (C), HOTS can be taught at this stage by having students find creative solutions. (Handayani et al., 2019)

CONCLUSION

One of the result from this study is teachers must develop Higher Order Thinking Skills (HOTS) when learning science because in the 21st century HOTS is a skill that students must have so that learning can continue. The step of reading, answering, discussing, explaining, and creating is the beginning of the RADEC learning model. The RADEC learning model is forming of HOTS to improve analytical thinking skills and actively supports HOTS at the creation stage which is the highest level of HOTS. Here are some results of this research: 1) HOTS is indispensable for science learning; 2) The application of RADEC is useful to improve the ability of HOTS in science education; 3) Support and inhibiting factors in the HOTS implementation are inseparable of the success

or failure achieving of the objectives or determined criteria. Teacher competence, infrastructure, classroom management, and lesson plans are considered as supporting factors for the HOTS success implementation. Inadequate teacher education qualifications, low understanding, limitations and difficulties in maximizing HOTS application are inhibiting factors.

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Missing "?" Remember to use a question mark at the end of a question.

Article Error You may need to use an article before this word.

Article Error You may need to remove this article.

PAGE 4

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Article Error You may need to use an article before this word.

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Missing "," You may need to place a comma after this word.

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Article Error You may need to use an article before this word.

Article Error You may need to remove this article.

Article Error You may need to use an article before this word. Consider using the article **the**.

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Verb This verb may be incorrect. Proofread the sentence to make sure you have used the correct form of the verb.

Missing "," You may need to place a comma after this word.

Verb This verb may be incorrect. Proofread the sentence to make sure you have used the correct form of the verb.

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Verb This verb may be incorrect. Proofread the sentence to make sure you have used the correct form of the verb.

Missing "," You may need to place a comma after this word.

Prep. You may be using the wrong preposition.

Verb This verb may be incorrect. Proofread the sentence to make sure you have used the correct form of the verb.

Article Error You may need to remove this article.

P/V You have used the passive voice in this sentence. Depending upon what you wish to emphasize in the sentence, you may want to revise it using the active voice.

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Possessive You may need to use an apostrophe to show possession.

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